

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

VOLUME V

APPENDICES L - N



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- N. Data Center Program Evaluation Report

APPENDIX L



EXPRESS PROGRAM FOR SMALL BUSINESS CUSTOMERS

2017 Evaluation Report

Prepared for:

AEP OHIO



A unit of American Electric Power

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EXECUTIVE SUMMARY

This report presents the results and findings from the evaluation of the 2017 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. The program goal for 2017 was 14.42 GWh in energy savings and 3.68 MW in peak demand savings.

ES.1 Program Participation

The 2017 program year represents the eighth year of operation for the Express Program and for which Navigant has evaluated its operation. In 2017, 422 projects were completed. *Ex ante* electricity savings decreased by 19 percent compared to 2016 (Table ES-1), the program achieved 64 percent of its electric energy savings target (Table ES-2). The downward trend of completed projects continued from a high of 576 in 2015, to 442 in 2016 and 422 in 2017. The implementation contractor and the AEP Ohio Program Coordinator attribute 2017's slow performance to the late approval of the program plan in January 2017.

Table ES-1. Summary of Data Collection Activities

	2017 Program	2016 Program
Total Incremental Participant Cost	\$3,478,824	\$4,867,837
Amount of Incentives Paid by AEP Ohio	\$1,789,506	\$2,759,933
Total Participant and Incentive Costs	\$5,268,330	\$7,627,770
Number of Projects	422	442
<i>Ex Ante</i> Energy Savings (MWh)	9,296	11,407
<i>Ex Ante</i> Demand Savings (MW)	1.23	1.47

Source: 2017 values are from 2017 tracking database, 2016 values from 2016 Express Program Evaluation Report.

Table ES-2. Express Program 2017 Program Summary

	2017 Program Goals	2017 Program Reported
Program Budget	\$3,600,000	\$2,142,310
<i>Ex Ante</i> Energy Savings (MWh)	14,416	9,296
<i>Ex Ante</i> Demand Savings (MW)	3.678	1.23

Source: ENERGY EFFICIENCY / PEAK DEMAND REDUCTION (EE/PDR) PORTFOLIO 2017 to 2020 Evaluation Plan, September 27, 2017

ES.2 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, program web sites, application forms and other program inputs were also analyzed.

As part of the impact study, the evaluation team conducted desk reviews for all completed projects. A billing analysis for all completed, pending and projected participants was also conducted. Additionally, a sample of 20 randomly-selected sites underwent an onsite review. These sites were randomly selected using Navigant's Sample Design Tool. Impact evaluation of the data collected from site visits was conducted. Table ES-3 provides an illustration of the impact measurement and verification (M&V) activities' samples.

Table ES-3 Impact Sampling and Achieved Sampling

Sample Use	Sample Frame	Size	Achieved Sampling
Desk Review	Program Participants	Census of projects completed in 2017	Census of projects completed in 2017
Billing Analysis	Program Participants	Program participants with completed projects in 2017 and pending and projected participants in 2018	Program participants with completed projects in 2017 and pending and projected participants in 2018
Onsite Verification Visits	Program Participants	20	20

Source: Navigant

ES.3 Key Impact Findings and Recommendations

As summarized in Table ES-4, the verified savings did not meet the 2017 targets of 14.4 GWh and 3.7 MW coincident summer peak demand reduction. The *ex ante* energy and summer coincident demand annual savings are 9,296 MWh and 1.234 MW respectively. Based on the onsite data and the population roll-up, the *ex post* energy and demand annual savings are 9,403 MWh and 1.385 MW respectively. The realization rates are 1.01 for energy savings and 1.12 for demand savings. These results represent both increased program savings and increased realization rates compared to 2016.

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

Metric	2017 Program Goals* (a)	Ex Ante (b)	Ex Post (c)	Realization Rate RR = (c) / (b)	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	14,416	9,296	9,403	1.01	65%
Coincident Peak Demand Reduction (MW)	3.678	1.234	1.385	1.12	38%

Source: ENERGY EFFICIENCY / PEAK DEMAND REDUCTION (EE/PDR) PORTFOLIO 2017 to 2020 Evaluation Plan, September 27, 2017

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).

Impact Finding 1: The program had a very slow ramp up in 2017, with most projects being completed in the last quarter of 2017. This was primarily due to delayed PUCO approval, before which it was not possible to launch the program. The delay in approval led to loss and re-staffing of auditors leading to further delay in program ramp up. As a result, the program energy and demand savings goals were not achieved.

Impact Recommendation 1a: The program administration and launch should be closely monitored. An adjustment in annual program goals based on program launch timeline is recommended for greater realization of program targets.

Impact Recommendation 1b: Navigant recommends the implementation contractor to focus on quick completion of retrofits once an application is started.

Impact Finding 2: Refrigeration measures are increasing in their contribution to the program. The number of refrigeration measures increased from three percent (2016) to five percent in 2017. The team found the program has a good start by including anti-sweat controls, compressors and fan management, and EC motors.

Impact Recommendation 2: Navigant recommends additional measures to be added to the program, such as:

- Display case strip-curtains and continuous covers especially for grocery
- Floating head pressure controls
- Identifying some equipment that is near end of life, like an old ice maker and replacing with an energy star model

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.

Process Finding 1: Customer-facing promotional materials do not provide a clear vision of project success for individual potential customers. While customer materials appear clean, clear, and accessible, incentives and savings amounts are described inconsistently (as dollars and kWh), and are only loosely defined; the program supported project management and direct installation of recommended measures are understated.

Process Recommendation 1a: Consider promoting specific financial benefits of program participation to eligible customers, including the very favorable return on investment achieved by program participants over the lifetime of their projects.

Process Recommendation 1b: Describe energy savings in both annual and lifetime dollars including a calculated ROI for case studies and fact sheets, to support the projects' financial benefits and to be consistent with how project costs and incentives are provided. This is a cross-cutting recommendation across AEP Ohio's portfolio.

Process Recommendation 1c: Consider more explicit promotion of the program's project and contractor management services, to reduce the impact of small business owner time as a participation barrier.

Process Finding 2: The AEP Ohio website does not explicitly promote the Express Program as a possibility for small business customers. There is no overarching presentation of how customers should choose which AEP Ohio program service might best meet their needs, or description of the services provided by the Express Program in comparison to the other business programs to assist customers with identifying and prioritizing opportunities. For customers specifically seeking the Express Program, it takes six clicks to reach the Express Program page.

Process Recommendation 2: Consider updating the website to reduce the steps to reach key pages and broadly serve two main objectives:

- a. Clear path for new customers. Provide a high-level overview of the various programs available. Promote AEP Ohio's customer support, including technical assistance, to identify and prioritize projects, and manage the application process.
- b. Easy access to pertinent program details. Create a simple path for returning and otherwise knowledgeable small business stakeholders to access application forms, incentive details, program and measure specifications.

Process Finding 3: The majority of Express Program measures and savings are lighting replacement bulb measures; only a fraction of savings come from lighting controls. The database does not reference whether a control strategy exists for these light bulb replacement measures to indicate whether there are missed opportunities with lighting controls.

Process Recommendation 3a: Auditors should record lighting control strategy for each light bulb measure implemented. Where cost effective, lighting control measures should be bundled with light bulb measures to increase savings and diversify installed measures.

Process Recommendation 3b: Promote advanced lighting technologies.

1. INTRODUCTION AND PURPOSE OF STUDY

The Express Program provides turnkey energy audits at no-cost with direct installation of energy efficiency measures at low cost. The criteria for program participation in 2017 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. The program also achieves savings from refrigeration measures, such as ECM motors, compressor and fan management, anti-sweat heater controls, and LED case lighting. In 2017, the focus remained on LED measures, with LEDs accounting for the majority (86%) of measures installed. 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 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, considering 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 the 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, the contractor schedules and completes installation of the measures.

The 2017 program year represents the eighth year of operation for this program.

1.1 Evaluation Objectives

The three major objectives of this evaluation are to:

1. quantify annual energy and peak demand savings from the program during 2017
2. determine key process-related program strengths and weaknesses, and identify ways in which the program can be improved
3. determine program cost-effectiveness

1.2 Evaluation Methods

Program impacts for the 2017 Express Program were evaluated in terms of electric energy and coincident summer 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, and site verification of the installed components of the energy efficiency measures designed for the subject buildings. Additionally, *ex post* energy savings were also verified using a billing analysis, using monthly billing data for all completed projects, and projects pending in 2017.

Data collection activities are summarized in Table 1-1. During the 2017 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 2017 program	Process Evaluation
Secondary Literature Review	Publicly-available evaluations of other utility small business direct install programs	Impact and Process Evaluation
In-depth Telephone Interviews	Implementer staff	Process Evaluation
Onsite Verification and Participant Interviews	Onsite verification of 20 randomly selected sites	Impact Evaluation
Billing Analysis	All completed, pending and projected participants	Impact Evaluation
Deemed Savings / Desk Review	All measures included in 2017 projects	Impact Evaluation
Tracking Data Review	All program participants	Impact and Process Evaluation

Source: ENERGY EFFICIENCY / PEAK DEMAND REDUCTION (EE/PDR) PORTFOLIO 2017 to 2020 Evaluation Plan, September 27, 2017

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 2017 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.** Navigant established key evaluation questions as part of developing the 2017 Evaluation Plan with AEP Ohio staff.
- 2) **Tracking Data Review.** Navigant reviewed the program tracking data collected by the implementation contractor and provided to the evaluation team by AEP Ohio.
- 3) **Review of Marketing Activities.** Navigant reviewed the overall marketing activities and approach as implemented by the implementation contractor and AEP Ohio.
- 4) **Review of Participation.** Navigant reviewed program participation by building type, project size, completion date, and geographic location.
- 5) **Primary Data Collection.** Navigant 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 onsite 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. A billing analysis was also conducted using regressions for all completed, pending and projected projects. File reviews included verifying baseline selection, determination of incremental costs, quantifying operation hours, reviewing all inputs and assumptions, and engineering algorithms selected. For the billing analysis, the evaluation team utilized monthly billing data provided by AEP Ohio staff. Onsite visits were conducted on 20 randomly sampled projects. Onsite visits included verification of equipment specifications and quantities, a short participant interview, and verification of operating hours by logging equipment. The results from the onsite were used to estimate realization rate and relative precision for the entire population.
- 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 and the implementation contractors, and conducted a review of program tracking data.

2.2 Key Evaluation Questions

Navigant collaborated with AEP Ohio to identify key evaluation questions regarding the 2017 Express Program. Three broad evaluation questions were addressed by the evaluation study.

- 1) What is the status of implementing recommendations / issues identified in the 2016 evaluation?
- 2) How do the findings in the 2017 evaluation compare with findings from prior year evaluations?
- 3) Have changes made to the 2017 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, 2017 Evaluation

Research Objective	Information Sources	
	Database, Secondary Data Review & Onsites	Staff / Implementation Contractors
Impact Questions		
1. What were the evaluated <i>ex post</i> savings that were achieved in 2017?	√	-
2. What is the wattage draw for certain light fixtures in a sample of projects?	√	-
Process Questions		
What customer segments participate in the program?	-	√
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?	√	√
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?	√	√

Source: ENERGY EFFICIENCY / PEAK DEMAND REDUCTION (EE/PDR) PORTFOLIO 2017 to 2020 Evaluation Plan, September 27, 2017

2.3 Tracking Data Review

Program tracking data is critical for determining the impacts of the Express Program. A copy of the program tracking data collected by the implementation contractors 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, 2017.

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 prudence 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, project size and complexity; milestone dates, 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 2017. 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 EE/PDR 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

2.7.1 Onsite Data Collection, Participant Interview and Analysis (Population Roll-up)

Onsite visits are designed to verify measure installations and 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 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. The projects were not stratified.

Of the 20 sites, a total of 253 measure records, representing 12 individual measures, were verified. Of the sample, 19 sites had lighting only measures, and one site had refrigeration only measures. Interior and exterior fixtures were also covered.

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 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, reported measure quantities, measure nameplate data, verification of measure operating characteristics, including the schedule of operation, and HVAC system type. The evaluation team verified reported hours of use based on data provided by the customer during the visit as well as by logging fixture operation. The field team deployed loggers at 8 out of 20 sites. A total of 54 loggers were deployed and gathered information for a two-week time period. To determine hours of use, if there were logged hours, those were prioritized over verified hours. The onsite 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. Fulcrum, a web based data collection platform was used to collect the data. This method allowed the evaluation team to follow data collection on a real-time basis and make any necessary adjustments through the data collection process. The specific steps taken during the onsite data analysis are outlined in APPENDIX C.

The team then analyzed the results to estimate the realization rate for these 20 sites. The results from the onsite of 20 samples was rolled up for the entire population using a sampling tool to report the realization rate and relative precision for the entire population. The full tracking database for the Express Program, along with the onsite results, were used to develop the final *ex post* savings value.

2.7.2 Desk Review

The evaluation team reviewed tracking data and recalculated the energy and demand savings values using all of the formulas outlined by the program and verified all factors outlined in Appendix A. The specific steps taken during the review are outlined in Appendix B. The desk 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.

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 Express Program. The process activities for 2017 were relatively limited as there were no significant program changes between the 2016 and 2017 program years.

The 2017 Express Program process evaluation included detailed, in-depth qualitative interviews with AEP Ohio program and marketing managers and the implementation contractor 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 2017. Navigant also interviewed the outreach implementation staff. While not directly responsible for generating Express Program participants, the outreach implementer refers customers to the Express Program as appropriate. Additionally, program tracking databases were analyzed to identify implementation trends and data quality, as well as program materials were reviewed, including application forms, promotional brochures, and the program website. No participant surveys were conducted for the 2017 process evaluation.

3. DETAILED EVALUATION FINDINGS

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

3.1 Program Activity

In 2017, AEP Ohio completed just 422 projects, which is slightly less than the 442 completed in 2016. 357 unique customers completed projects in 2017, with some customers completing multiple Express Program projects throughout the year. One of the customers who participated in the program in 2017 completed four projects, three customers completed three projects each, and 56 customers completed two projects each. In total, the 422 projects included implementation of 4,191 unique measures.

Total 2017 *ex ante* energy savings reported for the program amounted to 9,296 MWh, and *ex ante* coincident demand reductions reported under the program totaled 1.23 MW. *Ex ante* energy savings decreased by 19 percent and demand savings decreased by 16 percent compared to 2016. This is probably due to the program shutting down which caused the implementer to lose energy service representatives. These factors contributed to a significant time investment to ramp up the program.

Incentives in 2017 decreased by 35 percent to \$1,789,506 compared to 2016. Incremental participant costs decreased by 29 percent in 2017 to \$3,478,824 as compared to 2016. Total participant and incentive costs decreased by 54 percent to \$3,478,825. The program is more cost effective now than in the previous year. The average 2017 Express project saved 22,028 kWh. Table 3-1 summarizes the key program indicators.

Table 3-1. Program *Ex Ante* Summary, 2016 & 2017 Program Years

	2017 Program	2016 Program
Total Incremental Participant Cost	\$3,478,824	\$4,867,837
Amount of Incentives Paid by AEP Ohio	\$1,789,506	\$2,759,933
Total Participant and Incentive Costs	\$5,268,330	\$7,627,770
Number of Projects	422	442
<i>Ex Ante</i> Energy Savings Reported to Program (MWh)	9,296	11,407
<i>Ex Ante</i> Demand Savings Reported to Program (MW)	1.23	1.470

Source: 2017 values are from the 2017 tracking database and general ledger, while 2016 values are the cost effectiveness numbers provided by AEP Ohio

Figure 3-2 and Table 3-2 shows the number of projects and savings by economic sector, based on information reported in the tracking database. There were a number of projects with the building type “Other”. In those instances, Navigant reclassified the “Other” categories based on their facility type to the following economic sectors: Auto Related, Dining /Bar, Laundromats, Grocery, Gymnasium, Multi-Family, Office/Retail, Retail, School, Small Services. In 2017, Navigant observed 28 percent of projects (120 out of 422) were labeled as ‘Other’ in the “BuildTypCd” field, inadequately describing the source of program

savings and impacts on AEP Ohio's business customers. Navigant continues to recommend identification and recording of business type for each project in the database, to allow program managers the data to align program services with market needs.

Figure 3-1. Percentage of Projects by Economic Sector, 2017 Program (n= 422)

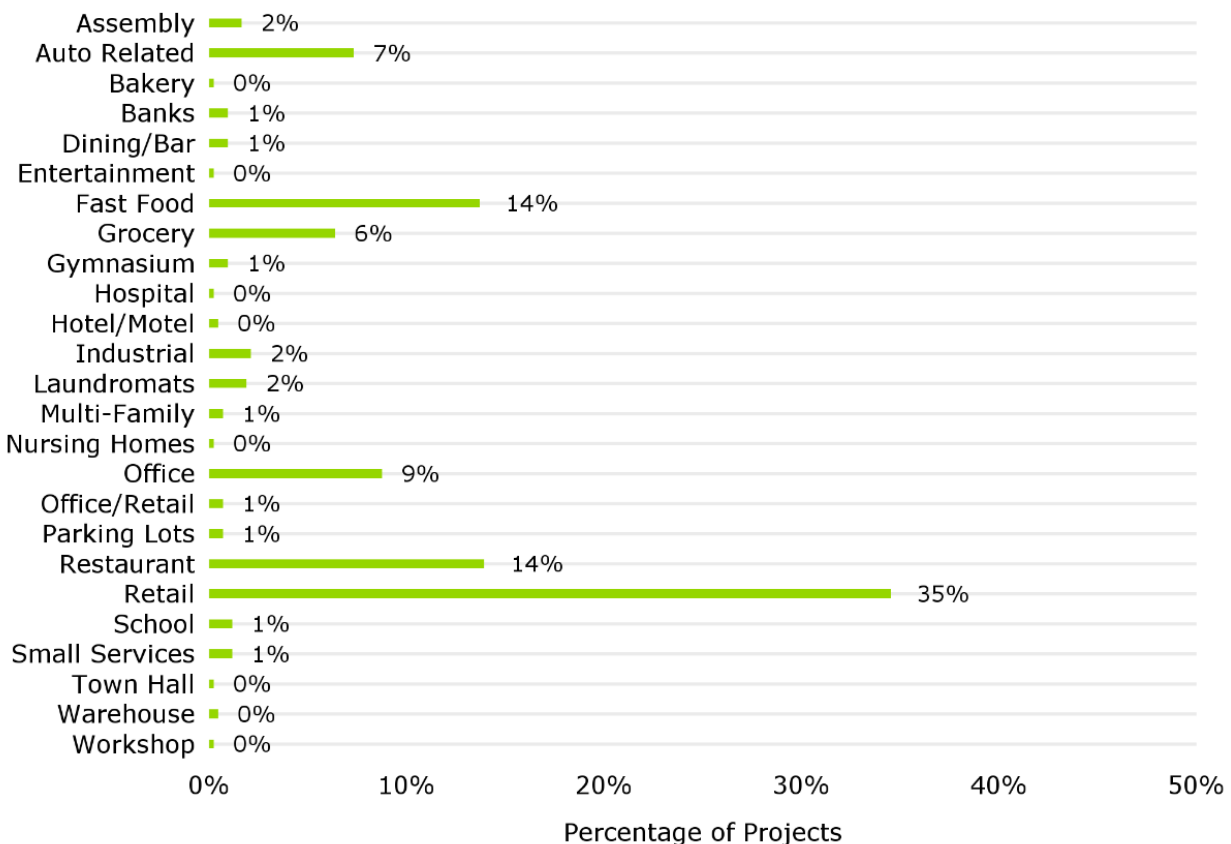
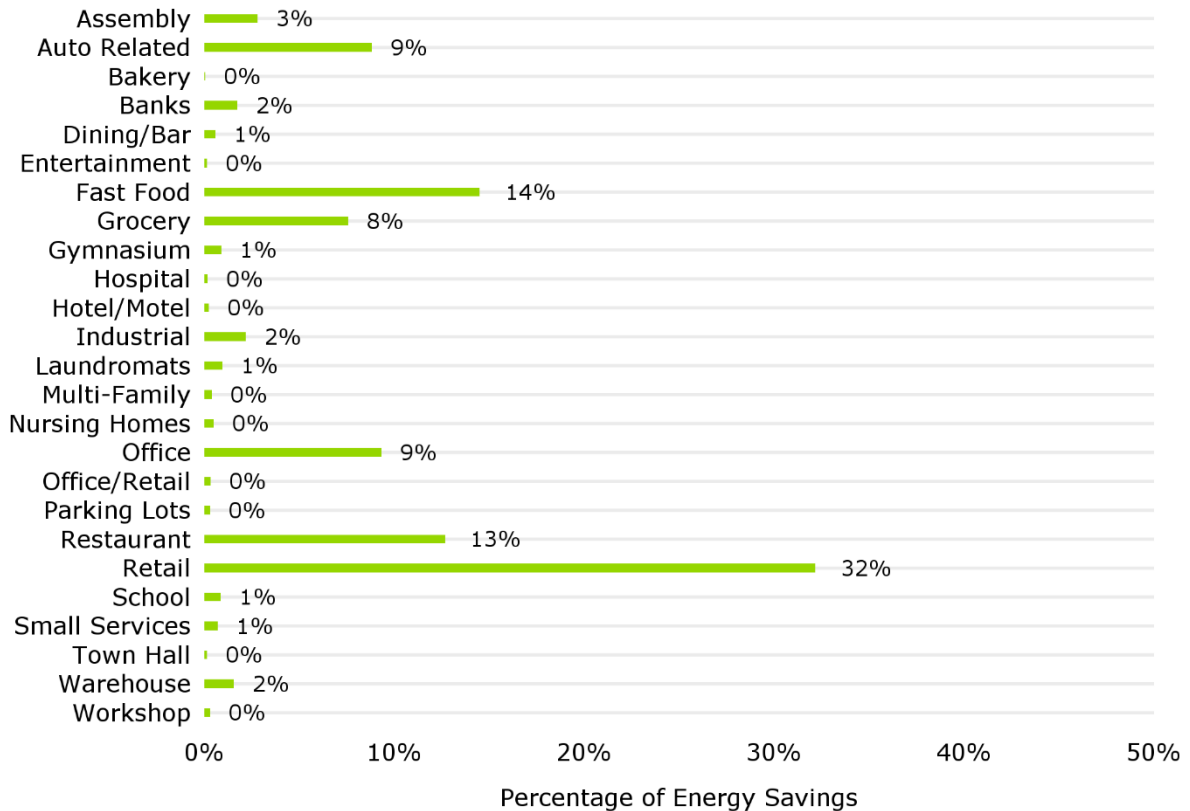


Table 3-2 and subsequent tables and figures present the participation by economic sector based on Navigant's interpretation of entries in the tracking database.

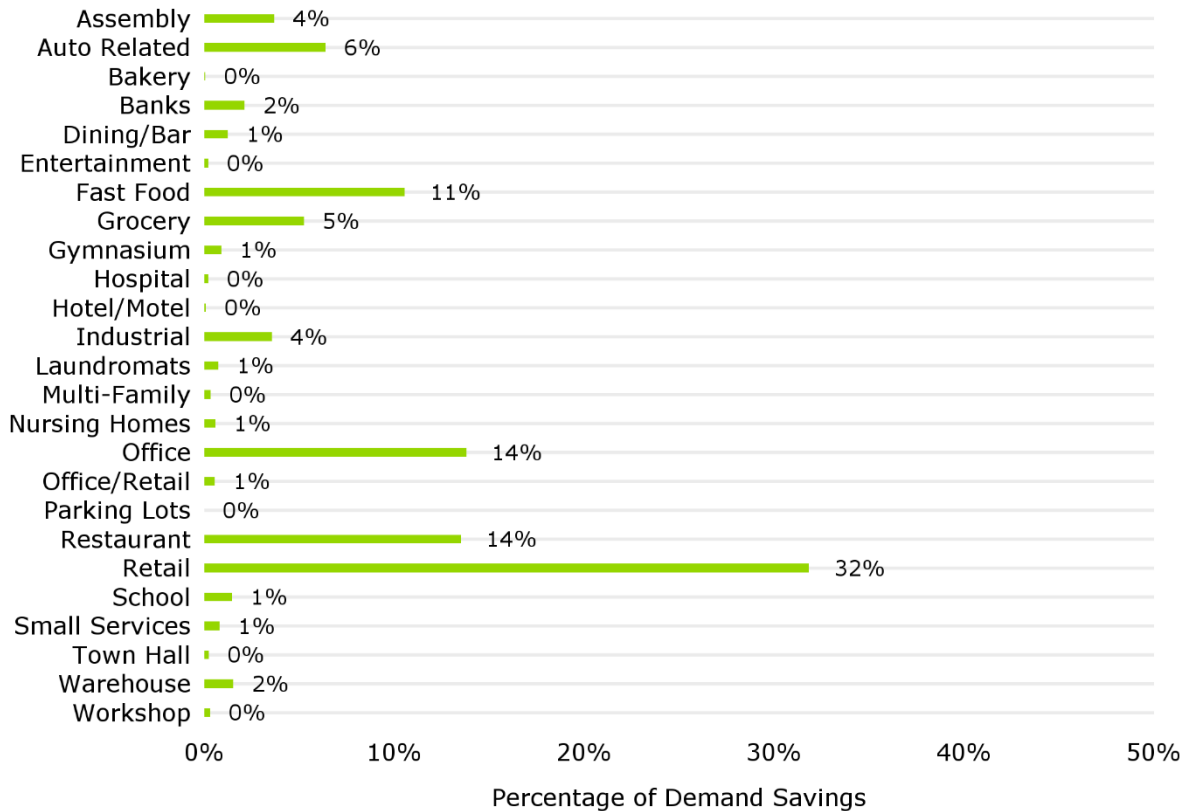
Of the 25 Economic Sectors served in 2017, 85 percent of the 422 projects came from six sectors: retail, fast food, restaurant, office, auto related, and grocery. One project had two business types, hence n=423, as in Figure 3-2. These six sectors correlate directly with energy savings, accounting for 85 percent of Express Program energy savings. The remaining projects and savings were distributed across 19 different economic sectors, with savings and project counts below three percent each. Distribution of projects and savings across economic sectors is illustrated in Figure 3-2, Figure 3-3, and Table 3-2.

Figure 3-2. Energy Savings by Type of Business, 2017 Program (n= 423)



Source: Navigant Analysis of AEP Ohio Program Tracking Database

Figure 3-3. Demand Savings by Type of Business, 2017 Program (n= 422)



Source: Navigant Analysis of AEP Ohio Program Tracking Database

Table 3-2. 2017 Program Activity by Economic Sector

Economic Sector	Number of Projects	Percent of Projects	Ex Ante Savings			
			Energy kWh	Percent of Energy kWh	Demand kW	Percent of Energy kW
Assembly	7	2%	260,622	3%	45.6	4%
Auto Related	30	7%	816,141	9%	77.1	6%
Bakery	1	0%	5,804	0%	0.5	0%
Banks	4	1%	161,003	2%	26.3	2%
Dining/Bar	4	1%	54,842	1%	15.4	1%
Entertainment	1	0%	14,792	0%	2.4	0%
Fast Food	58	14%	1,347,632	14%	130.3	11%
Grocery	27	6%	703,473	8%	64.8	5%
Gymnasium	3	1%	80,403	1%	9.8	1%
Hospital	1	0%	16,342	0%	2.6	0%
Hotel/Motel	2	0%	21,728	0%	1.2	0%
Industrial	9	2%	203,317	2%	44.0	4%
Laundromats	8	2%	88,774	1%	9.1	1%
Multi-Family	3	1%	37,809	0%	4.0	0%
Nursing Homes	1	0%	46,304	0%	7.4	1%
Office	37	9%	870,684	9%	171.8	14%
Office/Retail	3	1%	32,130	0%	6.8	1%
Parking Lots	3	1%	27,399	0%	-	0%
Restaurant	59	14%	1,177,803	13%	166.9	14%
Retail	147	35%	2,996,273	32%	394.2	32%
School	5	1%	79,136	1%	18.1	1%
Small Services	5	1%	65,963	1%	9.9	1%
Town Hall	1	0%	14,696	0%	3.1	0%
Warehouse	2	0%	143,408	2%	8.9	2%
Workshop	1	0%	29,184	0%	3.8	0%
Total	422	100%	9,295,660	100%	1,233.9	100%

Navigant reclassified the "Other" categories based on their facility type to the following economic sectors: Auto Related, Dining /Bar, Laundromats, Grocery, Gymnasium, Multi-Family, Office/Retail, Retail, School, and Small Services.

Source: Navigant Analysis of AEP Ohio Program Tracking Database

Fourteen contractors completed Express Program projects in 2017. The tracking database was missing contractor names for 15 of the 422 projects. Of the participating contractors, collectively, four contractors

completed over 50 percent of the projects and incurred 53 percent of program cost. Additionally, close to 46 percent of program savings were achieved by top four participating contractors based on energy savings.¹

The Tracking Database records key dates of program activity including dates for Audit, Proposal Sent to Customer, Proposal Signed, Work Schedule Date, Work Begin Date, and Act Proj Comp Date. Navigant's analysis of the Tracking Database dates provided the following findings:

- None of the date fields analyzed were missing data.
- There is no field to record the customer's initial program contact.
- On average, projects take 132 days from "Audit Date" to "Invoice Date".
 - As projects move through the system, the primary source of delay is the period between Proposal Sent to Customer and Proposal Signed. This period takes 48 days on average, with 81 projects taking more than 30 days to sign the proposal. Some outliers delaying project action include 14 projects that took over one year; of those, three took between two to three years.
 - On average once the proposal is signed, the work schedule is confirmed within just three days, and begins in 27 days.
 - The projects take an average of 13 days to complete.
 - The Invoice Date field contained some data errors, where 29 projects had invoice dates before the work completed dates. These appear to have been incorrectly entered as a 2016 invoice, instead of a 2017. For the analysis of elapsed time, Navigant removed these 27 outliers with negative elapsed time from the calculation. On average, with outliers removed, projects took seven days between Work Complete Date and Invoice Date.

The project database includes fields for Project Cost, Project Incentive, Customer Payment, Customer Discount, and Total Project Cost. None of these fields had missing data, with the exception of Customer Discount. The Customer Discount field appeared to only be used for project specific instances.

Incentives are calculated based on project specific energy savings. As such, there is no correlation between project cost and incentive amount. Incentives and costs are provided at the project level; there are no cost details in the measures database. Project incentives ranged from 15.6 percent to 83.2 percent of Project Costs; the average incentive covered 60.8 percent of Project Costs. Incentives ranged from a low of \$161, to \$43,808.

Lighting measures accounted for 94.7 percent of all 2017 Express Program measures and 88.9 percent of energy savings. Of the lighting measures, control measures (such as occupancy sensors and photo cells) accounted for two percent of lighting measures and 1.1 percent of energy savings. The project database does not reference whether the existing lighting system included lighting controls for the programs' lighting fixture or bulb measures. While the data does not definitively state whether there were lighting control opportunities in 2017 projects, the low incidence of lighting control measures suggests there is an opportunity to further diversify the program measure mix. This will likely be of critical importance in the future, as savings from light bulb replacements decreases due to regulatory and market

¹ The four contractors who incurred maximum project cost were not the same as the one who achieved maximum savings.

transformation. At a minimum, Navigant recommends AEP Ohio record the status of lighting controls for each measure to analyze these opportunities. Table 3-3 shows the quantity and savings of Express Program measure categories.

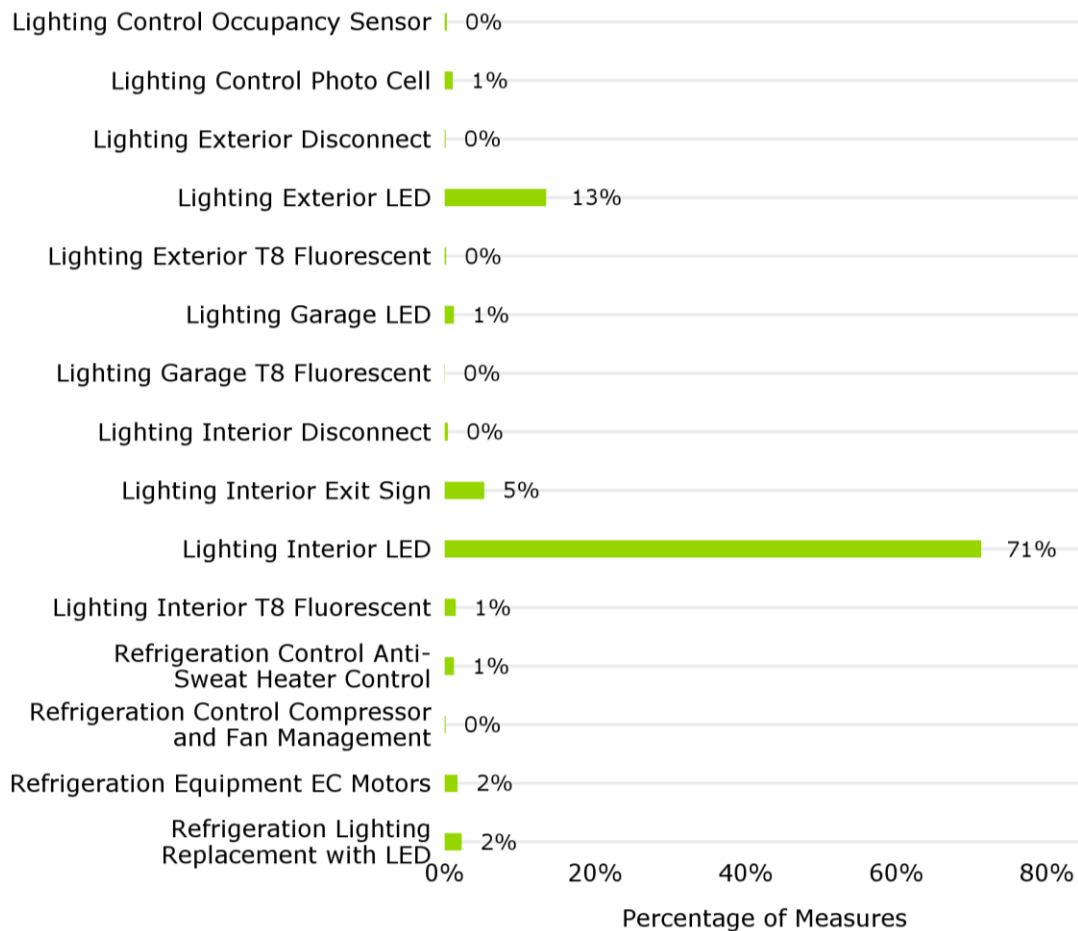
Table 3-3. 2017 Measures by Category

Measure Type	Number of Measures	Total Savings (kWh)	Total Savings (KW)
Lighting Measures			
Controls	79	87,649	7.3
Exit Signs	220	117,741	11.2
LED fixtures / lamps	3,601	8,010,947	1,089.6
Linear Fluorescent	70	46,996	12.7
Total Lighting Measures	3,970	8,263,333	1,120.8
Refrigeration Measures			
Refrigeration	128	615,050	51.7
Refrigeration Lighting	93	417,278	61.4
Total Refrigeration	221	1,032,328	113.1
Grand Total	4,191	9,295,660	1,234

Source: Navigant Analysis of AEP Ohio Program Tracking Database

Figure 3-4 shows the percentage of measures by measure type. 71 percent of measures installed were interior LEDs, while another 13 percent were exterior LEDs. Five percent of measures were exit signs.

Figure 3-4. Percentage of Measures by Measure Type (n= 4,191)



Source: Navigant Analysis of AEP Ohio Program Tracking Database

3.2 Impact Evaluation Findings

This section includes a summary and discussion of the evaluation-calculated electrical energy and peak demand savings for the 2017 Express Program. Annual electricity savings were calculated using the data collected through document reviews and field visits for the sample of sites, as well as billing analysis and deemed savings calculation.

3.2.1 Summary of Impact Findings

The *ex post* annual energy savings for 2017 are 9,403 MWh. Based on the onsite verification, the realization rates are 1.01 for energy savings and 1.12 for coincident demand reduction. Results are shown in Table 3-4. The table presents both program savings and increased realization rates compared to 2016.

Table 3-4. Impact Savings, Realization Rate and Precision of Sample

Metric	2017 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)	14,416	9,296	9,403	1.01	12%	65%
Coincident Peak Reduction (MW)	3.678	1.234	1.385	1.12	17%	38%

Source: ENERGY EFFICIENCY / PEAK DEMAND REDUCTION (EE/PDR) PORTFOLIO 2017 to 2020 Evaluation Plan, September 27, 2017

The program did not meet its goals due to a temporary shutdown which led to a slow ramp-up in 2017, with most retrofits completed in October of 2017. However, the *ex post* values were higher than the *ex ante* values. While the desk review did not result in any program tracking or reporting issues, the onsite verification did discover that some of the reported factors are off. Based on the onsite verification, hours of use continue to be realistic based on interviews, but actual fixture hours are understated, while reported efficient wattage is overstated.

The realization rate was calculated based on the onsite verification and population roll-up while the desk review and billing analysis did not affect it. The energy savings realization rate is 101 percent while the demand realization rate is 112 percent. The full tracking database for the Express Program, along with the onsite results were used to come up with the final *ex post* savings value. The onsite sample included 20 sites, which was intended as an additional check (due diligence) to the billing analysis. With the Express program's population size of 422, a sample 59 projects would be needed to yield a 90% confidence and 10% margin of error. Thus, with such a low number of sites, the 90/10 precision was not reached; 90/12 was reached for energy and 90/17 was reached for demand. The realization rate being greater than 100% is likely due to minor adjustments the team made during the onsite analysis, such as using the logged hours instead of reported hours, verified wattage, and data to determine an actual "Verified Coincidence Factor". The Navigant team is in the process of fine tuning the Coincidence Factor. The team made a slight adjustment to how the baseline watts were applied. (e.g., included a ballast factor which the implementation contractor did not). It is important to note that:

- 1) The logged CF is most often higher than the deemed CF, even though the actual logged HOU might be lower. That affects the kW results more than the kWh results.
- 2) Since there are so many exterior measures (which generally do not have kW savings), the kW number is proportionally smaller than the kWh number. Therefore, smaller changes to kW numbers at individual sites cause larger changes in the overall realization rate.

The remainder of this section presents the impact activities in more detail, including:

- Onsite Verification and Population Roll-up
- Desk Review

3.2.2 Onsite Verification and Population Roll-up

Navigant conducted onsite verification visits for a total of 20 randomly-selected projects throughout the service territory. One project contained refrigeration only measures, the rest were lighting only projects.

LED fixtures comprised 87 percent of fixtures verified during the onsite visits. This is consistent with the distribution of LED fixtures in the population of measures (84%). 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.

Hours of use continue to be realistic based on interviews, but actual fixture hours are understated. The evaluation team verified reported hours of use based on data provided by the customer during the visit, as well as by logging fixture operation. The field team deployed loggers at 8 out of 20 sites. Six out of 20 loggers were able to log hours correctly. To determine hours of use, if there were logged hours, those were prioritized over hours obtained by onsite interviews. The hours of use were weighted and separated by schedule. Overall, the evaluation team verified hours had a realization rate of 1.13, which is higher than the 0.977 realization rate for the sample in 2016 and 0.986 in 2015. The metering of hours of use provided a more accurate determination, and the results indicate the auditing team at times underestimates hours. Thus, paying close attention to hours of use is recommended to avoid underestimating hours.

Reported efficient wattage is overstated. During the site visit, efficient fixture wattage was recorded. The realization rate for fixture Wattage was 0.81. This difference is primarily due to the efficient wattage found on site. The quantities of efficient fixtures were within about five percent of the expected values. The remainder must be due to the efficient fixture wattages being lower based on the field findings.

3.2.3 Desk Review

AEP Ohio also provided Navigant with a detailed description of all formulas for both lighting and refrigeration measures. Navigant reviewed these formulas and found these to match industry standards. 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 as reasonable, but these 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.

3.2.3.1 Hours of Operation

Prior Express Program Evaluation Reports² identified over-estimated hours of operation as a driver of over-estimated reported program savings, while more recently, the 2014 Express Program Evaluation³ and 2016 Express Program Evaluation⁴ determined hours of use appear to 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. This indicates the hours of use estimates are consistent with energy savings estimates from other sources.

For the 2016 evaluation, based on the desk review, the team found hours of operation were missing in a few cases, specifically for refrigeration measures.

3.2.3.2 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 addition, the linear LED T8 retrofit lamp wattages, while generally consistent with manufacturer specification sheets, should consider additional power consumption of the electronic ballast under certain configurations (e.g. wired directly to line voltage versus an electronic ballast)⁵.

While the evaluation team did not determine that 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.

3.2.3.3 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, and climate data from Poughkeepsie NY, rather than Ohio. The evaluation team used these values again for 2017 since these consider the HVAC system type found onsite, rather than making weighted assumptions on system type for a building type.

² <https://aepohio.com/save/business/>

³ <https://aepohio.com/save/business/>

⁴ <https://aepohio.com/save/business/>

⁵ http://images.philips.com/is/content/PhilipsConsumer/PDFDownloads/United%20States/ODLI20160302_001_UPD_en_US_LED-Lamps-PLt-1309BN_LED-T8-IF_Gen1.pdf

In 2015, there were some lighting measure records that appeared to be in unconditioned spaces, but were still credited with HVAC interaction effects. However, in 2016 and 2017, the locations marked “exterior” or “outside” were correctly marked with a zero (0) HVAC interaction factor in the tracking data.

3.2.3.4 Coincidence Factors

The coincidence factor is used to calculate the percentage of time an efficient measure operates during the utility 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 evaluation team applied screw-in coincidence factor (CF) values for screw-in LED measures. This adjustment was the primary driver of the demand savings realization rate of 0.94. 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.

3.2.3.5 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 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 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.

3.2.3.6 Refrigeration Measure Assumptions

Refrigeration measures in 2017 account for 11 percent and 9 percent of *ex ante* reported energy savings and demand savings, respectively, which is a slight decrease from 2016 (14% energy and 10% demand savings). The evaluation team found the refrigeration assumptions were based on the New York TRM, and are appropriate.

3.3 Process Evaluation Findings

For 2017, 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.

The evaluation review found the program did not meet the 2017 energy savings goals. The number of projects and average savings per project have both decreased compared to 2016. Table 3-5 compares the 2016 program year with 2017.

Table 3-5. 2016 – 2017 Program Comparison

Type of Statistic	2017 Program	2016 Program
Number of Projects	422	442
Total <i>Ex Ante</i> Energy Savings (MWh)	9,296	11,407
Total <i>Ex Ante</i> Demand Savings (MW)	1.23	1.47
Per Project Average <i>Ex Ante</i> Energy Savings (MWh)	22.02	25.81
Per Project Average <i>Ex Ante</i> Demand Savings (MW)	0.0029	0.0033

Source: Navigant Analysis of AEP Ohio Program Tracking Database

The core processes and basic program theory of the 2017 Express Program did not change significantly from 2016. The evaluation team identified two changes from the 2016 program that may have contributed to the 2017 program performance, (1) delayed start to the program year, and (2) reduced incentives.

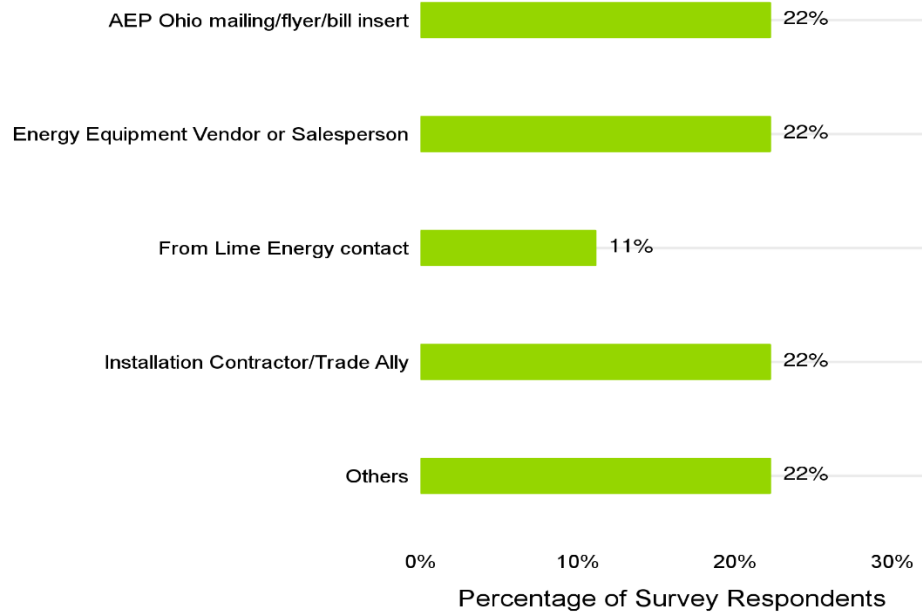
1. **Delayed 2017 Start:** Outreach to 2017 program participants was delayed due to two unrelated reasons. First, the program had sufficient projects in the pipeline to meet the 2016 goal by October of 2016. Second, the 2017 portfolio plan was not adopted by the commission until January of 2017. The result was a gap, where energy auditors were not actively seeking new participants. Five of the six auditors left during this downturn. When the 2017 plan was approved, staff had to be hired and trained; a three to five-month process to restart the program.
2. **Incentives:** The average incentive for Express Program projects decreased from to \$0.220/kWh for 2017.

3.3.1 Marketing Efforts and Program Awareness

The primary Express Program outreach efforts are through an energy service representative (ESR) walking into a customer's business as a cold call. Based on the AEP Ohio 2017 Marketing Summary, the primary marketing effort is through direct mail or email to potential customers. Both non-participants and past participants are included in this direct outreach; non-participants are encouraged to participate, and previous participants are encouraged to refer other customers or even upgrade their previous fluorescent lighting based project to LED lighting. During the onsite verification visits, customers were interviewed.

Twenty program participants were surveyed during the onsite verification visits. Participants were asked about their awareness of the program. As shown in Figure 3-5, the four-main sources for program awareness are Trade Allies, Energy Equipment Vendors, AEP Ohio's mailing/flyer/bill insert and other sources. This shows that marketing efforts are working well; there are several avenues to reach participants and they all are reaching their intended audience. Marketing efforts to raise program awareness are reinforced through the ESR visits, which are needed to convince customers to move forward with their projects.

Figure 3-5. Express Program Awareness (n=18)



*Note: The percentages have been rounded to zero decimals.
Source: Navigant Analysis of Onsite Survey*

3.3.1.1 Program Material Review

The implementation contractor is responsible for Express Program outreach and materials. Table 3-6 lists the documents reviewed as part of the Express Program process evaluation.

Table 3-6. Express Program Materials Reviewed

Document	Description
2017_SmallBusExp_FactSheet	Single page brochure. Available to customers as link from the AEP Ohio website, Express Program page.
AE_17000_SM_LED_retail_HR	Two-page brochure tailored for specific market sectors
AE_17001_SM_LED_Restaurant_HR	
AE_17002_SM_LED_auto_HR	
AE_17003_SM_LED_Grocery_HR	
AE_17004_SM_LED_Office_HR	
AE_17005_SM_LED_Warehouse_HR	Two-sided direct mail, targeted to various business types
AE_17006_pc_TestAddValDrev	
AE_17007_pc_TestAddVal_hr_060617	
AE_17008_ENV_addedvalue_hr	Envelope and one-page letter to prospective new customers.
AE_17008_LTR_addedvalue_hr	
AE_17020_ENV_pastcustomer_HR	Envelope and one-page letter to previous customers, encouraging follow-up lighting upgrade to LED.
AE_17020_LTR_pastcustomer_HR	
AE_17022_pc_paystoknow_HR	Mailer encouraging customer referral for \$50 gift card.
AE_17023_ESR_paystoknow_HR	
AEP Ohio 2017 Marketing Summary	PDF/Excel doc with 12-month outreach plan and examples of outreach correspondence (emails and letters).
AEP Ohio Express Proposal Customer Information Removed 2017	14-page power point customer presentation of assessment results, estimated savings, costs, and the project contract for signature.
AEP Ohio web site	www.aepohio.com

Source: AEP Ohio

3.3.1.2 Value Proposition

The evaluation team finds customer-facing materials to appear clean, clear, and accessible. The call to action is consistent across the documents for customers to call for a free assessment. The value proposition can be summarized as AEP Ohio will pay up to 80 percent of project costs and customers will realize energy savings.

While the customer messaging consistently prioritizes the value proposition of incentive payments and savings, Navigant observes incentives and savings amounts are described inconsistently, and are only loosely defined. Additionally, the turn-key nature of the program, described by program staff as a significant benefit to small business customers, is understated. By turn-key, the evaluation team includes the entire project process, but specifically the program supported project management and direct installation of recommended measures.

Incentive amounts are described as “up to 80% of project costs” in customer facing documents. While some potential customers will read this as “80%”, other customers will read this as 0%, due to its

undefined nature. Many customers may read this as somewhere in between 0 – 80%, ultimately undercutting a key component of the program value proposition.

The evaluation team reviewed a proposal document (“AEP Ohio Express Proposal Customer Information Removed 2017”) as part of the materials review. The proposal presents costs and savings, to encourage customer commitment to the project. Lifetime energy savings (in dollars) are not directly presented in relation to customer costs net of incentives; the project is not described as an investment decision for the customer. This project provides a very strong return on investment (ROI) of 1,155 percent (\$245 customer costs, \$3,075 lifetime savings = 1,155% ROI). It is unlikely a small business customer could invest \$245 in any other part of their business and achieve that result. Additionally, if the customer utilized the available financing, the project would be cash flow positive.

Analysis of the 2017 Express Program tracking data illustrates total lifetime savings and total customer costs (net of incentives) delivers an average return on customer investment of over 1,000%. Businesses make investment decisions based on how their money can improve their bottom line. To encourage participation, Navigant recommends promoting the very favorable ROI available to Express Program participants.

Currently, potential energy savings are described inconsistently throughout the documents, and do not position participation as delivering tangible benefits, or that the savings can be expected to pay for the project, and provide a strong return on investment. Rather, potential savings are described inconsistently throughout the document set and sometimes with a single document (including kWh, dollars for specific projects, and a variety of different savings ranges), Table 3-7 shows examples of savings descriptions.

Table 3-7. Customer Facing Descriptions of Program Savings

Customer Facing Text	Source
The Express Program cuts the cost and hassle of energy efficiency upgrades, making it easier than ever for small businesses to save energy and money .	www.AEPOhio.com website
Annual Energy Savings (projected) 9,168 kWh	2017_SmallBusExp_FactSheet
Greg's Annual Savings, \$824!	
You can lower your energy usage up to 50%	AE_17000_SM_LED_retail_HR
Big energy savings are in store for you.	
Improve profitability by saving on energy costs	
You could save up to 20% or more on energy costs!	AE_17008_LTR_addedvalue_hr
LED lights offer up to 30% energy cost savings when compared to 28w and 32W fluorescent T8s.	AE_17020_LTR_pastcustomer_HR

Source: AEP Ohio

Consistent with other AEP Ohio programs, the 2017_SmallBusExp_FactSheet presents project success stories. The project costs and incentives are both presented in dollars, but savings are presented in kWh.

To increase relevance for potential customers, Navigant recommends presenting savings in dollars, including a calculated ROI. This is a cross-cutting recommendation across AEP Ohio's portfolio.

The value of the Express Program's project management and direct installation services are understated on all program documentation. Industry-wide surveys of commercial customers regularly indicate time and energy efficiency experience are a significant barrier to program participation. Express Program staff report the high level of customer service provided by the program is a key driver of customer satisfaction. The Express Program offers a solution to overcome the customer time barrier, but this benefit is not clearly presented to customers. AEP Ohio should consider emphasizing these services, particularly including project management of contractors and measure installation. Where these references do exist, these are often deemphasized on a second page, and in the context of other program services as shown in Figure 3-6.


Figure 3-6. Presentation of Project Management Services

SOURCE: E_17008_LTR_addedvalue_hr

How the program works:

- Local energy efficiency experts who understand your business conduct a **FREE** energy assessment to identify potential saving opportunities.
- After completion, the energy efficiency expert shares a no-obligation proposal, including a list of recommendations, estimated energy savings, project cost and payback period.
- AEP Ohio may pay up to 80% of the project cost — upfront!**
- Installation of new, approved energy-efficient lighting or refrigeration upgrades is completed by an AEP Ohio approved contractor.
- 0% financing for 12 months is available for qualified customers.

SOURCE: AE_17002_SM_LED_auto_HR



Did you know? Installing new LED lighting in your car dealership or automotive business space will:²

- Reduce the need for lighting maintenance and replacement
- Lower your air conditioning load and energy usage
- Allow you to better control your showroom lighting
- Improve the look of cars in showrooms
- Reduce glare on car windows
- Improve safety for mechanics and service staff

Achieving all of this is easier than you think. We take care of everything!

HERE'S WHAT WE DO:

- Perform a **FREE** energy assessment
- Install new equipment and manage the entire process
- May pay **up to 80%** of the project cost

Source: AEP Ohio

3.3.1.3 Program Website

As discussed above, the Express Program uses a direct cold call and direct mail outreach approach to promote the program and generate requests for energy assessments. Program staff do not indicate the website is a key method for small business customer engagement.

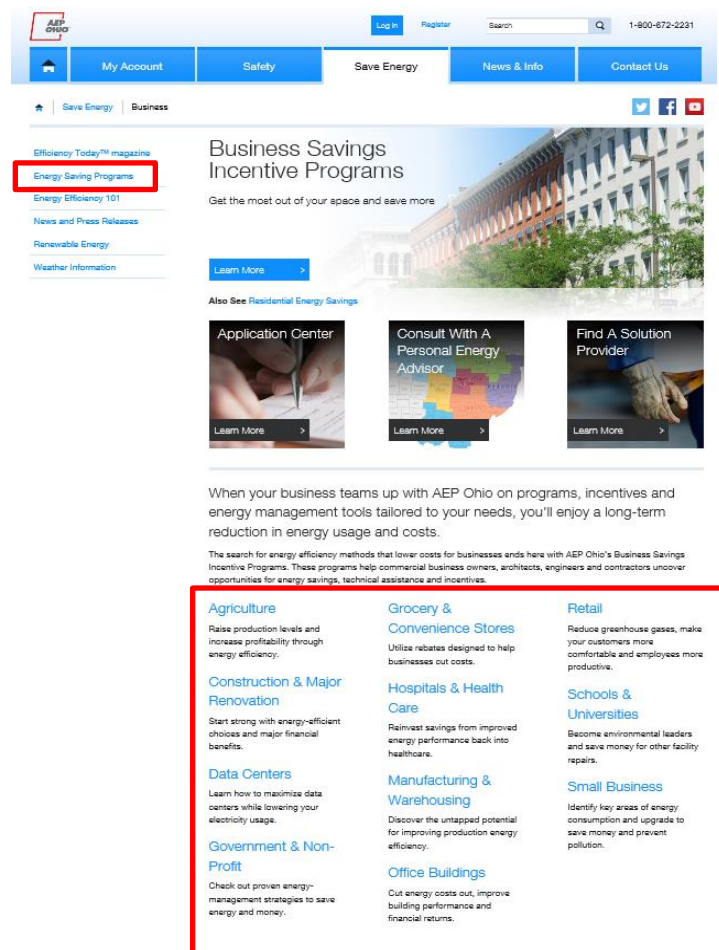
Conversely, the overall marketing objective for AEP Ohio's portfolio of business programs is to drive customers to the AEP Ohio website. This objective conflicts with a cross-cutting finding for AEP Ohio's

commercial programs; there is no overarching tool or document on the website to guide customers to the best program to meet their needs. Additionally, business program web pages, such as the Express Program, are difficult to find (requiring 5-6 clicks through residential program pages). The ramifications for the Express Program is some customers may not be aware of the program, or when it may be appropriate for them. From the AEP Ohio home page, it takes three clicks to access the 'Business Savings Incentive Programs' page.⁶ Two of these three steps take the customer through residential pages: 'Save Energy' (residential), 'Rebates and Programs' (residential), and finally, 'Business'. On the Business page, customers seeking information about energy efficiency opportunities have two broad options: self-select a 'market type' most closely aligned with their business, or select 'Energy Saving Programs' from the side bar menu as shown in Figure 3-7.

Figure 3-7. Business Savings Incentive Programs

1. **Market Type:** Customers self-selecting a market type have the option to choose 'Small Business'. On the Small Business landing page⁷, customers are presented with three generic statements about national small business energy costs, that small business can save as much per square foot as larger businesses, and that "Small Businesses have received incentives up to \$6,904,634". (energystar.gov is offered as a source for all the data on this page, including the incentives which presumably came from AEP Ohio). The page does not include a call to action for Small Business Customers.

There is a link to the Express Program, but there is no context for why a customer should choose this option ("Read more about the Express Program"). This link brings the customer to a single page Express Program brochure PDF. Adjacent to the Express Program link, is a link to "Request Incentive (PDF)". This link brings customers to the 22-page application form for Efficient Products for Business, Process Efficiency & Self-Direct, and does not reference the Express Program. Finally, the page refers customers to call a Solution Provider, an action that does not support the Express Program.



Source: AEP Ohio

⁶ <https://aepohio.com/save/business/>

⁷ <https://www.aepohio.com/save/business/programs/SmallBusiness.aspx>

A graph on this page⁸ illustrates the “largest contributors to electricity consumption in a small business with suggestions for reducing this consumption,” with lighting load as 30.4 percent of small business energy use. This stands in contrast to program’s very heavy reliance on lighting measures. (94% of measures and 89% of energy savings.)

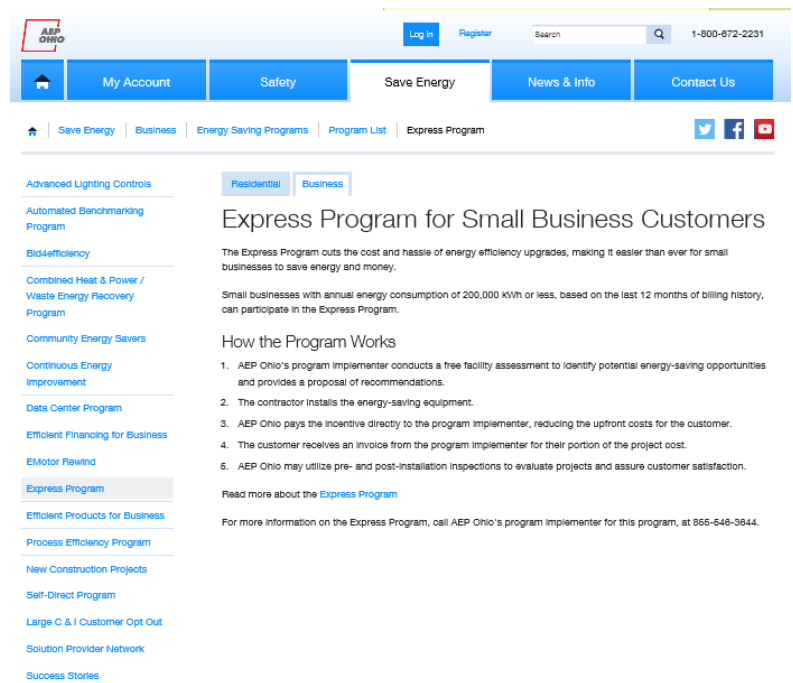
The small business market page is unlikely to drive Express program projects, as there is no description of relevant services, potential measures, or how a customer should choose among the variety of commercial programs.

2. **Energy Savings Programs:** Customers choosing this option from the “Business Savings Solutions Page”⁹ are brought to the “Energy Savings Programs”¹⁰ page, where the same list of market types is displayed in a list format. The side-bar menu changes slightly on this page, offering customers a choice of “Program List”.

Clicking “Program List” link, customers are presented with the “Efficient Products for Business” page¹¹ describing details of that program, with no reference to the Express Program. The side-bar menu has changed again, now presenting a list of 17 program options to choose from (although not all are programs: “Solution Providers” and “Success Stories” are included in this list). Customers are not offered an explanation for how to choose which program may best serve their needs.

Figure 3-8. Express Program for Small Business Customers

Customers specifically seeking the Express Program may select “Express Program”, from the list, which links to “Express Program for Small Business Customers” web page¹² shown in Figure 3-8. This page describes the value proposition as “The Express Program cuts the cost and hassle of energy efficiency upgrades, making it easier than ever for small businesses to save energy and money.” The page also lists program requirements (max 200,000kWh/year) and provides five steps of participation. There is a link to the same single page Express Program brochure pdf. If customers have questions, they are given the implementation contractor’s phone number.



Source: AEP Ohio

⁸ <https://aepohio.com/save/business/programs/SmallBusiness.aspx>

⁹ <https://aepohio.com/save/business/>

¹⁰ <https://aepohio.com/save/business/programs/>

¹¹ <https://aepohio.com/save/business/programs/PrescriptiveProgram.aspx>

¹² <https://www.aepohio.com/save/business/programs/ExpressProgram.aspx>

In summary, where one of the key objectives in raising awareness of AEP Ohio's commercial programs is to drive customers to the website, the website does not directly promote the Express Program or its key benefits as a possibility for many small business customers. There is no overarching presentation of how customers should choose the AEP Ohio program service to best meet their needs, or description of the services provided by the program to assist customers in identifying and prioritizing their opportunities. For customers specifically seeking Express Program information, it takes six clicks to reach the Express Program page, as illustrated in Table 3-8.

Table 3-8. Steps to Reach Express Program Web Page

Action	Landing Page
Go to AEP Home Page	https://www.aepohio.com/
Click "Save Energy"	https://www.aepohio.com/save/residential/ "Rebates & Savings Programs" (NOTE: This is a <i>residential</i> page)
Click "Rebates and Savings Programs"	https://www.aepohio.com/save/residential/programs/ "Incentive Programs for Residents"
Click "Business"	https://www.aepohio.com/save/business/ Business Savings Incentive Programs
Click "Energy Savings Programs"	https://www.aepohio.com/save/business/programs/ Energy Saving Programs
Click "Program List"	https://www.aepohio.com/save/business/programs/PrescriptiveProgram.aspx Efficient Products for Business
Click "Express Program"	https://www.aepohio.com/save/business/programs/ExpressProgram.aspx https://www.aepohio.com/save/business/programs/DataCenterProgram.aspx Express Program for Small Business Customers

Source: AEP Ohio

3.3.2 Program Requirements

Express Program requirements have not changed in 2017. AEP Ohio business customers with annual energy consumption of 200,000 kWh or less 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.

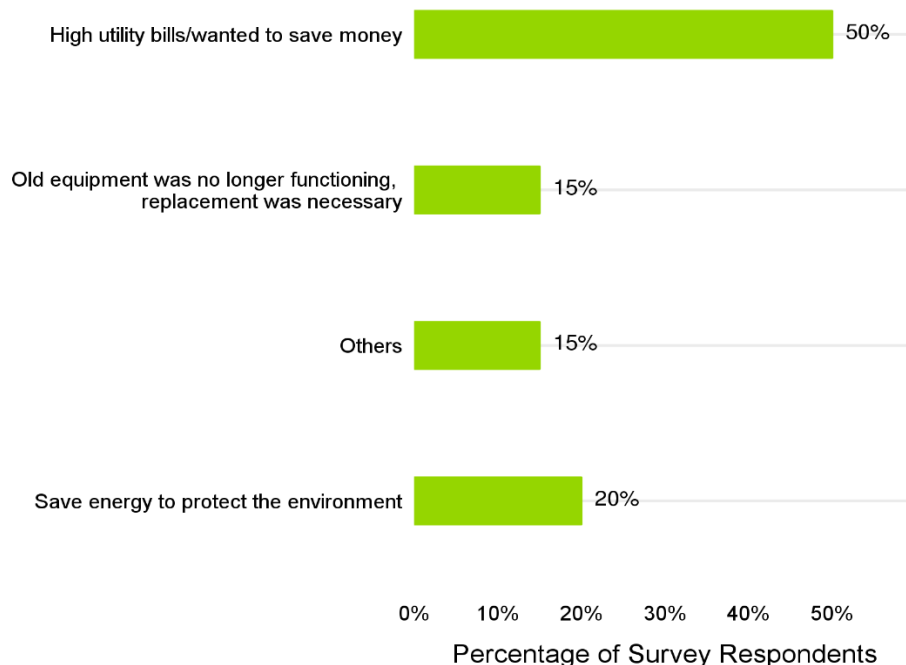
As the program is focused on overcoming the time and financial barriers to implement basic energy efficiency measures in small businesses, these criteria are appropriate for the Express Program. No changes to the program requirements are recommended at this time.

3.3.3 Drivers of Program Participation

Desire to save money was most often mentioned as the key driver for replacing the equipment, followed by saving energy to protect the environment, and replacing old equipment. Figure 3-9 shows 50 percent of the Express customers wanted to save money and reduce their high energy bills. Marketing efforts should focus on these factors.

Additionally, and equally as important, sixty-seven percent (12 respondents) said that they replaced old equipment on burnout and 33 percent (6 respondents) said they planned to remodel their existing system. Existing equipment age was found to be around 18 years, with about five percent not functioning. Most respondents did not consider any other technologies for their projects and they went with the recommendation of their contractor. One participant reported it had the light on less when using the old equipment. The rest of the participants reported similar usage patterns. These survey findings suggest program motivators to participation must overcome customer resistance to replacing their existing, functional equipment.

Figure 3-9. Main Reason for Replacing Equipment (n=20)



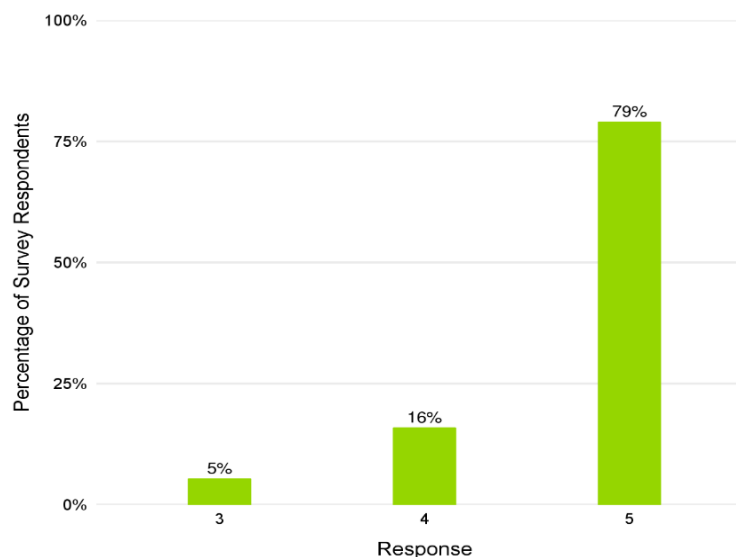
Note: The percentages have been rounded to zero decimals

Source: Navigant Analysis of Onsite Survey

Based on the onsite surveys, the primary reason for program participation was to save money/energy (50%; 10 respondents). Better light quality was the second most important (28%; 5 respondents) and getting the rebate and less maintenance were tied for third (22%; 4 respondents). Primary program benefits mentioned were primarily to save money/energy/reduce utility bill (94%; 16 respondents), followed by better quality lighting (35%; 6 respondents), and to get the rebate (29%; 5 respondents). Multiple response options were allowed for these questions; thus, the sum does not equal 100%. For customers, while saving money and energy is the most important benefit of the program and the primary reason to participate, better light quality, less maintenance, and receiving a cost reduction in the form of a rebate are also very important reasons. These messages should be used in marketing materials to attain customer interest in the program.

Figure 3-10 indicates most customers would very likely recommend the program to others, which shows that they are satisfied with the program and see value in it. For this question, the rating scale was from 1 to 5, 1 being not at all likely, and 5 being very likely to recommend program to others. This finding suggests that once the program convinces customers to overcome the initial resistance to replace their existing equipment, those customers recognize benefits to program participation. While a high percentage of respondents indicated they would be willing to recommend the program to others, Figure 3-5 indicates none of the surveyed customers heard of the program from a peer business. Leveraging successful past participants to promote the program, either directly to their peers, or through additional case studies may be a potential avenue for marketing for AEP Ohio to explore.

Figure 3-10. Likelihood to Recommend the Energy Efficiency Program for Business (n=19)



Note: The percentages have been rounded to zero decimals.

Source: Navigant Analysis of Onsite Survey

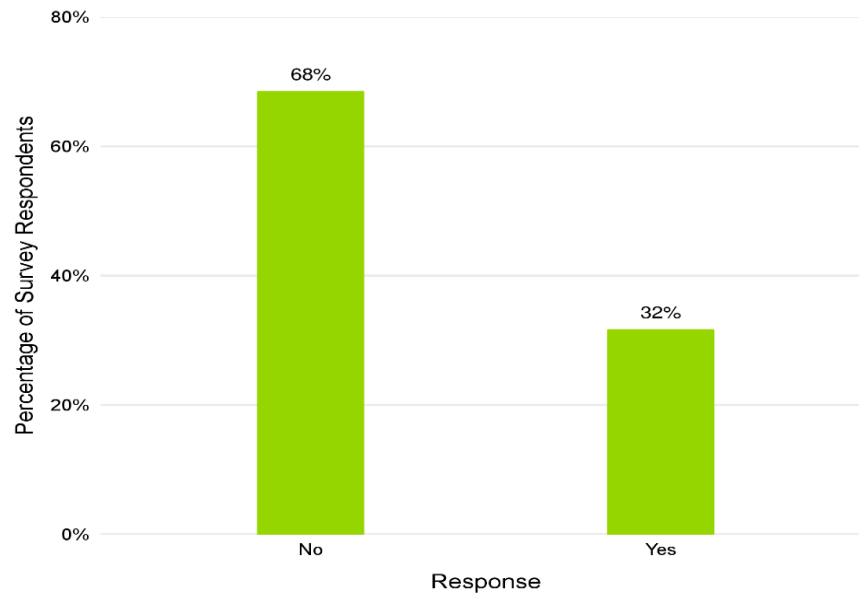
3.3.4 Channeling to Other Programs

Figure 3-11 indicates most customers have not participated in the Express Program or any other AEP Ohio EE/PDR programs before 2017. This graph also reflects the opportunity for AEP Ohio to identify the non-participants of its Energy Efficiency programs to develop an outreach effort to reach these customers. Of the six respondents who participated in other programs, 17 percent participated in the

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Express Program in the past, and 83 percent participated in the program formerly known as Prescriptive (now Efficient Products for Business).

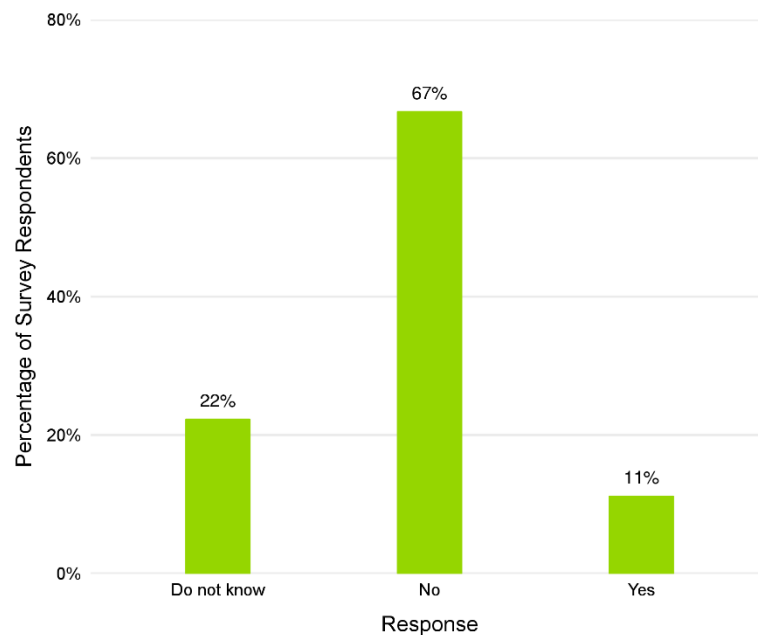
Figure 3-11. Participation in AEP Ohio EE Programs Prior to 2017 (n=19)



*Note: The percentages have been rounded to zero decimals.
Source: Navigant Analysis of Onsite Survey*

Figure 3-12. indicates most participating customers are either unaware of, or don't know about, additional energy efficiency projects

Figure 3-12. Awareness of Additional Energy Efficiency Projects the Participant Could Pursue (n=18)



*Note: The percentages have been rounded to zero decimals.
Source: Navigant Analysis of Onsite Survey*

For those people who are aware of additional energy efficiency projects that could be completed at their site, but have not been pursued this at this time, one customer mentioned ECM Motors and another mentioned refrigeration-new walk-in cooler. While this may be in line with the narrow focus of the Express program on lighting and refrigeration projects, it indicates that there may well be additional lost opportunities at these sites. AEP Ohio may be able to leverage additional participation and savings by Express program auditors identifying and recommending additional measures that could be managed through the appropriate program.

3.3.5 Barriers to Participation

Express Program staff estimate it takes ten walk-in cold calls to result in one audit. In 2017, 75 percent of audits did not result in projects (1,800 audits, 455 projects). The implementation contractor estimates energy service representatives return to the site up to five times after the proposal is delivered. Additionally, after the proposal is delivered to the customer, the implementation contractor sends reminder emails at 15, 30, and 60 days. The goal is for at least 35 percent of audits to result in completed projects.

Program staff do not have data regarding why projects stall after the audit stage. Anecdotal reasons include incentives did not meet customer expectations, savings did not meet customer expectations, or program engagement was not made with the relevant business decision maker.

The evaluation team reviewed the completed project tracking database delivered to Navigant, which did not include unconverted audits. This database does not include fields related to the customer engagement which would allow analysis of the reasons for customer participation, or delay.

78 percent (14) of respondents to the onsite customer survey said there are no drawbacks to the program. The remaining four respondents provided drawbacks: two customers are unsure how much new LED lights are saving, one mentioned the high price of LEDs, while another said LEDs are not their personal preference.

3.3.6 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 confirm progress. If projects are delayed, particularly between program years, monies reserved for a particular project may be freed up. In 2016, incentive funds were completely committed early in the fourth quarter. The implications of this, combined with the delay of AEP Ohio's 2017 plan, caused outreach to new customers to stop. This in turn led to the turn-over of five of the six energy Express Program ESRs.

The project database includes fields for Work Complete and Invoice Date. Neither of these fields had missing data. The Invoice Date field contained some data errors, where 29 projects had invoice dates *before* the work completed dates. These appear to have been incorrectly entered as a 2016 invoice, instead of a 2017. For our analysis of elapsed time, Navigant removed these 29 outliers with negative elapsed time from the calculation. On average, with outliers removed, projects took 9 days between Work Complete Date and Invoice Date.

Incentives are calculated based on project specific energy savings. As such, there is no correlation between project cost and incentive amount. Incentives and costs are provided at the project level; there are no cost details in the measures database. Project incentives ranged from 15.6 percent to 83.2 percent of Project Costs; the average incentive covered 60.8 percent of Project Costs. Incentives ranged from a low of \$161, to \$43,808.

The average incentive for Express program projects decreased from \$0.244/kWh in 2016 to \$0.220/kWh in 2017. Incentives are projected to be further reduced in to \$0.215/kWh in 2019 and to \$0.210/kWh in 2020. Program staff observe that this reduction in incentives may contribute to the low conversion rate, however there is no formal customer feedback mechanism or data available to the implementation team to confirm this assumption. The program attempted to overcome the reduced incentive through a 0%, 12-month financing offer. Program staff observe the financing offer may be more useful to influence conversions if it were better promoted to customers.

While not promoted on either the Small Business Program or Express Program web page, the Express Program one-page brochure indicates financing is available for projects: "12-month, interest-free financing for qualified customers". This is confirmed through the program staff interviews. Program staff also report the financing can be extended up to three years, with interest, to align payments with energy savings and create positive or cash flow neutral projects. This option is not presented to customers in the program materials, or website.

The Efficient Financing for Business Program web page¹³ links to a two-page financing brochure pdf¹⁴ that describes financing as “Available for participants in our Efficient Products for Business, Process Efficiency, Data Center and New Construction/Major Renovation programs.” None of the Express Program documentation reviewed describes the financing option in detail, or explicitly promotes how a customer’s project could be cash flow positive when using financing. While the Express Program has this powerful tool available to overcome customer upfront cost barriers, it is not presented in such a way to encourage customer initial participation.

3.3.7 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.

The tracking database does not include any indication of how a customer learned of the Express Program. AEP Ohio should consider asking participants how they learned of the program as part of the onsite visit questions, and record in the tracking database. This would allow program managers to track and align marketing and outreach activities with participant results.

In order to calculate the realization rate for the desk review, the evaluation team used the tracking data to recalculate the energy and demand savings values according to the methodologies outlined in the technical documentation, and from conversations with AEP Ohio staff for all sites. 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. Values were missing only for a few measures.

3.3.8 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.

No significant disputes were reported to have occurred during 2017. 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.

¹³ <https://www.aepohio.com/save/business/programs/EfficientFinancingPilot.aspx>

¹⁴ https://www.aepohio.com/global/utilities/lib/docs/save/business/programs/AEPOhio/AE5633-Fact%20Sheet-Business-Programs_o_EffFinForBus_no%20crops_171213.pdf

3.4 Cost Effectiveness Review

This section addresses the cost effectiveness of the Express Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-9 summarizes the unique inputs used in the TRC test.

Table 3-9. Inputs to Cost-Effectiveness Model for the AEP Ohio Express Program

Item	Input
Measure Life (Years)	14
Projects	422
Ex Post Annual Energy Savings (kWh)	9,402,505
Ex Post Coincident Peak Savings (kW)	1,385
Third Party Implementation Costs	\$81,206
Utility Administration Costs	\$271,597
Utility Incentive Costs	\$1,789,506
Incremental Participant Cost	\$3,478,824

Source: AEP Ohio Program Tracking Database and AEP Ohio

Based on these inputs, the TRC ratio is 1.4 and the Express Program passes the TRC test. Table 3-10 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-10 Cost Effectiveness Results for the Express Program

Benefit-Cost Test	Benefit/Cost Ratio
Total Resource Cost	1.5
Participant Cost Test	2.5
Ratepayer Impact Measure	0.6
Utility Cost Test	2.6

Source: AEP Ohio

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 2017 Express 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.

Impact Finding 1: The program has a very slow ramp up in 2017, with most projects being completed in last quarter of 2017. This was primarily due to delayed PUCO approval, before which it was not possible to launch the program. The delay in approval led to loss and re-staffing of auditors leading to further delay in program ramp up. Hence, the program goal was not achieved, with 65 percent of the savings achieved.

Impact Recommendation 1: The program administration and launch should be closely monitored. An adjustment in annual program goals based on program launch timeline is recommended for greater realization of program targets.

Impact Recommendation 1b: Navigant recommends the implementation contractor to focus on quick completion of retrofits once an application is started.

Impact Finding 2: The realization rate (defined as verified *ex post* savings divided by *ex ante* reported savings) is 1.01 for energy savings and 1.12 for demand savings. The realization rates improved from 2016, increasing 21 percentage points for both energy savings and summer peak demand savings.

Impact Recommendation 2: The program administration should be monitored to ensure the ramp up happens earlier in the year. 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 installed are accurate, and heating and cooling are accurately characterized, etc.

Impact Finding 3: Hours of use continue to be realistic based on interviews, but actual fixture hours may be understated. Overall, the evaluation team verified hours of use at 113 percent, which is higher than the 97.7 percent of reported hours for the sample in 2016 and 98.6 percent in 2015. The metering of hours of use provided a more accurate determination, and the results indicate the auditing team at times underestimates hours.

Impact Recommendation 3: Interviewing participants for specific hours of use for various areas where fixtures are installed (for example, different hours of use for office vs kitchen vs restroom) recommended to avoid underestimating hours by the auditing team. Navigant also recommends using loggers to report hours or review hours of use before reporting.

Impact Finding 4: Reported efficient wattage might be overstated. The realization rate for fixture wattage was 0.81 from the onsite visits. This difference is primarily due to the efficient wattage found on site. The quantities of efficient fixtures were within about five percent of the expected values. The remainder must be due to the efficient fixture wattages being lower based on the field findings.

Impact Recommendation 4: The implementer should review and update the efficient fixture wattage look up tables, and could be informed by a review of sample of projects by the auditing team.

Impact Finding 5: While the evaluation team did not determine the implementation contractor is overestimating baseline wattages from the documentation provided, the potential exists.

Impact Recommendation 5: Proper identification of baseline fixture and ballast type is critical to make accurate savings estimates.

Impact Finding 6: Refrigeration measures are increasing in their contribution to the program. Refrigeration measures increased from three percent (2016) to five percent in 2017. The team found the program has a good start by including anti-sweat controls, compressors and fan management, and EC motors.

Impact Recommendation 6: Navigant recommends additional measures to be added to the program, such as:

- Display case strip-curtains and continuous covers especially for grocery
- Floating head pressure controls
- Identifying some equipment that is near end of life, like an old ice maker and replacing with energy star model

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.

Process Finding 1: Customer-facing promotional materials do not provide a clear vision of project success for individual potential customers. While customer materials appear clean, clear, and accessible, incentives and savings amounts are described inconsistently (as dollars and kWh), and are only loosely defined; the program supported project management and direct installation of recommended measures are understated.

Process Recommendation 1a: Consider promoting specific financial benefits of program participation to eligible customers, including the very favorable return on investment achieved by program participants over the lifetime of their projects.

Process Recommendation 1b: Describe energy savings in both annual and lifetime dollars including a calculated ROI for case studies and fact sheets, to support the projects' financial benefits and to be consistent with how project costs and incentives are provided. This is a cross-cutting recommendation across AEP Ohio's portfolio.

Process Recommendation 1c: Consider more explicit promotion of the program's project and contractor management services, to reduce the impact of small business owner time as a participation barrier.

Process Finding 2: The AEP Ohio website does not explicitly promote the Express Program as a possibility for small business customers. There is no overarching presentation of how customers should choose which AEP Ohio program service might best meet their needs, or description of the services provided by Express Program in comparison to the other commercial and industrial programs to assist customers identify and prioritize their opportunities. For customers specifically seeking the Express Program, it takes six clicks reach the Express Program page.

Process Recommendation 2: Consider updating the website to reduce the steps to reach key pages and broadly serve two main objectives:

- a. Clear path for new customers. Provide a high-level overview of the various programs available. Promote AEP Ohio's customer support including technical assistance to identify and prioritize projects, and managing the application process.
- b. Easy access to pertinent program details. Create a simple path for returning and otherwise knowledgeable small business stakeholders to access application forms, incentive amounts, program and measure specifications.

Process Finding 3: In 2017, 75 percent of audits did not result in completed projects; program staff do not have data available to assess key reasons that audit customers do not convert to completed projects. On average, projects take 132 days from "Audit Date" to "Invoice Date". As projects move through the system, the primary source of delay is the period between Proposal Sent to Customer and Proposal Signed. This period takes 67 days on average with 102 projects taking more than 30 days to sign the proposal.

Process Recommendation 3a: Consider conducting stakeholder research with a combination of participants (completed projects), partial participants (completed audits, not converted to projects), and non-participants. The research should probe program awareness, customer satisfaction, and identify barriers that prevent customers from requesting an audit, and (more importantly) what prevents customers from converting the audit into an actual project.

Process Recommendation 3b: Consider analyzing database fields for audited customers, to identify commonalities within the data about participant intent, expectations, and barriers.

Process Recommendation 3c: Consider clarifying program expectations for customers requesting an audit. Articulate AEP Ohio's expectations for how the customer will move through the process, and how AEP Ohio will help to overcome time constraint barriers, specifically in terms of contractor management.

Process Finding 4: The Express Program one-page brochure indicates that financing is available for projects: "12-month, interest-free financing for qualified customers". None of the Express Program documentation reviewed describes the financing option in detail, or explicitly promotes how a customer's project could be cash flow positive when using financing. Promotional materials do not reference the option to extend financing to three years to deliver cash flow neutral or positive projects. While the Express Program has this powerful tool available to overcome customer upfront cost barriers, it is not presented in such a way to encourage customer initial participation.

Process Recommendation 4a: Promote the 0%, 12-month financing option proactively to overcome first cost barriers, describing how projects can be cash flow positive when the financing is combined with program incentives. Promote the strong return on investment available with the

financing option. Acknowledge financing options to customize project cash flow to meet customer needs.

Process Recommendation 4b: Promote the Express Program financing option on the AEP Ohio Efficient Financing for Business Program web page.¹⁵

Process Finding 5: Customers are interested in installing other measures not offered by the Express Program, but are not referred to other AEP Ohio programs resulting in lost opportunities.

Process Recommendation 5a: Consider studying the logistical and contractor management implications of expanding program services to include other measures outside of lighting and refrigeration, including HVAC, shell measures, and other mechanical equipment.

Process Recommendation 5b: Auditors should channel Express Program participants to the Prescriptive Program if the customer is interested in installing measures the Express Program does not incentivize. Implement a Key Performance Indicator for the implementer to identify measures outside of the Express Program and recommend program options.

Process Finding 6: The majority of Express Program measures and savings are lighting replacement bulb measures; only a fraction of savings come from lighting controls. The database does not reference whether a control strategy exists for these light bulb replacement measures to indicate whether there are missed opportunities with lighting controls.

Process Recommendation 6a: Auditors should record lighting control strategy for each light bulb measure implemented. Where cost effective, lighting control measures should be bundled with light bulb measures to increase savings and diversify installed measures.

Process Recommendation 6b: Promote advanced lighting technologies.

Process Finding 7: Close to 90 percent of Express customers participated in the program to save money and reduce their high energy bill. Sixty seven percent of customers indicated they only replaced equipment at time of burnout. Less maintenance and better light quality is important for over a quarter of respondents.

Process Recommendation 7: AEP Ohio should prioritize the financial benefits, the return on investment available to customers who participate in the Express Program, and the better quality and longevity of the efficient equipment to overcome resistance to replacing functioning equipment.

Process Finding 8: A high percentage of surveyed participants indicated they would be willing to recommend the Express program to others. Conversely, none of the surveyed customers indicated they had heard of the program from a peer business.

Process Recommendation 8: Consider leveraging stakeholders from successful past projects to promote the program, either directly to their peers, or through additional case studies.

Process Finding 9: Most participating customers are either unaware of, or don't know about, additional energy efficiency projects that could be completed at their site; there may be lost opportunities at these sites.

Process Recommendation 9: Leverage the investment in onsite auditing, direct installation, and Express program customers' good will identify and recommend additional measures that could be managed through the appropriate program. Express program auditors should recommend these

¹⁵ <https://www.aepohio.com/save/business/programs/EfficientFinancingPilot.aspx>

measures (along with financial forecast) to the customer on site, as well as the appropriate AEP Ohio Program Coordinator to facilitate follow up and measure installation.

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.

Tracking System Finding 1: There is no field to record the date or method of a customer's initial program contact. It is not possible to assess the customer's initial experience with the program, how they learned of the program, or determine the length of time between initial customer contact and their request for an audit, and when the audit was conducted.

Tracking System Recommendation 1: Consider adding fields to the tracking database to record and monitor potential projects in the pipeline, including original customer contact, how customer learned of the program, and audit request date. Accurately complete the date of audits.

Tracking System Finding 2: The BuildTypeCd field had 1,166 measures out of the 4,191 measures labeled as "Other" or "None." Some business type descriptions are inaccurate, for example, descriptions in the field FacilityTypeCds of Exercise Center, Industrial - 1nd shift, Industrial – 2 shift, Laundromat, Small Services, and Workshop were all assigned the BuildTypeCd "Assembly."

Tracking System Recommendation 2: Train staff to identify and record business types to support program managers in assessing the business types well represented in the program and identify gaps.

APPENDIX A. METHODOLOGY OF BILLING ANALYSIS

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

For the Express Program, and the average *ex ante* savings per project is 23,886 kWh.

Because the billing analysis does not estimate electric demand savings, the engineering adjusted savings review serves as the basis for demand savings.

Data Cleaning

The tracking database included 1132 projects, including 422 completed 2017 projects, 83 pipeline pending projects and 627 pipeline projected 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.¹⁶

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 2016
5. The billing record was a duplicate
6. The bill period was less than 20 days or greater than 75 days in length
7. Observations for pipeline projects after the project work began
8. Customers who also participated in the Prescriptive, Custom, and/or Self Direct programs in 2016

¹⁶ 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.

Fixed Effect Regression Model

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.¹⁷ 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 below:

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 nine seasons include spring 2016 through winter 2018.
$PostSeasonYear_{it}$	= 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 2017 and winter 2018. 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

Seasons are defined by the following cut-off dates:

¹⁷ Harding, M. and A. Hsiaw. Goal Setting and Energy Conservation. July 2013. Available at: http://www.stanford.edu/~mch/resources/Harding_Goals.pdf.

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.

APPENDIX B. EXPRESS PROGRAM DESK REVIEW PROCESS

- T8 32 vs 28W or LEDs (Column N, note the type of efficient lamps)
- Lamp Base Lookup (Column O, make note what type of lamp (for ex: 4 foot 4-lamp T12) look at all T12s, but leave those out which are T12HOs.
- Next, index from database the following: Burnout quantity, base quantity and base watts, efficient quantity, watts). HVAC_e and HVAC_d.
- Create column HVAC_e NAV and HVAC_d NAV. Double check to ensure the values provided from the database are correct.
- Continue with indexing database; get building type, CF, SavkWh and SavkW.
- Insert column for Nav_cf. These values should be indexed from the params tab. Make sure params tab is updated with the newest values (from Draft Ohio TRM).
- Conditions to be applied:
 - For Lighting CFL and LED Dim, Nav_hou = AnnOpHrs, NAV_if_e = use HVACcc, if=0, use IakWh, Nav_if_d = use HVACd, if =0, use IakWh, Nav_cf=1
 - Lighting Interior, use values given for HVAC E and D, and for CF, use nonCFL and CFL as needed.
 - Lighting Exterior, use Nav_hou = AnnOpHrs, Nav_if_e = 0, Nav_if_d = 0, Nav_cf = 0.
 - Lighting Garage, use Nav_hou = AnnOpHrs, Nav_if_e = 0, Nav_if_d = 0, Nav_cf = 0.
 - Exit Sign, use Nav_hou = 8760, Nav_if_e = Nav_if_e, Nav_if_d = Nav_if_d, Nav_cf = 1.
 - Lighting Control, Nav_hou = AnnOpHrs, Nav_if_e = Nav_if_e, Nav_if_d = Nav_if_d, Nav_cf = cf_noncfl.
 - Refrigeration, use hours provided.
- For CF: low rise multifamily buildings are new category not included in the params tab. I used multi-family common area instead.
- For NavkWh and NavkW, for refrigeration, use the value provided by the database. For others, use the formula and the Nav calculated values.
- Finally, calculate lighting, refrigeration and overall kW and kWh percentage

APPENDIX C. NOTES FOR ONSITE VISIT CALCULATION

$$\Delta kWh = (kW_{base} - kW_{ee}) \times [HOU \times (1 + IF_{energy})]$$

$$\Delta kW_{peak} = (kW_{base} - kW_{ee}) \times [CF \times (1 + IF_{demand})]$$

$$\Delta kWh = kW_{controlled} \times HOU \times (SVG_{ee}) \times (1 + IF_{energy})$$

$$\Delta kW_{peak} = kW_{controlled} \times (SVG_{ee}) \times (1 + IF_{demand}) \times CF$$

$$kW_{base} = Watts_{base} \times Qty_{base}$$

$$kW_{ee} = Watts_{ee} \times Qty_{ee}$$

Table A-1. Sources for Onsite Visit Calculation

Value	Preferred Source	Secondary Source	Tertiary Source
Watts _{base}	Tracking database	NA	NA
Watts _{ee}	Onsite Data	Tracking Database	Appendix A
Qty	Onsite Data	Tracking Database	
HOU	Logged Data	Customer Interview/Posted hours	Appendix A
CF	Logged Data	Appendix A	
IF	Appendix A		
Building Type (For HOU, CF, and IF lookup)	Onsite Data	Tracking Database	
SVG	Appendix A		

Source: Various Sources Listed in Table

APPENDIX D. FULCRUM ONSITE SURVEY GUIDE

Site Information

Project number
Short project number
Customer/Site Name
GPS ready address
Manual Distance from: Baltimore, Ohio 43105 (hrs)
Scheduled Date
Scheduled Time
Second follow-up site visit date
Second follow-up site visit time
Confirmed meeting location
Safety equipment required
Field Technician Name(s)
Arrival Time
Departure Time
Site Contact Name
Site Contact Office Number
Site Contact Cell Number
Site Contact Email
Alternate Site Contact Name
Alternate Site Contact Office number
Alternate Site Contact cell number
Trade Ally-Contractor Company
Trade Ally-Contractor Contact Name
Trade Ally-Contractor Contact Email
Navigant Engineer's Name
Navigant Engineer's Phone
Navigant Engineer's Email
AEP Program type
Project Summary
Project Completion Date
Payment Date
Payment amount
Lighting only
Level of M&V requested:
Is there a person onsite qualified to work on live electrical equipment to the degree necessary to install a data logger or take a spot reading?
Other sampled projects possibly at this site
Additional site visit information
Site Photos

Site details

Stratum
Sample Status
Verification Track
Logger Qty needed
Any other logger/equip. needs
Notes on where loggers are to be installed
Fixture Height
Fixture Locations
Internal Logger notes
Crawford Logging Site notes
QC status
Measure project description
Loggers on hand

Address details

Construction Type
Unique ID (navid)
Premise Number
Address
Street address
City
State
Zip code
Wave number

Measure Details

Measure Line Id
Measure Project Number
Measure Category
Measure (short)
Measure Description
Measure Location
Expected EE Qty
Qty Unit (Fixture, Lamp, etc.)
Measure Notes
Measure Photos
Measure identifier
VFD Measures Only:
Manufacturer
Model
Efficiency
Capacity
Capacity units

Customer Interview

Table A-2. Customer Interview Questions

Q#	Question	Response
Q1	Is that a reasonable business type? [following up on project record business type from Database]	Yes No there is a better option
Q2	Or is there a better option on this list	Assembly College/University Conditioned Warehouse Government/Municipal Grocery Hotel/Motel Guest Room Large Office Large Retail/Service Manufacturing - Light Industrial (1 Shift) Manufacturing - Light Industrial (2 Shift) Manufacturing - Light Industrial (3 Shift) Medical-Hospital Medical-Nursing Home Miscellaneous Multifamily Dwelling Restaurant School Small Office Small Retail/Service Unconditioned Warehouse Exterior (Ohio) Garage (Ohio)
Q3	What is the approximate total floor area occupied at your site? [Open-ended, please specify]	
Q4	What is the approximate floor area impacted by the project? [Open-ended, please specify]	
Q5	Was this project completed as replace on burnout, as part of a planned remodel or expansion, or new construction?	Replaced old equipment on burnout (or near end of life) Planned remodel of existing system (same footprint) Expansion of existing site or system (expanded footprint) New Construction DK
Q6	Was the old equipment replaced one-for-one with new equipment?	Yes No DK NA Other
Q7	Site specific questions [Open-ended, please specify]	

Source: Navigant Onsite Survey Guide

Express Interview

Table A-3. Express Interview Questions

Q#	Question	Response
Q1	Was this equipment part of a gut rehab project affecting 50% or more of the building or building lighting systems?	1 Yes 2 No DK NA Other
Q2	What other technologies/efficiency levels/options did you consider (if any) when replacing this equipment? [Open-ended, please specify]	
Q3	What was the functionality of the pre-existing equipment? [Open-ended, please specify]	
Q4	Did you receive a post-installation inspection (Lime Energy or AEP Ohio)?	1 Yes 2 No DK NA
Q5	Does your facility use the new equipment the same as the old equipment?	1 Yes 2 No DK NA
Q6	Would you say that the new lights are on about the same amount of time as the old lights, or more / less?	Same More Less DK NA Other

Source: Navigant Onsite Survey Guide

Process Interview

Table A-4. Process Interview Questions

Q#	Question	Response
Q1	How did you first hear about the AEP Ohio [insert program name] program?	<ul style="list-style-type: none"> a. AEP Ohio Energy Account Manager b. AEP Ohio website c. Meeting/seminar/workshop d. Installation Contractor/Trade Ally e. Energy Equipment Vendor or Salesperson f. Energy Services Company g. Newsletter h. Family/colleague/word of mouth i. AEP Ohio mailing/flyer/bill insert j. Newspaper/magazine/print media k. Retailer advertising l. OTHER, please specify:
Q2	What were your main reasons for implementing the project/measure? (ASK AS OPEN END)	<ul style="list-style-type: none"> a. AEP Ohio/ Energy Efficiency Program for Business incentive b. Special deal from contractor c. Recommended by contractor d. Product was on sale at store e. Old equipment was malfunctioning f. Old equipment was no longer functioning, replacement was necessary g. High utility bills/wanted to save money h. Save energy to protect the environment i. Other, please specify:
Q3	What was the age (in years) of the pre-existing equipment? [Open-ended, please specify]	
Q4	How many more years would the previous equipment have been in service in the absence of the program? [Expected remaining years of useful life] [Open-ended, please specify]	
Q5	What percentage of useful equipment was no longer functioning/burnt out? [Open-ended, please specify]	
Q6	Have you participated in the [insert program name] program or any other AEP Ohio energy efficiency programs before 2017? If yes, please circle all that apply:	<ul style="list-style-type: none"> a. Efficient Products (Formerly: Prescriptive) b. Process Efficiency (Formerly: Custom) c. Self Direct d. Retro-commissioning e. Data Center f. Continuous Energy Improvement g. Express h. Other, please specify:
Q7	What was the primary reason you participated in the AEP Ohio [insert program name] program? [Open-ended, please specify]	

Q8	On a 0 to 5 scale where 0 is extremely unlikely and 5 is extremely likely, overall, how likely are you to recommend the Energy Efficiency Program for Business to others? [Open-ended, please specify]	
Q9	On a scale from 0 to 10 where 0 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your satisfaction with each of the following aspects of your experience with the Energy Efficiency Program for Business I'll mention...?	<ul style="list-style-type: none"> a. The overall cost of the measures or improvements b. The incentive amount provided by AEP Ohio c. The energy savings resulting from the measures or improvements d. The program application process e. The communications you had with AEP Ohio's program staff, including technical assistance f. The list of measures that were eligible for incentives through the program g. The time required to receive your incentive check h. Ease of access to online applications and program website i. Don't Know j. Other, please specify:
	[If rating is 0-10, ask "why did you give the satisfaction rating of ____ for _____?"]	
Q10	What do you see as the main benefit(s) to participating in the AEP Ohio [insert program name] Program? [Open-ended, please specify]	
Q11	What do you see as the drawbacks to participating in the program? [Open-ended, please specify]	
Q12	Are you aware of any additional energy efficiency projects that could be completed at your site that you have decided not to pursue at this time? [If 12 = yes, ask 12a]	<ul style="list-style-type: none"> 1 Yes 2 No DK REF
Q12a	What types of energy efficiency projects are you aware of, but have decided not to pursue at this time? [Ask as open end; accept 6 mentions]	<ul style="list-style-type: none"> 1 Lighting 2 Food Service 3 Insulation (including pipe wrapping) 4 HVAC 5 Heating 6 Other types of projects; record here: [OTHER: Please Specify] DK REF

Source: Navigant Onsite Survey Guide

Operation Schedules

If you have two spaces on the same schedule but they have different types of heating and cooling equipment, please define them separately.

Regular Schedule

Annual HOU this schedule regular)

Schedule ID

Schedule Description

Control Type

Were these lighting controls (occ sensor, photocell, time clock) pre-existing or part of the project under review?

Number of days per week

Hours per week (Regular)

Days off per year (regular)

Percent security lights

Heating Type

Cooling Type

Regular schedule notes

Regular ID

HOU per year (regular)

Does this site have a seasonal schedule?

Seasonal Schedule

Subtotal HOU (seasonal)

Schedule ID (seasonal)

Control Type

Percent security lights

Start month segment 1

Start day of month segment 1

End month segment 1

End day of month segment 1

Start month segment 2

Start day of month segment 2

End month segment 2

End day of month segment 2

Start month segment 3

Start day of month segment 3

End month segment 3

End day of month segment 3

Start month segment 4

Start day of month segment 4

End month for schedule

End day of month for schedule

Schedule Description

Hours per week (seasonal)

Days off in year(seasonal)

Seasonal ID

Annual HOU (seasonal)

Fixture Details

Fixture ID

Fixture Description

Fixture zone ID

Lamp or fixture type

Lamp Diameter

Lamp watts

Lamps per fixture

Ballasts per fixture

Lamp Manufacturer

Lamp Model

Ballast type

Ballast Model

Photos fixture

Lighting Counts per Zone

Zone Number

Which measure does this match?

Schedule ID

Fixture ID

Fixture count in zone

Zone notes

Light zone id calculation

Photos

Lighting Logger Counts

Logger Information

Logger details

Logger number

Logger location (short)

Logger Barcode

Logger Serial Number

Rescan Barcode on pickup

Pickup Logger Serial Number

Logger Schedule ID

Fixture ID(logger)

Location description

Take a wide photo of the logger installation

location for perspective and a close up of the logger installed.

Photos

VFD Details

What type of equipment is this VFD controlling?

Please describe Other equipment controlled by VFD

What is the control feedback point for this VFD?

Please describe what conditions EMS use as control input for VFD

Please describe Other control input for VFD

Briefly describe the baseline condition for this system (was the motor/load upgraded at the same time the VFD was installed? If so, describe the previous load. If same, simply indicate "no change in equipment")

How was the baseline equipment controlled?

Please describe other baseline condition for VFD

Please describe typical DAILY operating schedule for this equipment

Please describe typical WEEKLY operating schedule for this equipment (does operation vary by day of week, week day vs weekend)

Please describe typical ANNUAL operating schedule for this equipment (Does operation vary seasonally?

Note any regularly scheduled maintenance cycles.)

IF VFD has a digital display AND you are comfortable navigating the menu (OR the site contact wants to help navigate the menu for you), provide as many of the following as possible

Current load (amps)

Current operating Hz

Total run hours

Total run hours

Any additional, notable stats

Was a data logger installed on this equipment?

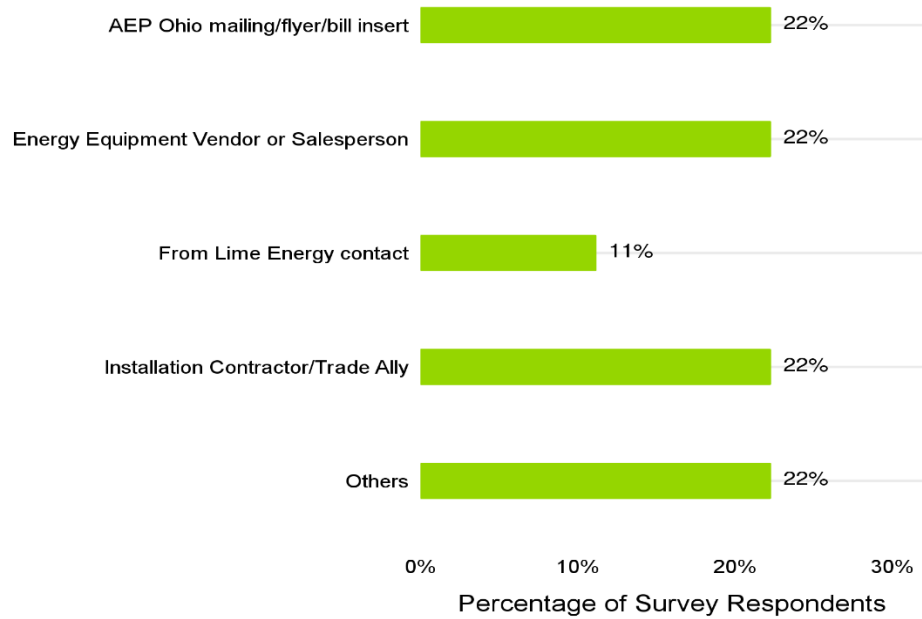
Is there a Line Filter installed on the LINE side of the VFD?

Is there a Series Reactor installed on the LINE side of the VFD?

If possible, will you do spot readings on this equipment while in operation?

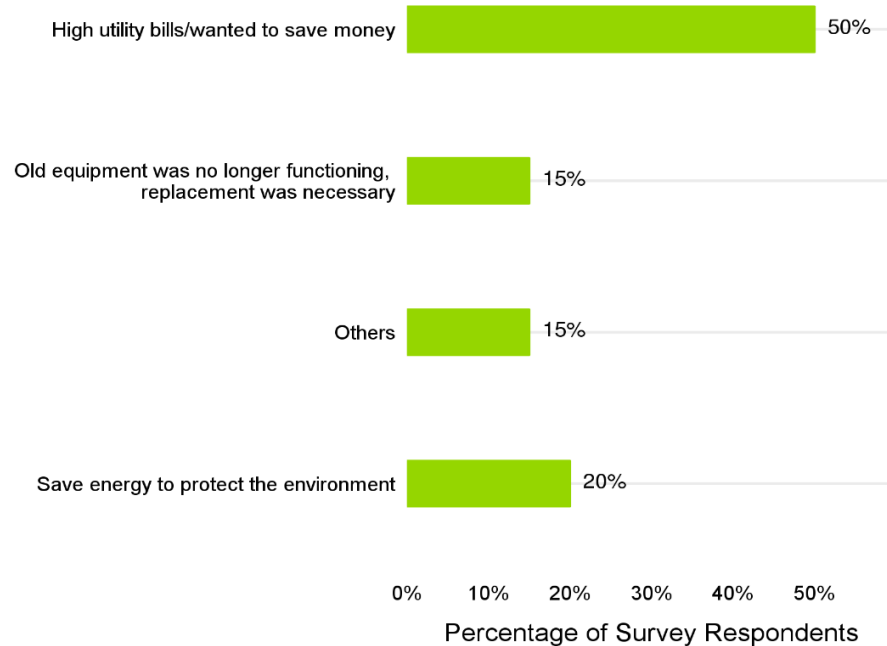
APPENDIX E. ONSITE SURVEY RESULTS

Figure A-1 Express Program Awareness (n=16)



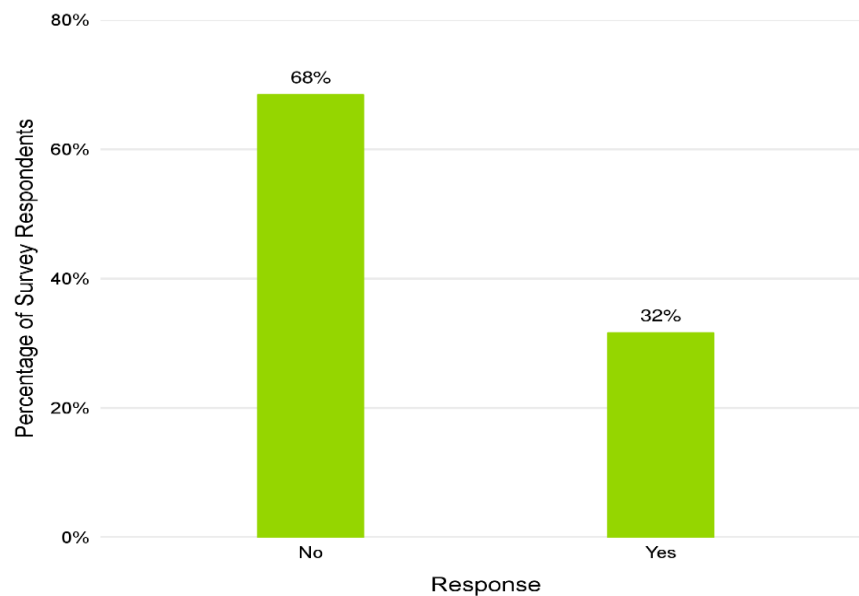
Source: Navigant Analysis of Onsite Survey

Figure A-2. Motivating Reasons to Participate in the Express Program (n=18)



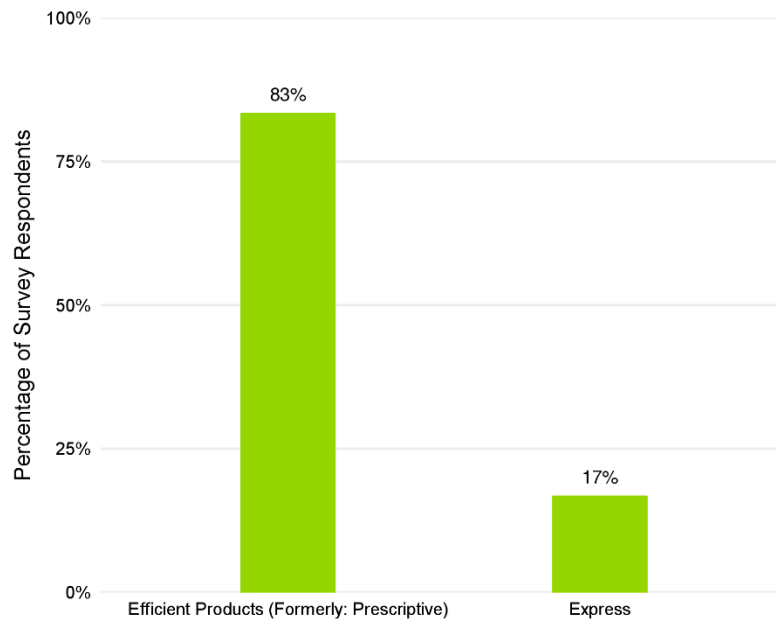
Source: Navigant Analysis of Onsite Survey

Figure A-3. Participation in AEP Ohio EE Programs Prior to 2017 (n=17)



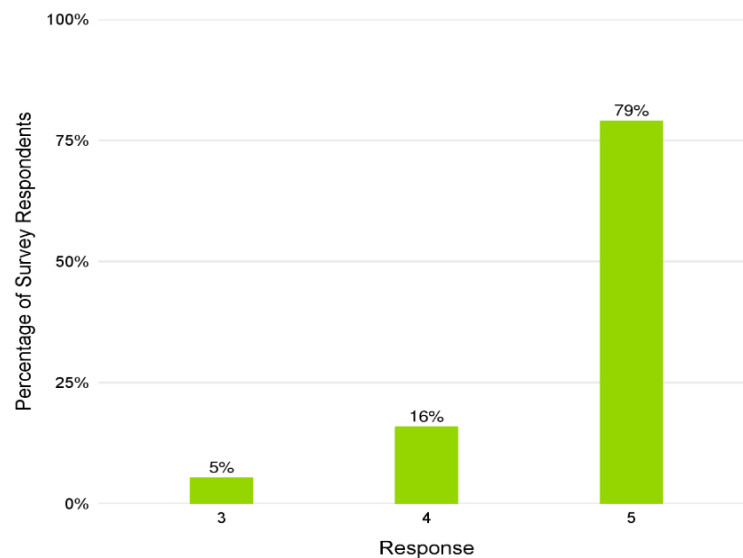
Source: Navigant Analysis of Onsite Survey

Figure A-4. Participation in AEP Ohio EE Programs Prior to 2017 (n=6)



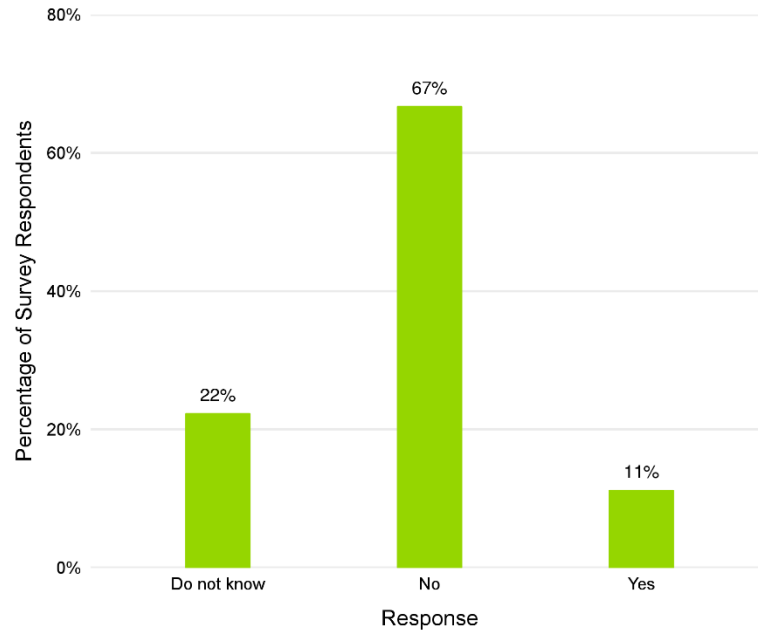
Source: Navigant Analysis of Onsite Survey

Figure A-5. Likelihood to Recommend the Energy Efficiency Program for Business (n=18)



Source: Navigant Analysis of Onsite Survey

Figure A-6. Awareness of Additional Energy Efficiency Projects the Participant Could Pursue (n=17)



Source: Navigant Analysis of Onsite Survey

APPENDIX F. PROGRAM MANAGER 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 Responsibilities

1. Can you describe your roles and responsibilities and how they've changed over the last year for the [Insert Name] Program?
2. When considering the implementation contractor and AEP Ohio staff job functions, have there have been any substantial changes in the roles or people assigned to these programs in the past year compared to previous program years? If so, what were they?
3. How often do you meet with the implementation contractor(s) for the program, and in what manner? How does the implementation contractor share program progress? Are there times when it would have been helpful to have earlier updates?
4. How often are you in contact with the program Solution Providers (or Contractors)? What are you hearing from the SPs (Contractors)? And how do they provide feedback? (emails, calls, in person...)?
5. How would you describe your interaction with the Business Programs Manager, Andy McCabe?

Program Design

6. Have the program materials, your procedural documentation or outreach documents for any of the three programs changed since last year? If so, can you send me the most current version?
7. What have been the key challenges in implementing the program in the past year? What steps have you taken to overcome these challenges?
8. Is the program on track to meet the filed savings goals? What about internal savings goals?
9. What other key performance indicators do you use to measure the performance of the program? Are you on track to meet those goals?

10. Regarding Navigant's Conclusions and Recommendations from last year's evaluation report, where are you in the process of implementing Navigant's recommendations? Please note any recommendations that will not be implemented and the corresponding reasoning.
11. Have there been any significant changes to the program (delivery, components, etc.) in 2017, and do you have any significant changes planned for 2018? Why were/are these changes made, and how do they affect program performance?
12. Have there been any changes to measures offered in 2017? Are there any planned changes on the horizon? From your perspective, does the program rely on a particular measure or end use to meet its goals? Do you have suggestions for measures that should be added?
13. Have you made any changes to incentive levels in 2017, and do you plan to make any in 2018?
14. How active are account managers in the program? In what ways do account managers improve the customer experience? Are any improvements needed in the role account managers play?

Customer Experience

15. Please describe your interactions with Program participants. (Have any issues or areas for improvement been identified?)
16. Describe a typical first engagement with a new participant.
 - a. How is the first 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?
17. How often and at what points do you visit participant project sites in person? How do you select the sites to be visited? Which staff are responsible for visiting sites? How often does the site visit identify energy efficiency measures or future energy efficiency projects not already under consideration? Are those recommendations ever put in writing, and if so would you send some examples?
18. How do you decide if you should meter baseline conditions? What thresholds trigger metering?

Customer Satisfaction

19. From your perspective, how satisfied are Business customers with the range of programs offered by AEP Ohio? What are some common complaints you hear, and what are some common positive comments you hear from customers?
20. Do you have a sense of how satisfied customers are with various aspects of this specific program (application process, time to process incentives, interaction with implementation contractor, AEP Ohio staff, or SP (contractor), 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?

21. Have customers indicated any issues with, or are confused by, any program requirements or documentation?
22. How are customer problems, concerns, issues handled post-installation? Is there a call center? Who is it staffed by? Do the implementation contractors talk to customer directly and fix any issues?
23. Have some customers who could be eligible for the program declined to participate? If so, why?
24. From the customer's perspective, what are the perceived barriers to participation?
25. How is the program overcoming these barriers? Have Solution Providers (Contractors) and Implementation Contractors been successful at removing these barriers to participation? If so, how, if not, why?
26. Are there any program requirements that have caused projects to be ineligible or unfeasible?
27. Have you seen any change in the value placed on "non-energy" benefits to program participants? Please describe.
28. How has customer opt-out affected participation?

Marketing

29. Please describe the program marketing approach in your own words. Include all relevant components, and describe how effective you think they are.

Have you seen any changes in the key motivations and perceived barriers for program participants?
30. Is the current level of marketing sufficient and does it address all measure end-use categories equally well, or are some over or under represented?

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. How are efforts carried out consistently across the AEP Ohio service territory?
31. Are there additional customer segments you think the program could market to in order to increase participation?
32. What marketing/outreach activities worked well? Which didn't work as well as expected?
33. How could marketing for the program be improved?
34. Have you conducted outreach / recruitment / education / marketing activities for Solution Providers (Contractors)? Have you considered creating a qualified Solution Provider (contractor) network? Was there a Solution Provider (contractor) bonus in 2017?

35. Does the program provide any recognition or acknowledgement (i.e. a certificate or plaque) to program participants or Solution Providers (contractors)? If yes, please describe.
36. Does the program follow-up with past participants (whom may not have been contacted in a year or more) to see if other opportunities exist for new projects?
37. What role does the Website play in generating interest and participation by customers, and how has this changed over time? Are there improvements still needed?
38. 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?
 - a. IF YES – ASK - Would that hold true if the resources were made available by reducing the level of incentives available?

Implementation

39. What processes work really well in the program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and implementation contractor, etc.)
40. 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?
41. Does this program offer or require pre-applications or application pre-approval? If yes, please explain.
42. When do you advise the participant of incentive amounts available?
43. What are the follow-up procedures with “stale” applications?
 - a. How are projects reviewed to see if they are stalled? What options are available to move them forward?
 - b. How does the implementer track “drop outs” (participants who have chosen not to proceed under the program)?
 - i. What proportion of customers “drop out”?
 - ii. What causes customers to “drop out”?
44. Is the implementation contractor meeting your expectations for the Program? If not, what could be improved?
45. Please describe your interactions with Solution Providers (contractors) involved in the program. (Have any issues or areas for improvement been identified?)
46. Has the involvement of Solution Providers (contractors) in the program changed in the last year?
47. Do you know how many Solution Providers (contractors) were active in 2017, and is this number increasing or decreasing, and why?

Do you have a sense of Solution Providers’ (contractors) overall satisfaction with their participation in the program in 2017 and in working with the implementation contractors? Have you noticed or heard any changes from past years?

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?

48. Are the Solution Providers (contractors) meeting your expectations for the Program? If not, what could be improved?

Data Tracking and Quality Control

49. Can you walk us through the QA/QC procedures?
50. Can you describe the quality control procedures in place to ensure complete information is obtained, and accurate information is entered into the database?
51. 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).
52. At what point do you visit participant project sites to conduct final inspections or verifications? (For programs with multiple paths such as NRNC, ask for specific results for each pathway.)
- 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?
53. Have there been any changes to how the program verifies participant savings estimates?
54. Have there been any changes to the structure of the program database or how it is maintained? (For programs with multiple implementation contractors; how is consistent data quality assured?)
55. Have you encountered any projects where it was unclear whether the project was eligible?

Summary Questions

56. 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?
57. 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?

APPENDIX G. IMPLEMENTATION CONTRACTOR INTERVIEW GUIDE

Name of Interviewee:

Date:

Title:

Company:

Contact Information:

Interviewer:

[Note to Interviewer] The Interview Guide is a tool to guide process evaluation interviews with 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 a member of Navigant's process evaluation team 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 Responsibilities

1. Can you describe your roles and responsibilities, and how they've changed over the last year for the [Insert Name] Program?
2. When considering the implementation contractor and AEP Ohio staff job functions, have there have been any substantial changes in the roles or people assigned to these programs in the past year compared to previous program years? If so, what were they?
3. How often do you meet with the AEP Ohio staff for the program, and in what manner? How does your firm share the program's progress with AEP Ohio?
4. How often are you in contact with the program Solution Providers? What are you hearing from the SPs? And how do they provide feedback? (emails, calls, in person...)?

Program Design

5. Have the program materials, your procedural documentation or outreach documents for any of the three programs changed since last year? If so, can you send me the most current version?
6. What have been the key challenges in implementing the program in the past year? What steps have you taken to overcome these challenges?
7. Is the program on track to meet the filed savings goals? What about your contracted savings goals?
8. What other key performance indicators do you use to measure the performance of the program? Are you on track to meet those goals?

9. Next, I'd like to ask about significant changes to the program in 2017, and whether you have any significant changes planned for 2018? Changes would include:

- a. Program Delivery
- b. Measures (added, removed, or changes)
- c. Incentives
- d. Application forms or processes

Can you describe the reasoning for the changes, and how they affect program performance?

10. From your perspective, does the program rely on a particular measure or end use to meet its goals? Do you have suggestions for measures that should be added?
11. How active are account managers in the program? In what ways do account managers improve the customer experience? Are any improvements needed in the role account managers play?

Customer Experience

12. Please describe your interactions with Program participants. (Have any issues (e.g., customer service, measure offerings, program design, application, etc.) or areas for improvement been identified?)
13. Next, we'd like to discuss the experience of new participants.
- a. What percentage of your program's customers are first time customers?
 - b. How is the first connection typically made?
 - c. Who is engaged from the participant side?
 - d. How is the program introduced to someone not wholly familiar?
 - e. What technical assistance is offered?
14. How often and at what points do you visit participant project sites in person? How do you select the sites to be visited? Which staff are responsible for visiting sites? How often does the site visit identify energy efficiency measures or future energy efficiency projects not already under consideration? Are those recommendations ever put in writing, and if so would you send some examples?
15. How do you decide if you should meter baseline conditions? What thresholds trigger metering?

Customer Satisfaction

16. From your perspective, how satisfied are Business customers with the range of programs offered by AEP Ohio? What are some common complaints you hear, and what are some common positive comments you hear from customers?
17. Do you have a sense of how satisfied customers are with various aspects of this specific program (application process, time to process incentives, interaction with implementation contractor, AEP Ohio staff, 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?

18. Have customers indicated any issues with, or are confused by, any program requirements or documentation?
19. How are customer problems, concerns, issues handled post-installation? Is there a call center? Who is it staffed by?
20. Have some customers who could be eligible for the program declined to participate? If so, why?
21. From the customer's perspective, what are the perceived barriers to participation?
22. How is the program overcoming these barriers? Have you as the Implementation Contractor or the Solution Providers been successful at removing these barriers to participation? If so, how, if not, why?
23. Are there any program requirements that have caused projects to be ineligible or unfeasible?
24. Have you seen any changes in the key motivations and perceived barriers for program participants?
 - a. Have you seen any change in the value placed on "non-energy" benefits to program participants? Please describe.
25. How has customer opt-out affected participation?

Marketing

26. Please describe the program marketing approach in your own words. Include all relevant components, and describe how effective you think they are.

Have you seen any changes in the key motivations and perceived barriers for program participants?
27. Is the current level of marketing sufficient and does it address all measure end-use categories equally well, or are some over or under represented?
28. Please describe customer recruitment/marketing strategy used in the last year.
 - a. Are specific market segments targeted?
 - b. Have potential participants been identified?
 - c. What outreach and marketing activities have you conducted in the past year?
 - d. How are efforts carried out consistently across the AEP Ohio service territory?
29. Are there additional customer segments you think the program could market to in order to increase participation?
30. What marketing/outreach activities worked well?
 - a. Which didn't work as well as expected?
 - b. How could marketing for the program be improved?
31. Have you conducted outreach / recruitment / education / marketing activities for Solution Providers (trade allies)? Have you considered creating a qualified Solution Provider network? (SP Qs N/A to Express, NRNC, CEI, ???) Was there a Solution Provider bonus in 2017?

32. Does the program provide any recognition or acknowledgement (i.e. a certificate or plaque) to program participants or Solution Providers? If yes, please describe.
33. Does the program follow-up with past participants (whom may not have been contacted in a year or more) to see if other opportunities exist for new projects?
34. What role does the Website play in generating interest and participation by customers, and how has this changed over time? Are there improvements still needed?
35. 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?
 - a. IF YES – ASK - Would that hold true if the resources were made available by reducing the level of incentives available?

Implementation

36. What processes work well in the program, and what processes need improvement? (e.g., communication, time processing applications, customer interaction, marketing, relationship between utility and implementation contractor, etc.)
37. 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?
38. Does this program offer or require pre-applications or application pre-approval? If yes, please explain.
39. When do you advise the participant of incentive amounts available?
40. What are the follow-up procedures with “stale” applications?
 - a. How are projects reviewed to see if they are stalled? What options are available to move them forward?
 - b. How do you track “drop outs” (participants who have chosen not to proceed under the program)?
 - i. What proportion of customers “drop out”?
 - ii. What causes customers to drop out?
41. Please describe your interactions with Solution Providers involved in the program. (Have any issues or areas for improvement been identified?)
42. Has the role of Solution Providers in the program changed in the last year?
43. Do you know how many Solution Providers were active in 2017, and is this number increasing or decreasing, and why?
44. Are the Solution Providers meeting your expectations for the Program? If not, what could be improved?

45. Do you have a sense of Solution Providers' overall satisfaction with their participation in the program in 2017 and in working with the implementation contractors? Have you noticed or heard any changes from past years?
46. 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?

Data Tracking and Quality Control

47. Can you describe the quality control procedures in place to ensure complete information is obtained, and accurate information is entered into the database?
48. Have there been any changes to the structure of the program database or how it is maintained? (For programs with multiple implementation contractors; how is consistent data quality assured?)
49. 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).
50. Have you encountered any projects where it was unclear whether the project was eligible?
51. Have there been any changes to how the program verifies participant savings estimates?
52. In your role of Implementation Contractor, how often and at what points do you visit participant project sites in person, including any final inspection or verification? (For programs with multiple paths such as NRNC, ask for specific results for each pathway.)
 - 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?

Summary Questions

53. 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?
54. 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?

APPENDIX M



RETRO-COMMISSIONING PROGRAM

2017 Evaluation Report

Prepared for:

AEP Ohio



A unit of American Electric Power

April 19, 2018

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ES. EXECUTIVE SUMMARY

This document presents a summary of the findings and results from the evaluation of the 2017 Retro-commissioning (RCx) Program implemented by AEP Ohio for the program year January 1, 2017 through December 31, 2017.¹ This report is the fifth annual evaluation of the program. Following the 2016 program year, AEP Ohio decided to discontinue the RCx Program. This report summarizes the activities that were started in 2016 and completed in 2017.

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 2017, the RCx Program had nineteen projects. Table ES-1 provides a summary of 2017 RCx Program reported results.

Table ES-1. 2017 Retro-commissioning Program Reported Projects, Measures, *Ex Ante* Savings

Metric	RCx Standard	RCx Lite	<i>Ex Ante</i> Reported
Number of RCx Projects	10	9	19
Number of Measures Implemented	45	44	89
Annual Energy Savings (MWh)	3,742	998	4,740
Peak Demand Savings (MW) ¹	0	14	14

Source: Evaluation analysis of AEP Ohio tracking data from January 12, 2018/January 12, 2018.

¹ The program calculated and reported demand savings for one of nineteen projects in 2017.

Among the nineteen projects submitted, there were sixteen unique customers. One hospital submitted multiple projects for different buildings on site. The savings from this single hospital comprised 25% of

¹ 2017 participation is based on final verification reports delivered to participants dated between January 1, 2017 and December 31, 2017.

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

total program savings, and 30 percent of RCx Standard program savings. The single project reporting demand savings was a Laboratory project. Nine different RSPs conducted studies through the program in 2017.

ES.3 Data Collection Activities

Table ES-2 provides a summary of data collection activities for the 2017 RCx Program impact evaluation. The 2017 impact evaluation utilized interval billing data analysis for five projects with substantial *ex ante* savings relative to baseline annual energy use at the meter.

Table ES-2. Data Collection Activities for 2017 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 2017	AEP Ohio Tracking Database	-	All	November 2017 to April 2018
Application File Review	2017 RCx Program Participants	Tracking Database	Certainty Sample ¹	12	December 2017 to April 2018
Interval Billing Data Analysis	2017 RCx Program Participants	Highlighted RCx Projects	Good Candidate ²	5	January 2016 to April 2018

Source: Evaluation activities conducted from August 2017 through April 2018.

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.

² Interval billing data analysis was conducted on those sites that had noticeable reported savings compared to baseline energy use, as well as adequate pre-post data based on how long the RCx measure had been installed.

ES.4 Key Evaluation Findings and Recommendations

The following section summarizes the findings of Navigant's evaluation and recommendation for the 2017 RCx Program.

ES.4.1 Key Impact Findings and Recommendations

As summarized in Table ES-3, the *ex post* energy savings did not meet the 2017 target of 8,622 MWh. This is due to the program being discontinued in 2016, therefore, active recruiting for additional projects did not occur in 2017. The *ex post* demand savings exceeded the 2017 target of 9 kW, however only one project reported demand savings for the total RCx program.

The *ex post* energy and coincident summer peak demand savings are 2,997.6 MWh/year and .014 MW respectively. The realization rate for energy is 0.632, while the demand realization rate is 1.0.

Table ES-3. Savings Estimates for the 2017 Retro-commissioning Program

	2017 Program Goals (a)	Ex Ante ¹ Savings (b)	Ex Post Savings (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Energy Savings (MWh)	8,622	4,740	2,997	0.632	15.3%	35%
Demand Savings (MW) ¹	0.009	0.014	0.014	1.00	NA	156%

Sources: Evaluation analysis of AEP Ohio tracking data from January 12, 2018.

¹ The program calculated and reported demand savings for one of nineteen projects in 2017. This one project was not sampled, and therefore could not be verified.

The 2017 RCx Program impact evaluation resulted in several key findings and recommendations. While the program will not be recruiting new participants in 2018, all recommendations in this report are written as though the program is continuing, for documentation purposes.

Impact Finding 1: Calculated savings were not always checked for reasonableness in the verification report.

Impact Recommendation 1a: Verify reported savings are reasonable per measure and for the overall project. This could be accomplished by checking installed measures against a “cheat sheet” with average savings seen by common measures. While each retro-commissioning project is slightly different, this cross check could raise the red flag for those measures that seem to be claiming excessively high savings. In addition, looking for individual measures that claim to save more than five percent of the total buildings energy use should be flagged for a more in-depth review, including interval or billing data from AEP Ohio.

Impact Recommendation 1b: Mandate that measures claiming large MWh savings, or greater than five percent of the total buildings energy use, be verified against the building automation system or with additional metering.

Impact Finding 2: Inputs into RSP calculators did not match applications, investigation reports, or equipment lists. For many sites, the size and efficiencies of specific measures did not match what was reported, or provided by the customer in the form of an equipment list.

Impact Recommendation 2: Ensure all inputted values match the application, or equipment list. If determined that the application, or equipment list, is incorrect, clear documentation stating the actual set points, equipment, etc. should be in the verification report.

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. Typical meteorological year (TMY) weather data for nearest location to the project
- e. actual installed building automation system (BAS) schedules and set points
- 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.

ES.4.2 Process Evaluation Findings and Recommendations

Due to the RCx Program being discontinued, a process evaluation was not conducted for the 2017 RCx Program.

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). After the 2016 program year, the RCx Program was discontinued. The 2017 evaluation will only look at those remaining projects that had not been completed by the time the 2016 program year report was created.

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 RSPs 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. The structure of the RCx Lite deliverable is very streamlined to reduce the engineering cost of retro-commissioning. The difference in services offered between RCx Lite and RCx Standard is the total amount of time and materials spent on the RSP study per project. The cost of the RSP study will not exceed \$7,000 for RCx Lite, or \$40,000 for RCx Standard. Either type of retro-commissioning study is offered to the customer at no cost if the customer commits a certain amount of financial capital towards implementing recommendations from the study. The minimum customer implementation commitment is \$5,000 for RCx Lite, and \$15,000 for RCx Standard. Both tracks also provide verification results to the customer.

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

1.2 Key Program Elements

The goal of the 2017 RCx Program was to close out projects started in 2016 but not yet completed, as the program was discontinued in 2017 for new projects. The program is designed to appeal to diverse commercial and industrial customers. The following sections provide a summary of key program elements.

1.2.1 Program Incentives

RCx Program incentives in 2017 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 2017

Program Track	Study Funding	Customer Commitment
RCx Lite	Up to \$7,000	\$5,000
RCx Standard	Up to \$40,000	\$15,000

Source: AEP Ohio Retro-commissioning Application Terms and Conditions.

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 2017

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 2017, measures typically focused on equipment optimization and equipment scheduling.

1.2.4 Service Provider Participation

AEP Ohio and the implementation contractor recruited and approved a network of RSPs for the program. Nine different RSPs completed projects through the program in 2017, as shown in Table 1-2.

Table 1-2. 2017 Retro-commissioning Service Providers

Service Provider	RCx Standard	RCx Lite	Program Reported
A	-	1	1
B	2	3	5
C	2	0	2
D	1	2	3
E	3	-	3
F	-	1	1
G	2	-	2
H	-	1	1
I	-	1	1
Total	10	9	19

Source: Evaluation analysis of AEP Ohio tracking data from January 12, 2018.

1.3 Evaluation Overview

The major objective of the evaluation is to quantify the impact of energy savings and summer peak demand reduction from the 2017 RCx Program. Since the program will no longer be offered in 2018 no process evaluation was done. Any incidental process observations attained from conducting the impact evaluation will be included in the impact findings.

The evaluation sought to answer the following research 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?

2. METHODOLOGY

This section describes the methodology used to conduct the impact evaluation for the RCx Program. Table 2-1 summarizes the various activities undertaken for the impact 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. In addition, Navigant conducted trend data analysis, interval billing data analysis, and documentation of building automation system programmed settings verification.

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 Evaluation
Application Technical Review	Sampled projects	Impact Evaluation
Interval and trend data analysis	Selected projects	Impact Evaluation

2.1 Tracking Data Review

The tracking data review includes analysis 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. In addition, tracking data was inspected to ensure quality, completeness, and to discover any process insights. 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 113.2.1.

2.2 Sampling Plan

Samples for the impact evaluation targeted all participants and staff in the respective population frames. Navigant targeted a certainty sample of twelve projects for the impact evaluation, representing 84% of reported program energy savings. Each project was broken down into one of three strata.

- Large (>500,000 kWh in savings)
- Medium (>100,000 kWh and <500,000 kWh in savings)
- Small (<100,000 kWh in 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 contributions within the Lite and Standard program tiers.

Based on this approach, Navigant completed detailed project reviews for seven of the projects representing 41 percent of the total program energy savings, and billing data analysis for five of the projects representing 43 percent of the total program energy savings.

2.3 Ex-Post Energy Savings Calculation

The evaluation of the 2017 RCx Program was conducted using one, or both, of two different review methods.

- Documentation technical review, or desk review
- Fifteen-minute interval billing data review

Desk review energy savings calculations were conducted in accordance with the 2010 Draft Ohio Technical Reference Manuals (Draft TRM) or other published methodologies, such as other, regional TRMs and accepted engineering approaches, as appropriate. Building code, when applicable, is defined by the State of Ohio. The default reference code in Ohio is IECC 2012, though an option is provided to use ASHRAE 90.1-2010. Standard approaches were taken with HVAC, shell, appliances, and other equipment. The desk review was conducted for a sample of project files to verify baseline energy use, quantify operation hours, review all inputs and assumptions and review engineering algorithms selected.

Additionally, engineering-based energy and demand reduction algorithms were used to compute *ex post* savings. For seven of the RCx projects, more rigorous *ex post* calculations, using a pre-post interval billing data analysis, were conducted. These seven projects were chosen based on the reported savings per total energy use ratio of the project site. For this analysis, Navigant looked at site specific fifteen-minute interval data, provided by AEP Ohio, and normalized it against the site-specific NOAA weather data. This step provides the average energy use for a building, based on time of day and building use, at a specific outside air temperature, which is then extrapolated over an entire year using typical meteorological year (TMY) data. Navigant then compared the energy at a given temperature before the RCx measures were installed, to the energy at a given temperature after the RCx measures were installed.

For calculations to project an accurate representation of savings, Navigant ensured there was adequate time between the pre- and post-measure installation. As a result, two of the projects were found to not have enough post data to accurately quantify savings, and therefore a standard desk review was conducted for these sites instead.

2.4 Realization Rates Calculation Method

Realization rates (RR) for each stratum were calculated with the following Equation 1:

Equation 1. Realization Rates for Each Stratum

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

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 2:

Equation 2. Realization Rates for Each Stratum Applied to Project Population

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

3. DETAILED EVALUATION FINDINGS

This section presents the detailed findings from the 2017 RCx Program evaluation related to (1) program activity, and (2) impact findings

3.1 Program Activity

The evaluation team analyzed tracking data delivered by AEP Ohio. As shown in Table 3-1, the 2017 RCx Program completed nineteen projects constituting 4,740 MWh of *ex ante* reported annual energy savings. As expected, the RCx Lite projects claim less savings on average than RCx Standard projects.

Table 3-1. 2017 Retro-commissioning Program Projects, Measures, and *Ex Ante* Savings

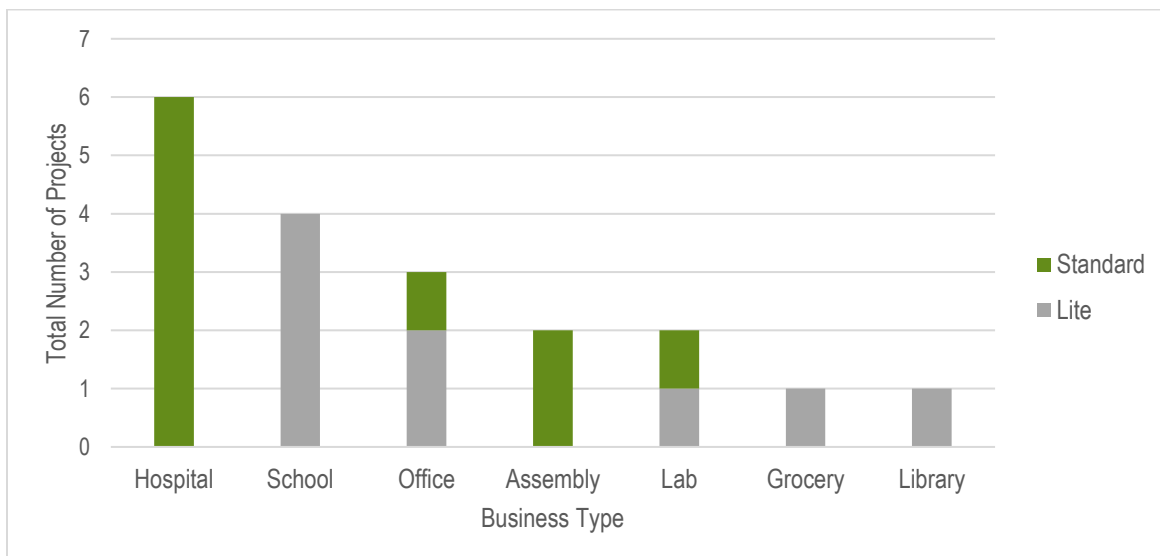
Metric	RCx Standard	RCx Lite	<i>Ex Ante</i> Reported
Number of Projects	10	9	19
Number of Measures	45	44	89
Annual Energy Savings (MWh)	3,742	998	4,740
Peak Demand Savings (MW)	0	14	14

Source: Evaluation analysis of AEP Ohio tracking data from January 12, 2018.

In 2017, most projects were completed in hospitals (six projects), followed by school/universities projects), office (three projects), assemblies and labs (both two projects), and library and grocery one project). The breakdown per business type for RCx Standard and RCx Lite is shown in

Figure 3-1.

Figure 3-1. Projects by Business Type, 2017



Source: Navigant analysis of 2017 Retro-commissioning tracking data

In 2017, the bulk of savings were generated by medical/hospital projects (47%), followed by (%). This is not unexpected, for these business types tend to consume a lot of energy and have the needed to implement multiple RCx measures. School projects were the second most common, accounted for a relatively small percentage of the total savings (8%). Demand savings were not except for one project, in 2017. Although 2016 was technically the last year of the program, 2017 greater quantity in the number of projects completed, as well as the diversity in participation per segment. Table 3-2 and

Figure 3-2 provide a profile of 2017 RCx Program participation at the business type level.

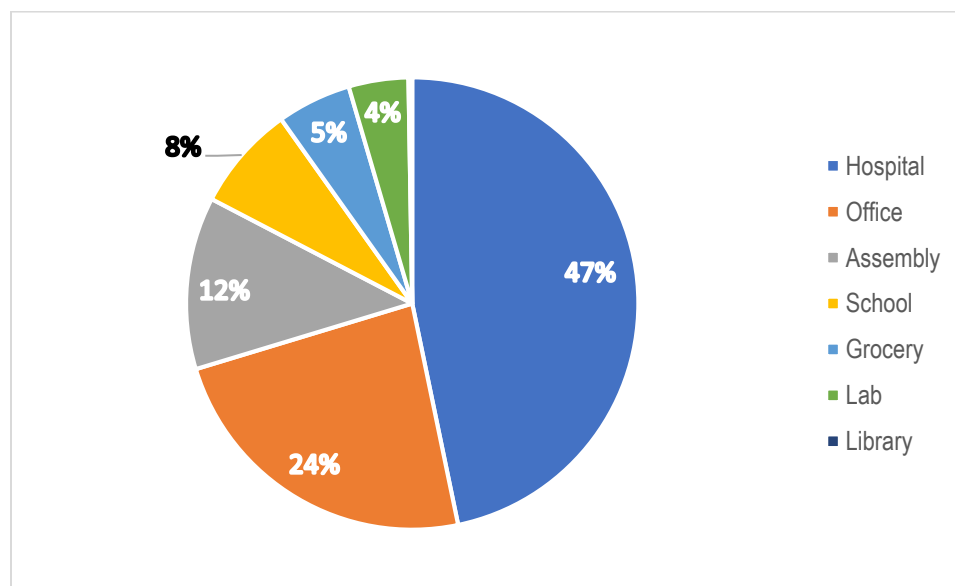
Table 3-2. 2017 Retro-commissioning Program Participation by Business Type

Business Type	Project Count		Ex Ante Reported Energy Savings (MWh)		Ex Ante Reported Demand Savings (MW)	
Hospital	6	32%	2,216	47%	-	0%
Office	3	16%	1,117	24%	-	0%
Assembly	2	11%	584	12%	-	0%
School	4	21%	356	8%	-	0%
Grocery	1	5%	251	5%	-	0%
Lab	2	11%	202	4%	14	100%
Library	1	5%	13	0%	-	0%
Total	19	100%	4,740	100%	14	100%

Source: Evaluation analysis of tracking data from AEP Ohio database exports.

Note: Totals may not sum due to rounding.

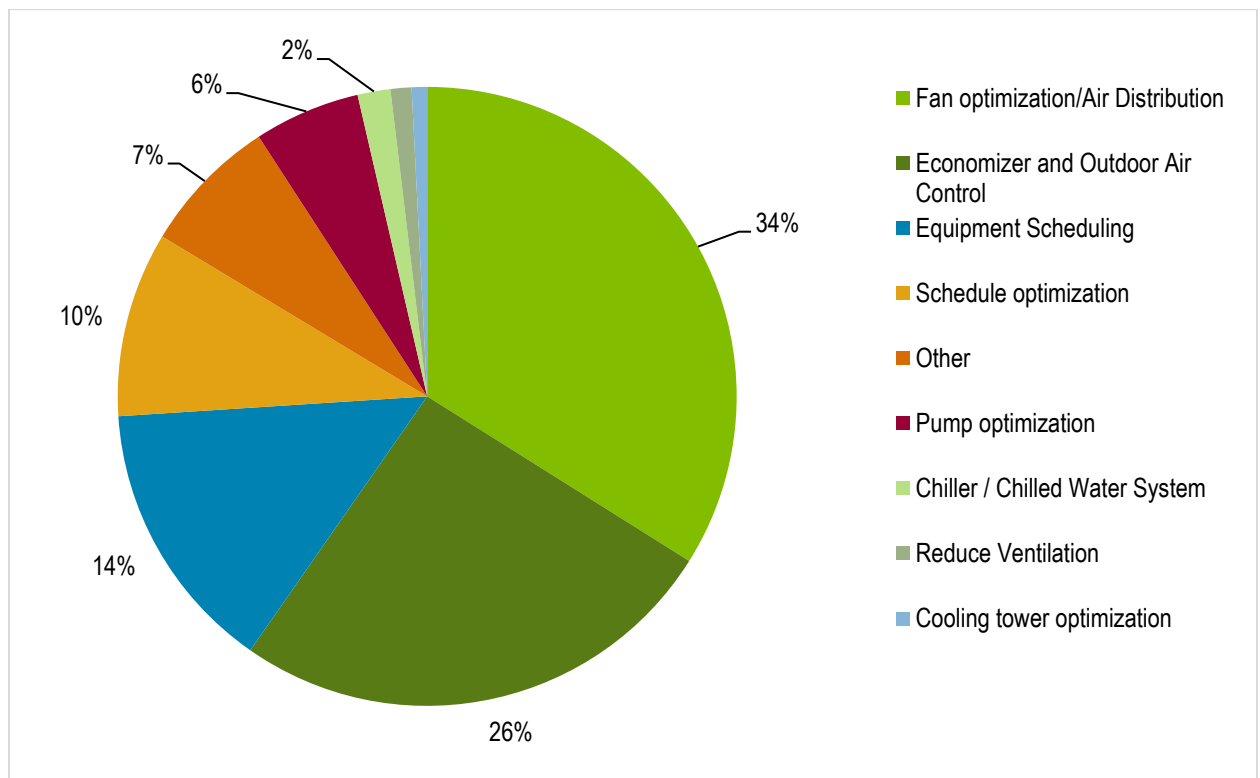
Figure 3-2. 2017 Retro-commissioning Program Ex Ante Energy Savings by Business Type



Source: Evaluation analysis of tracking data from AEP Ohio database exports.

The 2017 RCx Program year also demonstrated a well-rounded mix of end-uses being implemented to achieve savings for the program. This indicated the preferred, holistic approach to a retro-commissioning program. Fan optimization and air distribution made up a large portion of the overall savings (34%). However, it is surprising to see this measure comprise a large portion of the savings. Further investigation revealed two filter projects overestimated the reported savings. The breakdown of savings in 2017 by end-use is shown in Figure 3-3.

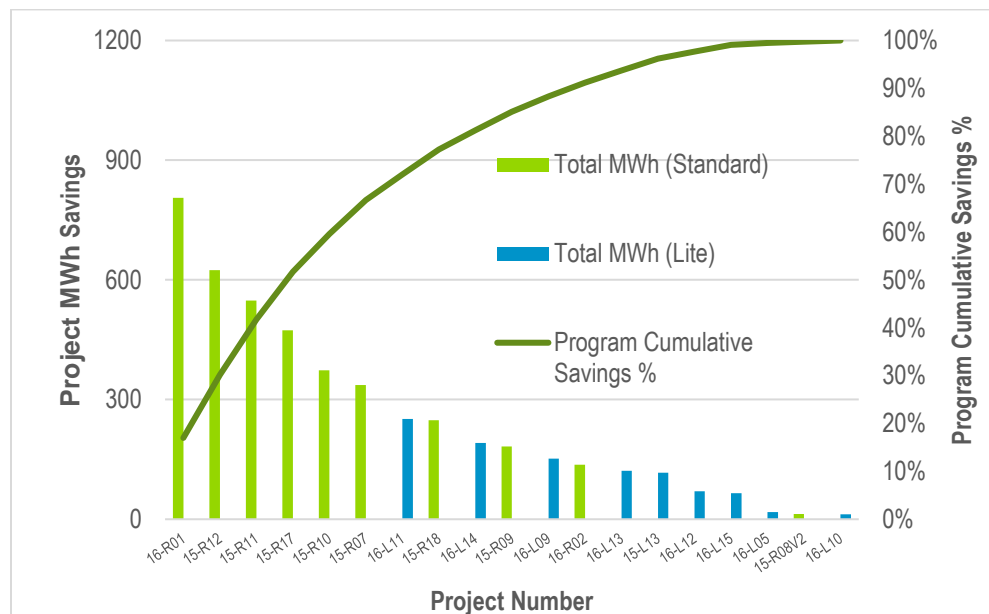
Figure 3-3. Percent Savings by End-Use, 2017



Source: Evaluation analysis of tracking data from AEP Ohio database exports.

The largest project in 2017 was an RCx Standard office project. The next four largest projects were hospitals. This is unsurprising as hospitals made up six of the ten RCx Standard projects. Some of the smallest projects included schools, which is understandable, since schools typically have limited budgets. Figure 3-4 shows the distribution of savings by project and the percentage of cumulative program savings contributed by each project.

Figure 3-4. 2017 Distribution of Energy Savings by Project

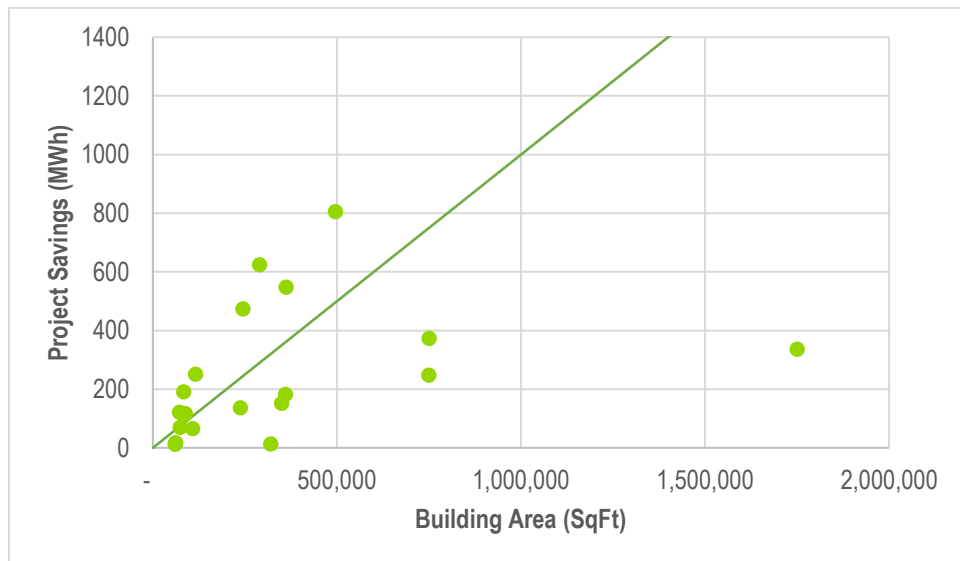


Source: Evaluation analysis of tracking data from AEP Ohio database exports.

Figure 3-5 plots ex ante MWh savings relative to building size. The line on the figure depicts savings equal to one kWh 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 showing less savings per square foot.

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. However, this project was not sampled, and therefore this assertion cannot be verified.

Figure 3-5. RCx Savings and Building Size (SqFt)



Source: Evaluation analysis of tracking data from AEP Ohio database exports.

3.2 Impact Evaluation Results

This section presents the results of the impact evaluation of the 2017 RCx Program.

3.2.1 Tracking System and Program Documentation Review

3.2.1.1 Tracking System

The database extract includes project total impacts, application submittal and status data, and internal approval information. Project data were 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.

Generally, 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 nine cases, Navigant found the customer financial commitment in the tracking database was below the application eligibility requirements, while in fourteen instances the RSP study cost was above the eligibility cap stated in the

2017 RCx Program application. While adequate for evaluation purposes, the evaluator did not address whether the tracking system is adequate for regulatory prudency 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.

Except for two projects located at the same site, which comprised 25 percent of the total savings for the program, documentation in the RSP calculators was complete. For both Lite and Standard program tracks, the calculators were comprehensive and transparent for all measures and all RSPs. This included 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, were inconsistent among the different RSPs.

Where present, invoices supporting customer financial commitment matched the tracking database. No supporting documentation could be found in the project file to support RSP study costs covered by AEP Ohio.

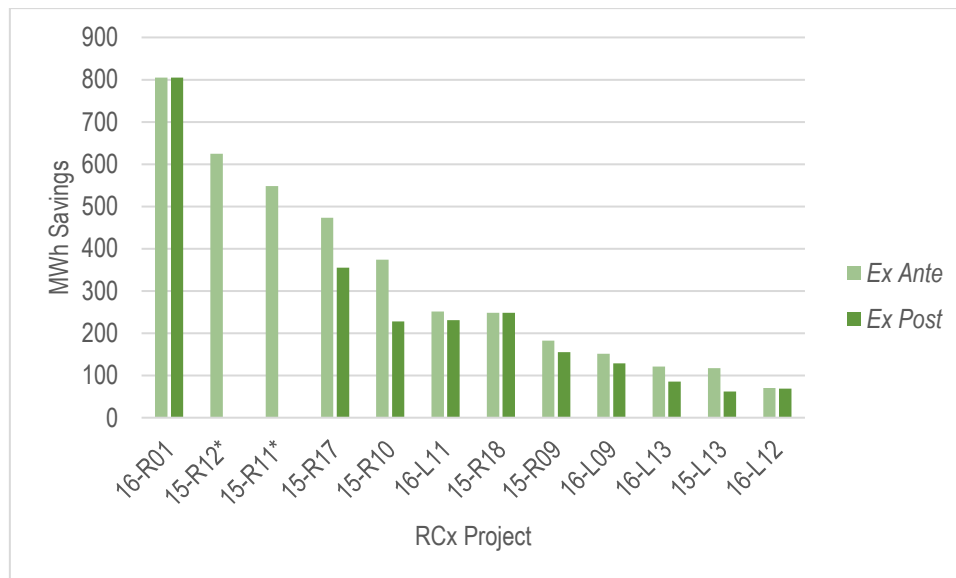
3.2.2 Program Impact Results

The realization rate for energy savings in the 2017 RCx Program is 0.632. One project reported demand savings, and this project was not sampled. Therefore, the realization rate for demand savings in the 2017 RCx Program is defaulted to 1.00. Reasons for changes to *ex ante* reported savings include the following:

- (1) Savings recorded in verification report did not match reported savings in tracking data.
- (2) Default equipment efficiencies were not updated to site-specific values for final verification phase RSP calculators submitted.
- (3) Unsupported assumptions regarding amount of outside air in baseline and efficient calculator models.
- (4) Inputs into RSP calculators did not match applications, investigation reports, or equipment lists.
- (5) Using projected savings from the manufacturer, rather than site specific calculated savings.

Navigant estimated the *ex post* program impacts, based on a sample of twelve sites, for the 2017 RCx Program, as shown in Figure 3-6.

Figure 3-6. Sampled 2017 RCx Program *Ex Ante* vs. *Ex Post* Energy Savings



Source: Evaluation analysis of tracking data from AEP Ohio database exports.

* Project received zero *ex post* savings

3.3 Driving Factors of Realization Rate

The 2017 RCx Program impact evaluation resulted in several key findings.

Project 15-R10. Savings recorded in some verification reports did not match reported savings in the tracking data. Project 15-R10 reported savings from six measures in the tracking data from AEP Ohio. However, the RSP's verification report stated five of the six measures were actually installed. The one measure not installed accounted for thirty-nine percent of the total savings for the project, resulting in a project realization rate of 61 percent.

Project 15-R09 and Project 16-L09. Inputs into RSP calculators did not match applications, investigation reports, or equipment lists. For many sites, including projects 15-R09 and 16-L09, the size and efficiencies of specific measures did not match what was reported or provided by the customer in the form of an equipment list. For project 16-L09, five of the ten measures installed had either different set points from the application, or the equipment was a different size than stated in the applications equipment list, and input into the calculator. Input values that did not match the application led to a lower baseline, and the appearance of greater savings. When the variables input into the calculator matched the application, this resulted in a realization rate of 84.8 percent for both Project 15-R09 and Project 16-L09.

Project 15-L13. Unsupported assumptions were made regarding the amount of outside air in baseline and efficient calculator models. Project 15-L13 involved a set of air handling units (AHU), and the cubic feet per minute (CFM) values based on an assumed twenty percent of the outside air temperature (OAT), rather than a measured CFM quantity or the more standard ASHRAE value of 400 CFM per ton default. This assumption lead to an over estimate in savings and a project realization rate of 53 percent.

Project 16-L12. Default equipment efficiencies were not updated to site-specific values in the final verification phase RSP calculators submitted. Project 16-L12 involved a chilled water supply pump and used a low default value of 56 percent for pump efficiency in the calculator rather than the higher efficiency of 72 percent per the actual pump specifications. This resulted in a lower energy consumption baseline, resulting in a project realization rate of 99 percent.

Project 15-R11 and Project 15-R12. These two projects accounted for 25 percent of the *ex ante* savings. With a realization rate of zero on the projects, these results drove the program level verified savings to deviate significantly from claimed savings.

The projected savings from the manufacturer, rather than site specific calculated savings, were used. The kWh savings calculations were conducted by the manufacturer, which was used as a third party “filter expert” by the implementing contractor. However, the calculations only accounted for the change in medium between the baseline filter and the new filters, while using assumed values for equipment performance and system setup. The calculations did not consider the changes needed by the system to accommodate the change in pressure after the new filters were installed, which inevitably led to a gross overestimate of project savings.

Calculated savings were not always checked for reasonableness in the verification report. Project 15-R11 and Project 15-R12 had excessively high savings for the installation of energy efficient filters, which historically had not seen savings of this size in the past. According to the tracking data, the installation of the filters saved nine percent of the buildings total energy use, which is not reasonable.

Additionally, *ex ante* savings for Project 15-R11 and Project 15-R12 did not fully account for how the installed measures interact with the HVAC system, and resulted in overestimated measure savings. Measures include the installation of high efficiency filters, an economizer reprogramming and sensor installation, and the shutdown of an underutilized exhaust fan.

Navigant examined interval data for the site and found slightly negative savings from the implementation of these measures. Therefore, Navigant conducted an in-depth investigation of the project files to determine why there was a lack of savings seen.

It appears the RSP took the manufacturer’s calculated savings at face value for the filters, without performing its own site-specific calculations. The manufacturer’s savings use the maximum design airflow (CFM) all year round, which does not account for expected part-load fan performance (lower CFM) for varying HVAC loads due to seasonal weather or other variables. Lower part-load CFM results in lower pressure drop through the filters, therefore the manufacturer’s assumption of maximum airflow throughout the year led to overestimated savings.

Although not independently verified, the verification report from the implementing contractor alluded to the system having a damper. In this case, the system would see zero savings from the new filters, unless the damper was adjusted to correctly accommodate the change in system parameters.

Finally, based on information from the participant that VFDs were installed, Navigant calculated lower savings for the filter measure, based on an industry-standard typical HVAC part-load performance curve. Even if VFDs are the primary method to reduce airflow, the filters may not be the largest driver of the duct

system curve, and the filter static pressure drop reduction may not be enough to trigger a change in fan motor speed.

3.4 Cost Effectiveness Review

This Section addresses the cost effectiveness of the 2017 RCx Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-3 summarizes the unique inputs used in the TRC test.

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

Item	2017
Measure Life	5
Participants	19
<i>Ex Post</i> Annual Energy Savings (kWh)	2,997,560
<i>Ex Post</i> Coincident Peak Savings (kW)	14
Third Party Implementation Costs	\$232,971
Utility Administration Costs	\$100,900
Utility Incentive Costs	\$457,102
Participant Contribution to Incremental Measure Costs	\$259,861

The cost effectiveness analysis is based on evaluation *ex post* impacts. Based on these inputs, the TRC ratio is 0.5 and the program does not pass the TRC test. Table 3-4 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 3-4. Cost-Effectiveness Results for Retro-commissioning Program

Benefit-Cost Test	Ratio
Total Resource Cost	0.5
Participant Cost Test	1.9
Ratepayer Impact Measure	0.3
Utility Cost Test	0.6

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Impact Evaluation Findings and Recommendations

The 2017 RCx Program impact evaluation resulted in several key findings and recommendations. While the program will not be recruiting new participants in 2018, all recommendations in this report are written as though the program is continuing, for documentation purposes.

Impact Finding 1: Savings recorded in verification report did not match reported savings in tracking data.

Impact Recommendation 1: Ensure all reported savings are in line with verification reports. This could be achieved through a designated QA/QC step, or completing a short checklist when entering information into the database.

Impact Finding 2: Inputs into RSP calculators did not match applications, investigation reports, or equipment lists. For several sites, the size and efficiencies of specific measures did not match what was reported, or provided by the customer in the form of an equipment list.

Impact Recommendation 2: Ensure all inputted values match the application, or equipment list. If determined that the application or equipment list is incorrect, clear documentation stating the actual set points, equipment, etc. should be in the verification report.

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. Typical meteorological year (TMY) weather data for nearest location to the project
- e. actual installed building automation system (BAS) schedules and set points
- 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.

Impact Finding 4: Unsupported assumptions were made regarding the amount of outside air in baseline and efficient calculator models.

Impact Recommendation 4: All assumptions should be documented and backed up with evidence for the reason why the assumed value is valid. The use of standard ASHRAE values is acceptable when direct measurements are not feasible.

Impact Finding 5: Projected savings from the manufacturer, rather than site-specific calculated savings, were used for two RCx projects.

Impact Recommendation 5: For a measure that is part of a larger system, the projected savings from the manufacturer should not be used. Independent calculations should be done for each measure. Cross checking calculated savings against the manufacturers projected savings should only be done to check for reasonableness.

Impact Finding 6: Calculated savings were not always checked for reasonableness in the verification report.

Impact Recommendation 6a: Verify that reported savings are reasonable per measure and for the overall project. This could be accomplished by checking installed measures against a “cheat sheet” with average savings seen by common measures. While each retro-commissioning project is slightly different, this cross check could raise the red flag for those measures that seem to be claiming excessively high savings. In addition, looking for individual measures that claim to save more than five percent of the total buildings energy use should be flagged for a more in-depth review, including interval or billing data from AEP Ohio.

Impact Recommendation 6b: Mandate that measures claiming large MWh savings, or greater than five percent of the total buildings energy use, be verified against the building automation system or with additional metering.

APPENDIX N



DATA CENTER PROGRAM

2017 Evaluation Report

Prepared for:

AEP OHIO



A unit of American Electric Power

May 11, 2018

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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 operating 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 project completion. The program is delivered by an implementation contractor on behalf of AEP Ohio.

The 2017 program goals were 16.58 GWh in energy savings and 1.48 MW in peak demand savings. A secondary goal was to ensure the program is available to customers of all sizes. *Ex ante* energy savings amounted to 31.18 GWh, and *ex ante* demand savings amounted to 4.10 MW, significantly exceeding the 2017 annual energy savings targets.

ES.1 Program Participation

The 2017 program year represents the fifth year of operation for the Data Center Program and the fifth year Navigant has evaluated its operation. In 2017, 11 projects were completed at ten different data centers. In 2017, eight unique participants¹ participated in the program. In 2017, one participant completed multiple projects, accounting for three of the 11 projects completed. Overall, the number of projects participating in the program decreased from the prior year's program. In 2017, *ex ante* electricity savings increased by 64 percent compared to 2016 (Table ES-1) additionally the program saved almost twice the electric energy savings target (Table ES-2).

Table ES-1. Data Center Program Summary, 2015 - 2017 Program Years

	2015	2016	2017	2017 Average per Project
Total Incremental Participant Cost	\$4,572,719	\$5,319,318	\$13,527,548 ²	\$1,229,777
Amount of Incentives Paid by AEP Ohio	\$866,480	\$1,079,969	\$1,376,962	\$125,178
Number of Projects	46	40	11	-
<i>Ex Ante</i> Energy Savings (MWh)	12,251	18,990	31,180	2,835
<i>Ex Ante</i> Demand Savings (MW)	1.35	2.43	4.10	0.37

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

Source: Navigant Analysis of Data Center tracking data for multiple years

Table ES-2. Data Center Program 2017 Program Summary

2017 Program Goals	2017 Program, Reported
--------------------	------------------------

¹ Navigant notes the tracking database contained a number of variations on some organization names. Navigant exercised judgement in identifying "unique" participants.

² Note that \$13,527,548 is the *ex ante* incremental cost. The *ex post* value is \$5,084,461

Program Budget	\$2,300,000	\$2,389,439
<i>Ex Ante</i> Energy Savings (MWh)	16,579	31,180
<i>Ex Ante</i> Demand Savings (MW)	1.48	4.10

Source: Navigant Analysis of 2017 Data Center tracking data

As in past years, the clear majority of 2017 savings achieved were from three large projects. The number of projects decreased again in 2017 by 73 percent compared to the prior year (40 completed in 2016), though the associated total *ex ante* savings increased.

The program application form asks participants to indicate how they had learned of the program. The tracking database shows all participants indicated they initially heard of the Data Center Program through an AEP Ohio Account Representative. None of the Data Center customers reported learning of the program from a contractor or Solution Provider.

The tracking database also recorded whether a Solution Provider was involved in implementing the efficiency project. Overall, the measure tracking database shows five different Solution Providers were involved with the eleven projects completed during the year. Both the number of Solution Providers and the number of projects completed are less than the levels reported in recent years. In 2017, three projects (27%) were reported as “self-performed” without the assistance of a Solution Provider. An additional three projects did not list a specific Solution Provider source in the measure tracking database, instead listing “Multiple Contractors”. Five unique Solution Providers were listed in the database.

ES.2 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, program web sites, application forms and other program inputs were also analyzed.

As part of the impact study, the evaluation team completed an engineering review on project files accounting for 95 percent of the claimed *ex ante* energy savings. Projects accounting for 30 percent of the *ex ante* energy savings also underwent an onsite review. Table ES-3 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-3. 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 Onsite Reviews ³
Large (> 4,000 MWh/yr.)	3	87.1%	3	1
Medium (> 250 MWh/yr., < 4,000 MWh/yr.)	3	11.2%	2	1
Small (< 250 MWh/yr)	5	1.6%	1	0

³ Onsite reviews are a sub-set of desk reviews. All projects in the sample received at least a desk review, while some received an onsite review in addition to the desk review. If a project received both an onsite and a desk review it is counted in both the onsite and desk review totals.

Total	11	100%	6	2
Percent of <i>Ex Ante</i> Savings			95.43%	30.29%

Source: Navigant Analysis

ES.3 Key Impact Findings and Recommendations

As summarized in Table ES-4, the verified electricity savings significantly exceeded the 2017 targets of 16.6 GWh and 1.48 MW coincident demand reduction. The *ex post* energy and summer coincident demand savings are 27.8 GWh and 3.19 MW respectively. The realization rate for energy is 0.89, while the demand realization rate is 0.78. These results represent increased program savings but decreased realization rates compared to the 2016 program year.

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

Metric	2017 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)	16,579	31,180	27,799	89%	7.19%	168%
Coincident Peak Demand Reduction (MW)	1.48	4.10	3.19	78%	11.28%	216%

Source: Navigant Analysis

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).

Impact Finding 1: There is a virtualization project, with nearly two GWh of *ex ante* savings, where no direct measurements were obtained for either the baseline or post-retrofit conditions. Even though savings were estimated to be nearly 15 percent of the participant's utility bill, no billing analysis was conducted.

Impact Recommendation 1a: For measures with more than 500 MWh in savings, make every effort to obtain critical savings measurements prior to issuing an incentive. Load factor on servers is one example of a critical measurement as it has a direct impact on savings.

Impact Recommendation 1b: For IT measures exceeding 500 MWh in savings where critical savings measurements are not possible, log power use through the PDU or UPS to compare baseline consumption to post-retrofit consumption. Normalize for any load growth. Collect at least two to four weeks of post-retrofit data before closing the project.

Impact Recommendation 1c: For measures with more than 500 MWh in savings, where critical savings measurements are not possible, isolation through the PDU or UPS is not possible, and savings at the project level is greater than five percent of the utility bill, conduct a billing analysis using 15-minute interval data comparing the baseline to the post-retrofit condition. Conduct interviews of the participant detailing energy changing modifications happening at the site outside of the energy efficiency project and quantify such modifications. Normalize data for outside weather conditions, load

growth, and any other independent variable affecting savings. Collect at least one month of post-retrofit data before closing the project and paying any incentive.

Impact Recommendation 1d: Any project whose *ex ante* savings exceeds ten percent of the utility bill should analyze billing data comparing baseline to the post-retrofit. If the billing analysis does not confirm the project savings, investigate the reasons. Any project with more than one GWh in savings with less than ten GWh of annual electricity use should reserve and not release incentives until one month of post-retrofit billing data can be analyzed.

Impact Finding 2: Two of the sampled projects frequently converted from imperial to metric units and from COP efficiency to kW/ton efficiency. In the many conversions, the project files confused load kW with cooling system power kW, resulting in substantial errors.

Impact Recommendation 2a: Keep custom engineering calculations as simple and straightforward as possible. Do not make several layers of conversions when one conversion will do.

Impact Recommendation 2b: Cooling load at data centers is calculated by determining the power delivered to the UPS or the power delivered to the IT equipment. The cooling load is in units of kW. Since the power driving the cooling equipment is also in kW, COP or SCOP is a convenient efficiency factor where one simply measures the power delivered to the UPS or IT equipment in kW and then divides that number by the measured power to the cooling system in kW to determine the COP. There is no need to convert the cooling load to tons, and no need to express the efficiency in terms of kW/ton.

Impact Finding 3: The large new construction projects, which will be updated annually for the next several years, had a project incremental cost analysis highly dependent on incremental cost relative to commissioning and monitoring systems. An interview with the participant revealed the commissioning and monitoring incremental cost is zero. When Navigant removed the commissioning and monitoring costs from the analysis, the project incremental cost became negative. Also, other costs listed were not well defined, adding confusion to the cost calculation. Despite possibly having a negative incremental cost, the new construction projects are not standard baseline solutions for cooling a data center, and do save considerable energy relative to conventional Data Center cooling.

Impact Recommendation 3: Soft or non-material costs need to be validated and documented as above and beyond baseline procedures. All cost line items need to be well defined and understood by the implementation contractor.

ES.4 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. Customer outreach does not drive program awareness to increase Data Center Program participation. Application forms are generally completed by program staff due to application complexity and customer time constraints. The range of participating Solution Providers and customers with data centers of different sizes continues to decrease.

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).

Process Finding 1: The program is overly reliant on a few very large projects to meet energy savings goals. This approach significantly reduces the number of customers the program can serve and could expose AEP Ohio to significant risk if a project does not materialize, or complete in each year. To

compensate, the program has adjusted the 2017 incentive structure to increase incentive funding available for smaller projects; however due to the size of the largest projects, the savings from smaller projects was not sufficient to invest in additional projects or program outreach.

Process Recommendation 1: Institute an annual per project incentive cap, or shift projects above a certain incentive level to Bid4Efficiency. Consider a phased-in approach over several program years to gradually decrease the large project incentives in relation to increase program support from Solution Providers. However, new incentive caps should not affect customers already participating even if projects span several years.

Process Finding 2: The three large new construction projects had already met the incentive threshold to apply the reduced incentive rate of \$0.035/kWh based on incentives provided in 2016. Consider continuing at the lower tier for additional projects that are considered phases or the original project.

Process Recommendation 2a: For projects split up into multiple program years, the incentive rate structure could be based on the combined incentive of all years. If the incentive structure has changed from one year to the next, the current incentive should be the total incentive due the project for all years minus any previously paid incentives.

Process Recommendation 2b: Revise Terms and Conditions to incorporate the intent of Process Recommendation 2a.

ES.5 Key Tracking System Findings and Recommendations

The following recommendations are offered to further improve the value of the tracking data. Additional process recommendations are included in Section 4.3 (Key Process Findings and Recommendations).

Tracking Database Finding 1: The program tracking database only includes completed projects; rejected projects⁴ are not included. As such, the evaluation team has not assessed the number of projects rejected, or reasons for rejection. Including rejected applicants in the database would provide the Program Coordinator's perspective into how customers and projects are managed through the entire project process, and identify points for the program to improve communications and services to reduce customer rejection.

Tracking Database Recommendation 1: Consider including rejected program applicants in the tracking database, along with the reason for rejection.

⁴ Rejected projects would include cancelled projects as well as projects that suffer from other issues like not meeting payback criteria or missing proper documentation.

1. INTRODUCTION AND PURPOSE OF STUDY

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, regardless of data center size.

The program goals for 2017 were 16.58 GWh for energy savings and 1.48 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. *Ex ante* energy savings amounted to 31.18 GWh, *ex ante* demand savings amounted to 4.10 MW, exceeding the 2017 targets for the year for both energy and demand savings.

The 2017 program year represents the fifth year of operation for this program. The program is delivered by an implementation contractor on behalf of AEP Ohio. AEP Ohio contracts with an additional implementation contractor to conduct program outreach and application pre-screening on behalf of several AEP Ohio commercial programs including Process Efficiency, Efficient Products for Business, New Construction, and Self-Direct. While the outreach implementer may include Data Center Program referrals, it has not been a focus of their work. The implementer manages Data Center applications.

1.1 Evaluation Objectives

This report presents the findings from the impact and process evaluations of the AEP Ohio Data Center Program for 2017. 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 2017.
- 2) Determine key process-related program strengths and weaknesses and identify ways in which the program can be improved.
- 3) Determine program cost-effectiveness.

1.2 Evaluation Methods

Program impacts for the 2017 Data Center 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.

Data collection activities are summarized in Table 1-1. During the 2017 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 2017 program.	Process Evaluation
Secondary Literature Review	<ul style="list-style-type: none"> Publicly-available evaluations of other utility Data Center Programs Available reports on Data Center Energy Management. 	Impact and Process Evaluation
In-depth Telephone Interviews	AEP Ohio Program staff	Process Evaluation
	Implementer staff	Process Evaluation
	Outreach Implementer staff	Process Evaluation
Project File Review	Sample of completed projects	Impact and Process Evaluation
Telephone Verification	Where project files were incomplete	Impact Evaluation
Onsite Verification	Where uncertainties in the savings calculations existed	Impact Evaluation
Tracking Data Review	All program participants	Impact and Process Evaluation

Source: Navigant

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 2017 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.** Navigant established key evaluation questions as part of developing the 2017 Evaluation Plan with AEP Ohio staff.
- 2) **Tracking Data Review.** Navigant reviewed the program tracking data collected by the implementation contractor and provided to the evaluation team by AEP Ohio.
- 3) **Review of Marketing Activities.** Navigant reviewed the overall marketing activities and approach as implemented by the implementation contractor and AEP Ohio.
- 4) **Review of Participation.** Navigant reviewed program participation by building type, project size, economic sector, and completion date.
- 5) **Primary Data Collection.** Navigant 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 onsite 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 baseline selection, determination of incremental costs, quantifying operation hours, reviewing all inputs and assumptions, and engineering algorithms selected. 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, and any other clarification needed to accurately determine the impact of the project.

Where uncertainties still existed in the savings calculations, onsite visits were conducted. Onsite 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 and the implementation contractors, and conducted a review of program tracking data.

2.1.1 Key Impact and Process Evaluation Questions

Navigant collaborated with AEP Ohio to identify key evaluation questions regarding the 2017 Data Center Program. Three broad evaluation questions were addressed by the evaluation study.

- 1) What is the status of implementing recommendations / issues identified in the 2016 evaluation?
- 2) How do the findings in the 2017 evaluation compare with findings from prior year evaluations?
- 3) Have changes made to the 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, 2017 Evaluation

Research Objective	Information Sources	
	Program Data Files and Onsites ^a	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 Data Center projects 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	
	Program Data Files and Onsites ^a	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?	-	√
7. How could the program encourage deeper comprehensive savings for participants?	-	√
8. 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?	√	√
9. 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?	-	√
10. 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	√	-
11. Does the program tracking system provide adequate information for QA/QC and program evaluation?	√	-
12. 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 solution providers?	-	√
13. Are incentives calculated accurately and according to program rules and policies?	√	-

Research Objective	Information Sources	
	Program Data Files and Onsites ^a	Staff/ Implementation Contractors
14. Does AEP Ohio award participants or solution providers with public recognition or acknowledgment (certificate, plaque, occupant communications, etc.) to publicize their energy efficiency achievements in their community?	-	√

(a) Program data files and onsites include program tracking databases, project files, utility consumption data, and Navigant field reports and analysis files.

2.2 Methods Used to Collect and Analyze Process Data

The purpose of the evaluation is to assess the effect of the program structure and program implementation on program performance and customer satisfaction. The evaluation team's efforts help to provide insights and recommendations to support the continued success of the Data Center Program.

The process activities for 2017 were relatively limited as there were no significant program changes between the 2016 and 2017 program years. The main activity of the 2017 process evaluation for the Data Center 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 2017. Additionally, program materials were reviewed, including application forms, promotional brochures, and the program website.

2.2.1 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 contractors 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, 2017.

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.

2.2.2 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.

2.2.3 Review of Participation

The evaluation team used the program tracking data to analyze program participation by a number of key factors including building type, project size and complexity; and business sector. 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.

2.2.4 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 2017. 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 demand side management programs and program evaluations were used to perform the interviews. Interviews were conducted by telephone to provide flexibility to the respondents' schedules.

2.3 Methods Used to Collect and Analyze Impact Data

Through a review of the tracking data, the evaluation team divided the completed projects into three strata. 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 engineering assumptions.

When additional information was needed from the customer, 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 additional 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, 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.

2.3.1 Impact Sample of Project Files

The impact sample for 2017 was chosen to achieve a 90% level of confidence and +/- 10% relative precision for the engineering review. The program was evaluated at the project level. There was one Data Center where two separate projects were completed during the 2017 program year, but neither project was in the impact sample.

The evaluation team sorted the projects from largest to smallest *ex ante* kWh savings and placed these 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 six projects to be selected for engineering review. In the end, Navigant completed desk reviews on a sample comprising 95 percent of the reported program MWh savings.

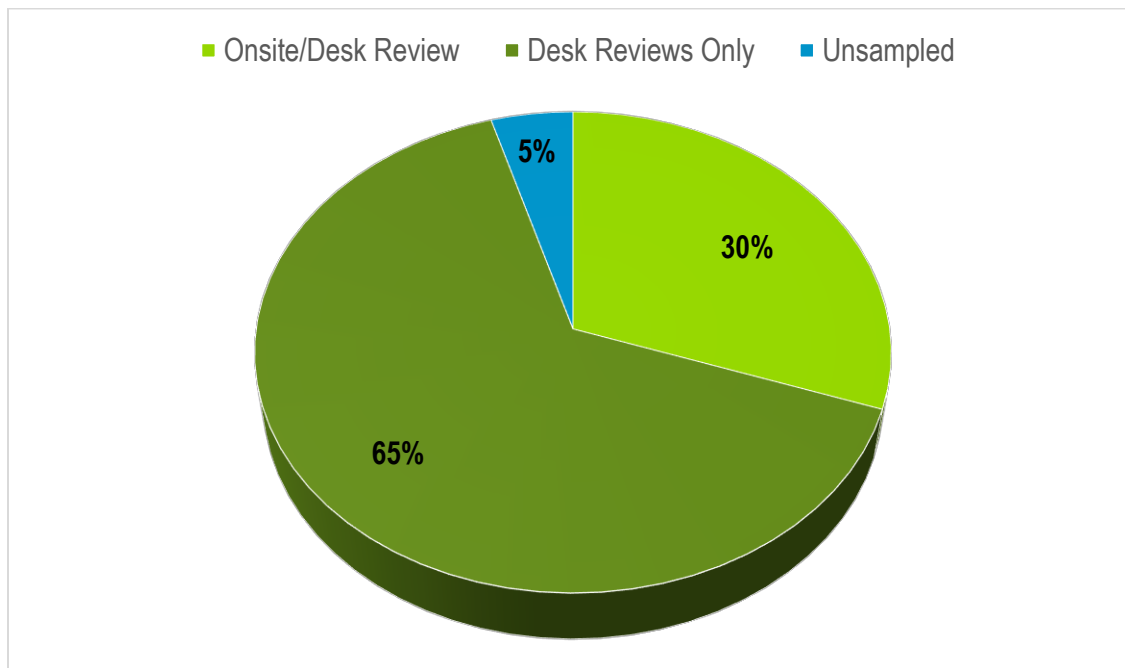
Table 2-2 provides an illustration of the impact measurement and verification (M&V) sample stratification and the level of review complete by the evaluation team within each stratum. Figure 2-1 illustrates the total *ex ante* energy savings claim for the program and the proportion on which the evaluation team completed either a desk or onsite level review.

Table 2-2. 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 Onsite Reviews ⁵
Large (> 4,000 MWh/yr.)	3	87.1%	3	1
Medium (> 250 MWh/yr., < 4,000 MWh/yr.)	3	11.2%	2	1
Small (< 250 MWh/yr)	5	1.6%	1	0
Total	11	100%	6	2
Percent of <i>Ex Ante</i> Savings			95.43%	30.29%

Source: Navigant Analysis

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



Source: Navigant Analysis of 2017 Data Center tracking data

⁵ Onsite reviews are a sub-set of desk reviews. All projects in the sample received at least a desk review, while some received an onsite review in addition to the desk review. If a project received both an onsite and a desk review it is counted in both the onsite and desk review totals.

2.3.2 Telephone Interviews with Participants and Onsite Verification (Impact)

Navigant conducted telephone interviews with participants to clarify and verify information in the *ex ante* project files. The purpose of these interviews was to verify key inputs to savings calculations to inform *ex post* evaluated program energy and demand impacts for 2017. Discussion points varied on a project-specific basis. Onsite validation of key savings custom algorithm inputs was performed for a selected subset of the impact evaluation sample.

2.3.3 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”⁶ (CA Baseline document) and standard ROB custom project analysis procedures where applicable.

2.3.4 Realization Rates Calculation Method

Realization rates for each stratum were calculated with the following Equation 1:

Equation 1. Realization Rates Per Stratum

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

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 2:

Equation 2. Realization Rates Per Stratum and Project Population

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

⁶ 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

3. DETAILED EVALUATION FINDINGS

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

3.1 Program Activity

The 2017 program year represents the fifth year of operation for the Data Center Program. In 2017, AEP Ohio completed just 11 projects, which is significantly less than the 46 completed in 2015 and 40 completed in 2016. Although less prevalent than previous years, some customers completed multiple projects throughout the year. One of the customers who participated in the program in 2017 completed three projects. Overall, eight unique customers completed projects in 2017, a decrease from 15 unique customers in 2016 and 32 unique customers in 2015. In total, the 11 projects included implementation of 11 unique measures. Table 3-1 summarizes the key program indicators.

Total 2017 *ex ante* energy savings reported for the program amounted to 31,180 MWh, and *ex ante* demand reductions reported under the program totaled 4.10 MW. *Ex ante* energy savings increased by 64 percent and demand savings increased by 69 percent compared to 2016. These results reflect a program trend seen in recent years of achieving increased savings by relying on a small number of very large customer projects.

Incentives in 2017 increased by 28 percent to \$1,376,962 compared to 2016. Incentives did not increase at the same rate as savings due to an adjustment to the methodology used to calculate project incentives.

Table 3-1. Program *Ex Ante* Summary, 2016 & 2017 Program Years

	2017 Program	2016 Program
Total Incremental Participant Cost	\$13,527,548 ⁷	\$5,319,318
Amount of Incentives	\$1,376,962	\$1,079,969
Floor Area of IT Room (sq. ft.)	230,700	605,300
<i>Ex Ante</i> Energy Savings Reported to Program (MWh)	31,180	18,990
<i>Ex Ante</i> Demand Savings Reported to Program (MW)	4.10	2.43

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

Source: Navigant Analysis of 2017 Data Center tracking data

Navigant observes the recording of business types has improved significantly in 2017 compared with previous years; all the 2017 projects included a descriptive business type. While none of the reported projects included descriptions of 'other', miscellaneous, or a generic 'data center'; the economic sectors are not adequately described in all cases causing the evaluation team to recharacterize some of the

⁷ Note that \$13,527,548 is the *ex ante* incremental cost. The *ex post* value is \$5,084,461

economic sector designations. Table 3-2 compares Navigant's recommended descriptions with those reported in the tracking data. All subsequent figures and tables in this program activity section use Navigant's recommended economic sectors. In the future a better approach would be to ask for the SIC/NAICS segments at a two-digit level in the application.

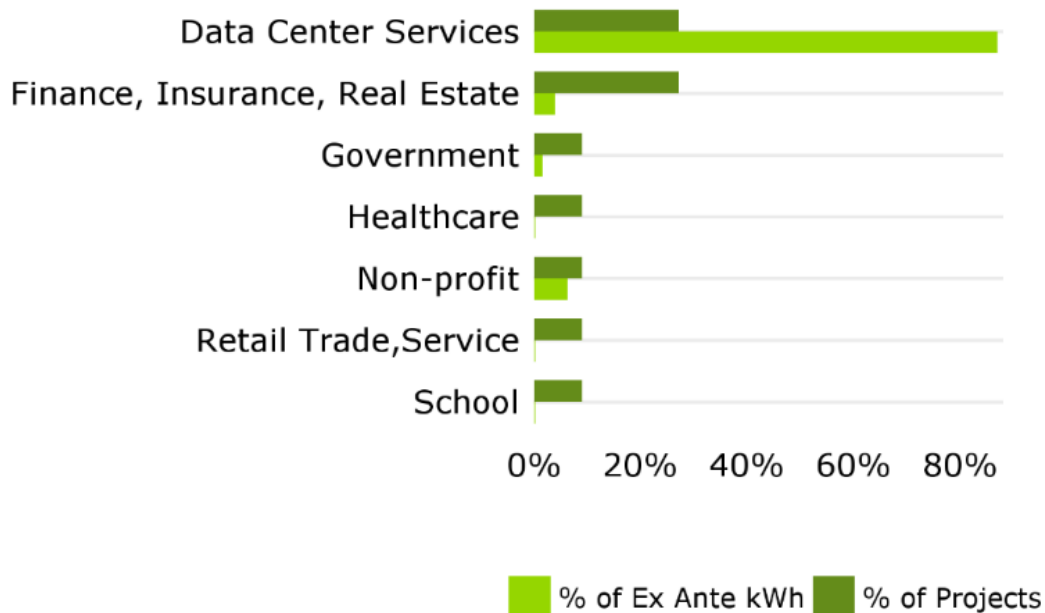
Figure 3-1 shows the number of projects and savings by economic sector, based on information reported in the tracking database. Three data center services projects dominate the program level savings in 2017. Removing these projects, an adequate distribution among economic sectors is observed.

Table 3-2. Recommended Economic Sector Description

Navigant Recommended Economic Sector Description	AEP Ohio Reported Business Type, and Segment
Data Center Services	Industrial / Manufacturing
Finance, Insurance, Real Estate	Large Retail / Service
	Large Office
Government	Large Office
Healthcare	Medical - Hospital
Non-profit	Large Office
Retail Trade, Service	Large Office
School	School

Source: Navigant Analysis

Figure 3-1. Percent of Energy Savings and Projects by Economic Sector, 2017 Program (n=11)



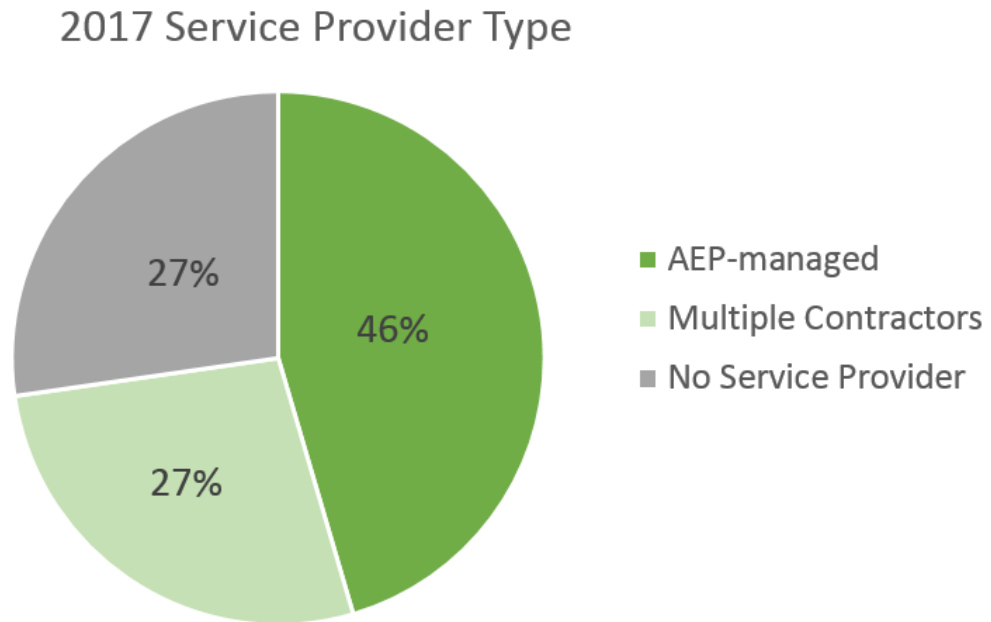
Source: Navigant Analysis of 2017 Data Center tracking data

All businesses participating in 2017 projects indicated project data center equipment operated 24/7 (8,760 hours per year), except one government project which reported 4,380 hours per year.

The application form for the program asks participants to indicate how they learned of the Data Center Program. All participants indicated they initially heard of the program through an AEP Ohio Account Representative; virtually no customers indicated they learned of the program from their contractor (Solution Provider). Navigant notes many customers in 2017 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 3-2 shows that the percentage of projects utilizing an AEP Ohio managed Solution Provider was relatively low, below 50 percent. The tracking database shows five unique Solution Providers were involved with five unique projects (46 percent of projects) completed during the year. Three data center services projects (27 percent of projects) are labeled as “Multiple Contractors”, without naming any of AEP Ohio’s managed Solution Providers, and the remaining three projects are listed as “Self-Performed”, that is, without the assistance of a Solution Provider.

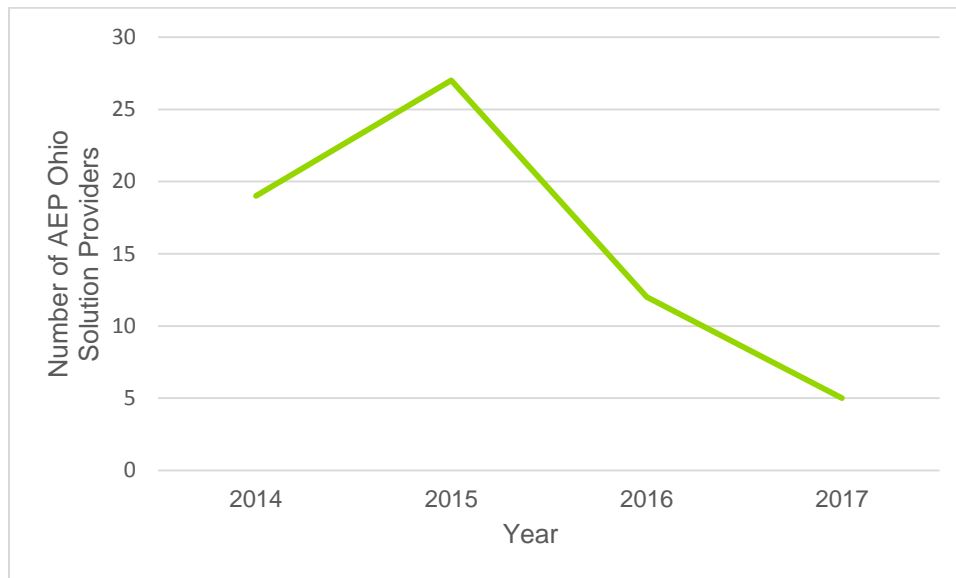
Figure 3-2. Percentage of Projects Utilizing a Solution Provider in 2017



Source: Navigant Analysis of 2017 Data Center tracking data

Figure 3-3 illustrates a continued year-over-year *reduction* in Solution Provider participation from the levels reported in 2015 and 2016, when 27 and 12 Solution Providers participated, respectively. The Solution Provider participation in 2017 is at its lowest in the last four years and is trending in a downward direction.

Figure 3-3. Historical AEP Ohio Managed Solution Provider Participation



Source: Navigant Analysis of Data Center tracking data from multiple program years

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 reviewed the Tracking Database and found the following:

- Project complete and site visit dates are the same day for all the 2017 projects. Measure install date and project complete date are also identical for seven of the eleven projects. Of the remaining four projects:
 - Two projects had their data reversed in the measure tracking data, and would otherwise have identical measure install and complete dates
 - One project was completed 212 days after measure installation, and one 352 days after
- Navigant notes it takes time to review the site visit data prior to logging the project as complete. This effort is essential to reporting accurate *ex ante* savings reflective of the as-installed measures. Therefore, the finding that the project complete and site visit dates are identical in most cases is unexpected. Navigant recommends these dates should generally not be the same day.
- Additionally, Navigant notes the site visit date is populated with a date even for projects that did not apparently receive a site visit on that date, according to the pre- and post-inspection date fields. Navigant recommends the field called “ActualVisitDate” should contain a meaningful value, such as one matching the post inspection date.
- All five of the projects receiving post inspections according to the post inspection date field, did not match the site visit date field in the tracking database, and for three of these, contained a date later than the site visit date field “ActualVisitDate”. For these three projects, the “PostInspectionPass” date was later than the actual project completion date, meaning the project

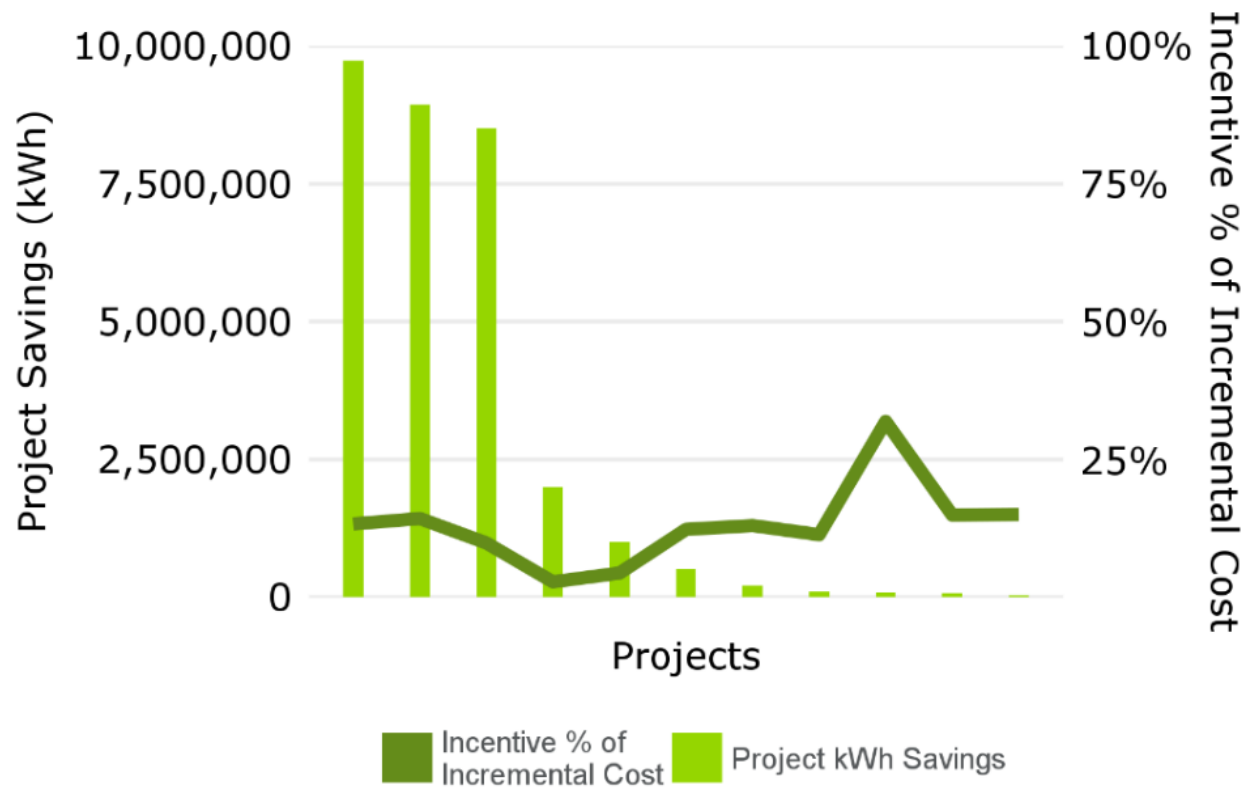
was marked complete and paid prior to passing the post inspection. Navigant recommends the tracking data should be self-consistent, and the field names should be meaningful.

- On average, Incentive Payment Date is 107 days (3.6 months) following the project complete date. Elapsed time ranges from 45 to 292 days. Actual recorded incentive payment time is significantly longer than the four to six weeks advertised to customers in the “AEP Ohio DCEE Lit”⁸ document.
- On average, projects took 101 days from application submitted to project completed. However, this includes three project applications submitted after the projects were completed (11, 57, and 166 days respectively). Removing these projects from the average increases project time to 168 days.
- All projects had data entries for application submitted, enrollment date, measure install date, project completed, site visit date, invoice date, and incentive paid date. Five of the eleven projects had an inspection passed data entry.

Incentives ranged from three to 33 percent of *ex ante* 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 electricity 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 the incentive will affect the project return on investment, the degree to which incentives affect customer project decisions is uncertain.

⁸ Five-page pdf with three Data Center customer-facing brochures.

Figure 3-4. Project *Ex Ante* kWh Savings and Incentives as a Percent of Incremental Cost (n=11)



Source: Navigant Analysis of 2017 Data Center tracking data

Projects completed under the program were divided into three broad categories: projects related to Data Center cooling, IT and power equipment, and new construction. Within each category, projects were further subdivided into the specific project types shown in

Table 3-3. In 2017, eight different Data Center measure types were installed. This is a sharp contrast with the 30 measures available to the program, and marketed to stakeholders through the 16-page “AEP Ohio Eligible Measures” document, specifying eligible measures for data centers.

As Table 3-3 shows Data Center cooling projects contribute 64 percent of 2017 Data Center projects and 89 percent of energy savings. The balance of Data Center project savings came from projects related to IT and power equipment.⁹

⁹ The three Data Center new construction projects effectively were comprised of large, comprehensive cooling measures, but also had a smaller power equipment component.

Table 3-3. 2017 Projects by Category

Measure Types	No. of Projects	kWh	Ex Ante Savings kW	Ex Ante Project Cost
Cooling Equipment Measures				
Containment and Floor Tiles	1	86,994	367.6	\$45,450
Directional Floor Tile	1	35,370	4.0	\$16,051
New RA Ductwork	1	77,413	8.8	\$35,377
Rack Level Cooling	1	509,503	49.9	\$214,838
Cooling Equipment Measures Total	4	709,280	430.3	\$311,716
IT and Power Equipment Measures				
PC Power Management	1	101,310	-	\$60,847
Server Virtualization	3	3,210,010	366.4	\$6,562,088
IT and Power Equipment Measures Total	4	3,311,320	366.4	\$6,622,935
New Construction				
Non-Residential Whole Building	3	27,159,675	3,304.5	\$43,977,721
Total:	11	31,180,275	4,101.2	\$50,912,372

Source: Navigant Analysis of 2017 Data Center tracking data

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 Account Representative direct-sales approach has been successful for AEP Ohio to meet its energy Data Center Program savings goals, Navigant continues to recommend this be supplemented with a broader outreach and communications campaign, to serve more customers and projects through increased awareness of both the program, and opportunities to reduce energy costs and energy use in Data Center operations.

3.2 Impact Evaluation Findings

This section includes a summary and discussion of the evaluation-calculated electrical energy and peak demand savings for the 2017 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 annual savings for 2017 are 27,799 MWh and 3.19 MW respectively. This result is larger than the historical *ex post* program savings (an increase of 30 percent for energy savings and 17 percent for coincident peak savings compared to 2016 levels) and greatly exceeded the 2017 goal of 16,579 MWh savings and 1.483 MW coincident demand reduction. The realization rate for energy savings was determined to be 0.89, while the demand savings realization rate was 0.78. These are the lowest realization rates since the 2014 program year; the Data Center Program typically achieves higher levels of realization rate. Overall results are shown in Table 3-4.

Table 3-4. Impact Savings, Realization Rate and Precision of Sample

Metric	2017 Program Goals* (a)	Ex Ante (b)	Ex Post (c)	Realization Rate RR = (c) / (b)	Overall Relative Precision at 90% Confidence	Percent of Goal = (c) / (a)
Annual Energy Savings (MWh)	16,579	31,180	27,799	89%	7.19%	168%
Coincident Peak Reduction (MW)	1.48	4.10	3.19	78%	11.28%	216%

Source: Navigant 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 individually followed by a discussion of lifetime savings and incremental cost data.

3.2.2.1 Energy Considerations

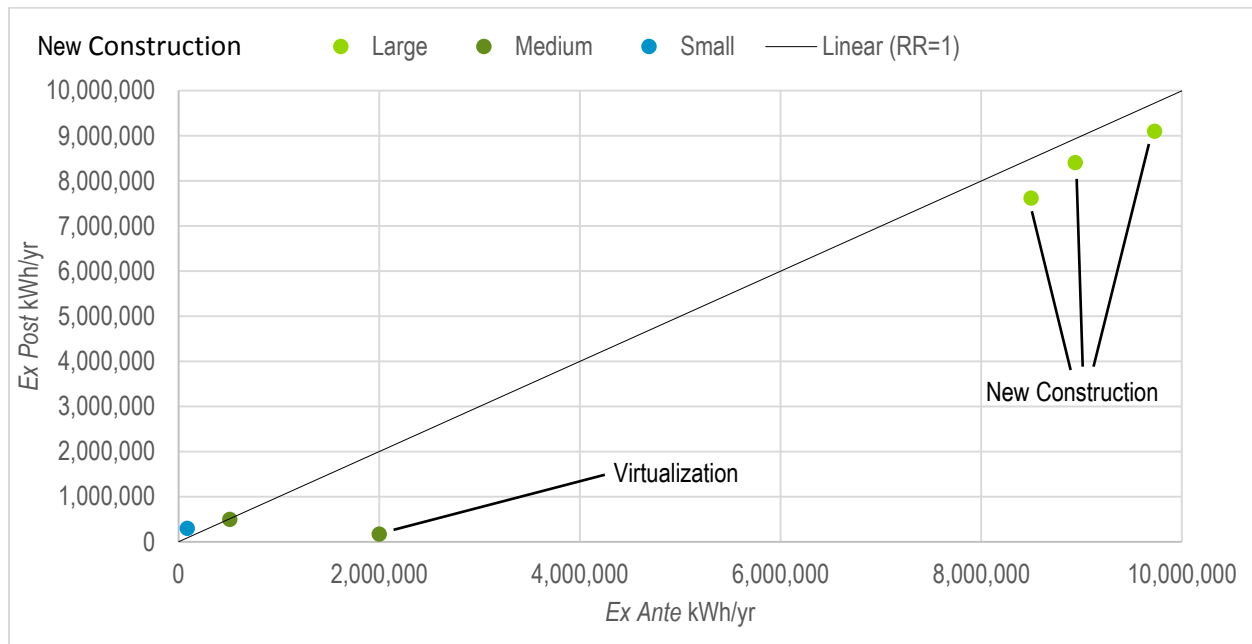
Data analysis revealed certain factors are driving the realization rate between claimed savings and verified savings. This section will discuss factors that influenced the energy realization rate and will save discussion of factors affecting the coincident demand reduction realization rate for the following section.

Six 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; one project is a server virtualization project; one project is the installation of rack coolers served by chillers in lieu of installing more computer room air conditioner units (CRAC units); and one sampled project is a hot aisle containment and new directional floor tiles project.

Figure 3-5 is a graphical representation of the sampled project level *ex ante* versus *ex post* energy savings grouped by sample strata. 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 are labeled with their respective measure types.

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



Source: Navigant analysis

3.2.2.2 New Construction Projects

A participant built three identical new data centers depicted in Figure 3-5 as “New Construction”. These projects represent phase two¹⁰ of the build out, with more phases to be built in the future. The data centers incorporate several advanced energy efficiency measures to lower the PUE and cooling energy required. 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 California (CA) Baseline document for new data centers. The implementation contractor provided a detailed analysis model to calculate savings.

Overall, the implementation contractor’s analysis of the three new construction projects was accurate with respect to the data available at the time the project completed. Navigant found an inconsequential error in the baseline energy calculation, where the baseline computer room air handler (CRAH) capacity should have been 16,800 CFM per unit, while the project files mistakenly entered 16,000 CFM. This error resulted in the number of CRAH units in the baseline to increase from 14 to 15. However, the primary driver of the realization rate adjustment is from Navigant collecting more operational data with the Data Center at a higher IT load, which affected both the baseline and actual energy profiles. Additionally, the 2017 *ex ante* energy savings subtracted the 2016 phase one *ex ante* savings, which was already

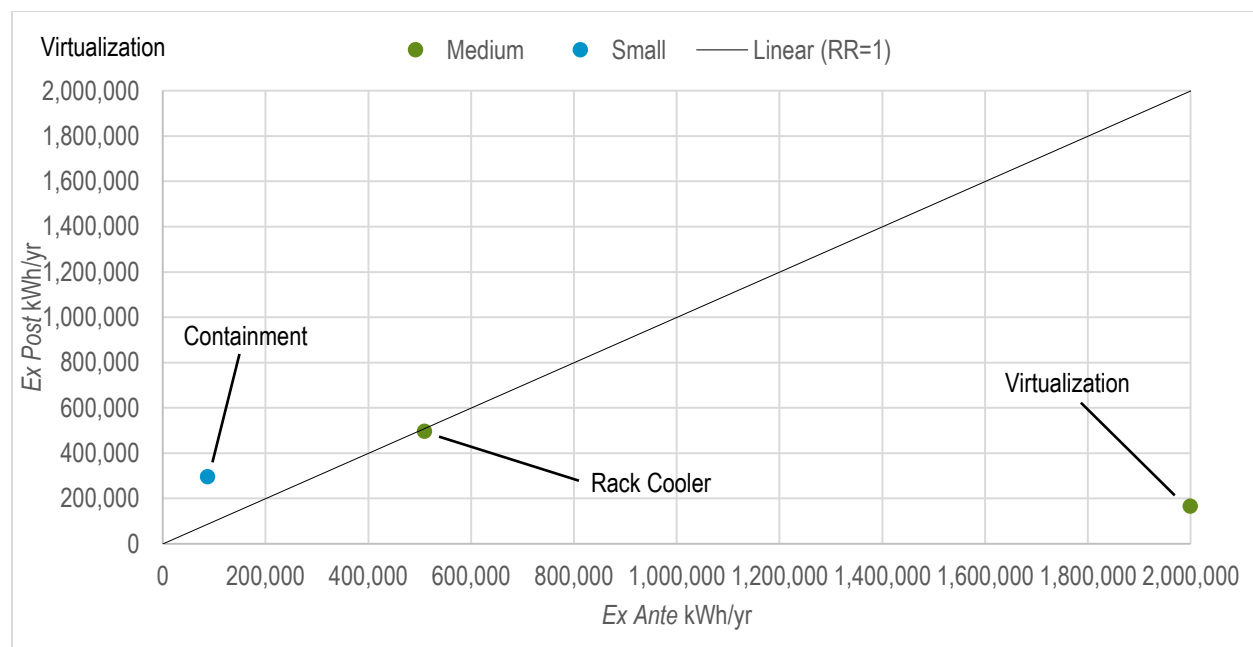
¹⁰ Phase one of the new construction project was completed in 2016 and were projects in the 2016 AEP Ohio Data Center Program. See the 2016 AEP Ohio evaluation report for further details on phase one.

accounted in the 2016 program year. The 2017 *ex post* energy savings subtracted the 2016 phase one *ex post* savings. Since the 2016 project level realization rate was 1.29, there was more 2016 *ex post* savings to subtract than there was 2016 *ex ante* savings to subtract, which reduced the 2017 *ex post* savings. Overall, while the additional data at the higher IT load increased savings, the difference in the phase one subtraction was a larger effect. The 2017 projects have realization rates of 0.94, 0.94 and 0.90 for energy savings.

3.2.2.3 Virtualization Project

Figure 3-6 presents the same information as in Figure 3-5, but with the large projects removed so detailed results can be demonstrated for medium and small projects.

Figure 3-6. *Ex Ante* vs. *Ex Post* Energy Savings without the Large Stratum



Source: Navigant analysis

The virtualization project reduced 681 various servers into 154 servers. The project's energy savings were calculated using an industry published server power consumption database intended for sizing UPS units. The *ex ante* savings calculation used a load factor of 0.7 on baseline calculations, but no direct measurements were obtained for either the baseline or post-retrofit conditions. Since *ex ante* savings totaled 15 percent of the participant's electricity bill, Navigant analyzed the project using IPMVP Option C, Whole Facility. Navigant conducted a multivariable regression analysis of utility 15-minute interval data, normalizing to date and outside dry bulb temperature. While energy consumption correlates to outside temperature, Navigant did not find any growth over time in either the 16-month baseline period or the 11-month post-retrofit period. Once Navigant adjusted for temperature, the interval data did not support the *ex ante* savings claim. As a result, the energy realization rate is 0.08.

The virtualization project also contained *ex ante* calculation errors. The direct savings from virtualization is correct if the assumed load factors are correct, however, the interactive savings were problematic. The

implementation contractor did not adequately measure the existing cooling system efficiency, and partially used ASHRAE 90.1 sensible coefficient of performance (SCOP) values. While ASHRAE 90.1 gives the energy code minimum efficiency, it is not representative of average industry standards, which generally have higher efficiencies. The project files frequently converted units from imperial units to metric and from COP to kW/ton. In the many conversions, the project files confused load kW with CRAC power kW, resulting in a substantial error.

3.2.2.4 Rack Cooler Project

To cool additional IT load, the rack cooler project utilized new rack level cooling equipment in lieu of adding additional CRAC units to the existing space. While the energy realization rate is 0.98 for this project, Navigant did adjust the *ex ante* savings. The project files correctly use ASHRAE 90.1 to calculate the baseline CRAC energy consumption, however the baseline SCOP given in ASHRAE 90.1 includes energy consumed by all ancillary equipment, including outside heat rejection units. The *ex ante* calculation did not include outside heat rejection. Navigant visited the site and metered the chillers supplying the rack coolers, resulting in a more accurate measurement of savings than the project file's spot measurements. These two effects would have resulted in a realization rate of 1.14, however the project files do not match the Data Center tracking data, with the tracking data reporting a value 16 percent higher than the project files. This error negated the additional savings Navigant had verified.

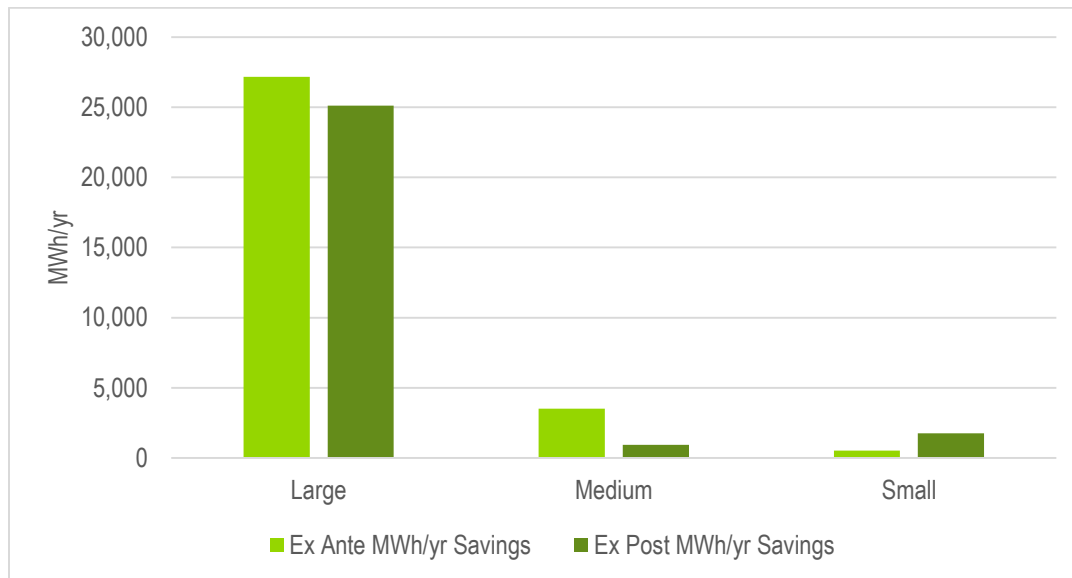
3.2.2.5 Containment Project

The containment project added hot aisle containment to its data center, allowing the participant to optimize their CRAC unit operation. The participant also installed directional floor tiles as part of the project. By replacing the floor tiles, the participant will drop the temperature at the top of the IT equipment by 4°F to 7°F, reducing energy use. Navigant identified shortcomings of the *ex ante* project files which include:

- In the "Containment Pre Calcs" tab, the cell reference for "Ave % Cooling" in "Cooling Baseline" table were shifted by one column, pointing to the wrong set of numbers.
- Similar to the virtualization project, the project files frequently converted units from imperial units to metric and from COP to kW/ton. In the many conversions, the project files confused load kW with CRAC power kW, resulting in a substantial error.
- The *ex ante* calculation did not normalize to outside air temperature and calculate relative to typical weather data.

By adjusting the energy savings calculation Navigant determined a realization rate of 3.40.

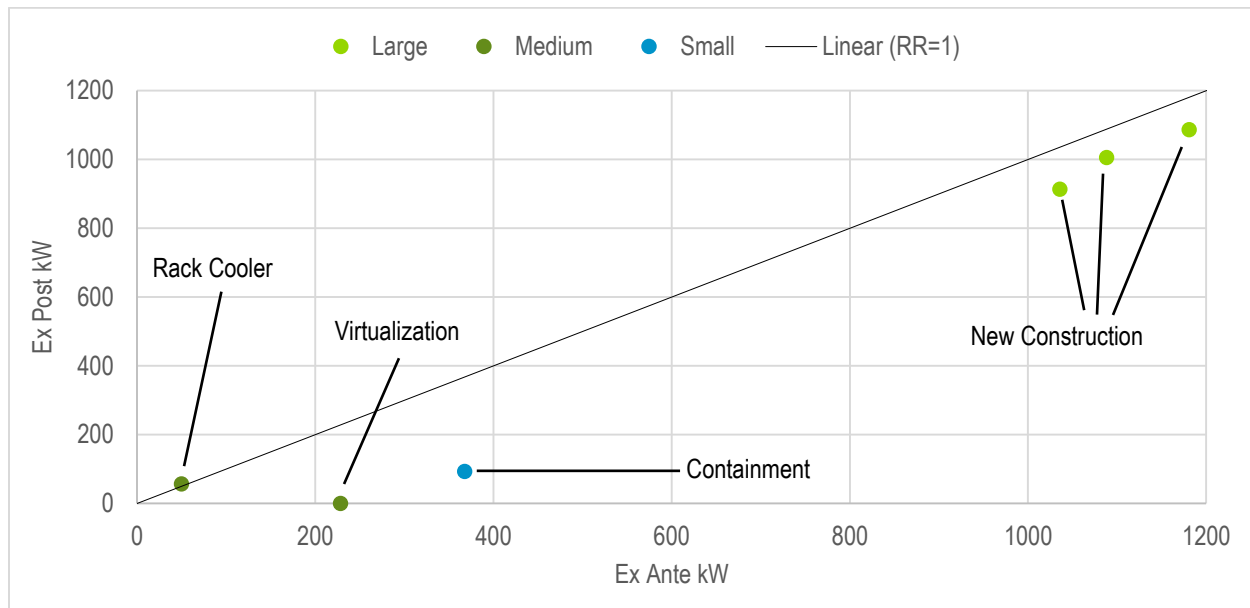
Figure 3-7 provides the *ex ante* and the *ex post* energy savings for each verification sample stratum. The realization rates for the large, medium and small strata are 0.92, 0.26 and 3.4, respectively. The large stratum had very little calculation errors and the overall realization rate is close to unity, while the medium and small strata had multiple calculation errors and realization rates far from unity. This trend indicates the implementation contractor is putting more emphasis on the large projects, however the amount of errors and large realization rate fluctuations is an area of concern in the medium stratum.

Figure 3-7. *Ex Ante* vs. *Ex Post* by Stratum


Source: Navigant analysis

3.2.2.6 Demand Considerations

Like the energy savings analysis, the discussion of coincident demand reduction is begun by analyzing Figure 3-8, which is a graphical representation of the project level *ex ante* versus *ex post* coincident demand reduction findings for the sampled projects. 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 demand realization rates above one, while those points below and to the right are projects with realization rates less than one. All sampled projects are represented in the figure.

Figure 3-8. *Ex Ante* vs. *Ex Post* Coincident Demand Reduction


Source: Navigant analysis

The three new construction projects' coincident demand values were adjusted for the same reasons the energy savings values were adjusted. Additionally, while the baseline demand reduction was calculated correctly, the efficient case used an average demand reduction for the entire year even though the *ex ante* calculation showed PUE has a temperature dependence. The *ex post* calculation looked at TMY3 data for the blend of temperatures observed during utility peak period. Navigant calculated the average PUE during peak period and used that value to determine the coincident demand. Realization rates for the three projects are 0.92, 0.92, and 0.88.

The virtualization project used the same 15-minute utility data analysis used for energy savings to calculate demand savings. No discernable demand reduction was found for typical outside air temperatures during the peak period. Thus, the demand realization rate is zero.

Unlike the energy savings for the rack cooler project, the coincident demand reduction tracking data matched the project file demand savings. Without a data entry error, the demand realization rate for this project is 1.14.

With respect to the containment project, in addition to all the findings noted in the Energy Considerations section, there are additional calculation adjustments. There is an incorrect factor of twelve multiplied to the demand reduction calculation on both the pre- and post-containment calculation. Data center energy use is generally more consistent year-round than other types of buildings, resulting in an energy to demand ratio of around 8,760 for the number of hours in a year. The hot aisle containment measure had a ratio of 192, which should have been noticed. Additionally, the *ex ante* demand reduction was the average demand reduction for the entire year, not the average demand reduction during the coincident period. As a result, the demand realization rate for this project is 0.25.

3.2.3 Effective Useful Life Considerations

The Effective Useful Life (EUL) was verified on a complete census of the completed measures. During verification Navigant noted discrepancies between the Data Center tracking data and the project files for the sampled projects on the three New Construction projects and the Containment project. Table 3-5 lists the discrepancies and the *ex post* EULs. The *ex ante* values are from the tracking data.

Table 3-5. *Ex Ante* vs. *Ex Post* Effective Useful Life

Project Description	Project File EUL	<i>Ex Ante</i> EUL	<i>Ex Post</i> EUL
New Construction	15	20	19
Virtualization and Refresh	5	5	5
Virtualization	N/A	5	5
Rack Cooler	5	5	20
Containment	15	5	15
PC Power Management	N/A	5	5
Grid Tech Refresh	N/A	10	5
Ducted Return Air Plenum	N/A	15	15
Floor Tiles	N/A	5	5

Source: AEP Ohio Data Center tracking data, AEP Ohio Data Center project files, and Navigant analysis

EUL adjustments are for the following reasons:

- The measures for the new construction projects were installed in the 2016 program year. The 20-year lifetime is reduced by one.
- The lifetime of the Rack Cooler project is driven by the lifetime of the chiller. Per previously agreed measure lifetimes between the implementation contractor and Navigant, all chillers are to have a 20-year lifetime.
- While containment measures have not been predetermined, past AEP Ohio Data Center evaluations have used a 15-year lifetime for containment projects.
- The Grid Tech Refresh project should use the same lifetime as a server refresh. That lifetime was agreed to be 5 years.

Each measure's lifetime savings is calculated by multiplying each measure's annual savings times its EUL. Data Center Program's lifetime savings is determined by summing all measure lifetimes. Data Center Program's average measure life is found by dividing the lifetime savings by the annual savings. Using this process, the program's average measure life is 18.12.

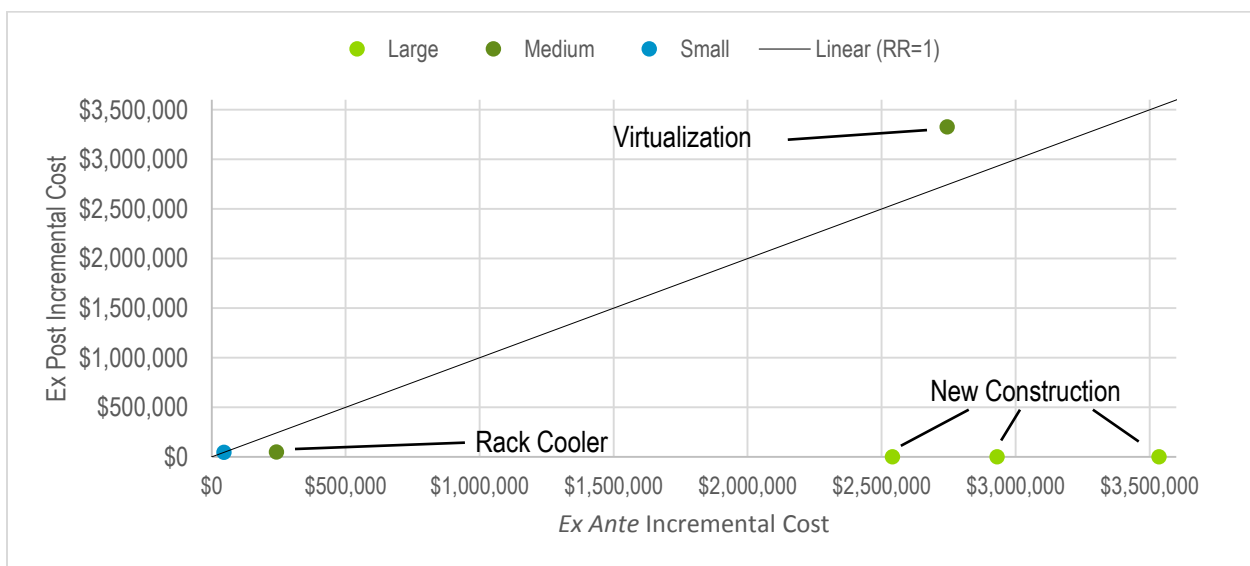
¹¹ N/A is input in projects that were not sampled as part of the impact study. They are not applicable because Navigant did not receive the project files

3.2.4 Incremental Cost Considerations

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.

Figure 3-9 is a graphical representation of the project level *ex ante* versus *ex post* project incremental cost grouped by sample stratum 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* Project Incremental Cost



Source: Navigant analysis

The virtualization project *ex ante* incremental cost is determined through server invoices, but those invoices do not account for all the servers installed. Navigant adjusted the incremental cost up to the proper number of servers installed. The incremental cost realization rate is 1.21 for this project.

The rack cooler project *ex ante* incremental cost is the material cost of the two new dedicated chillers and associated rack cooling equipment. If the participant had not installed the rack coolers, it would have had to install additional cooling capacity to maintain temperature on the new IT equipment. Therefore, Navigant subtracted the cost of baseline air-cooled CRAC units. The incremental cost realization rate is 0.20.

The cost analysis for the three new construction projects is very similar between the three projects since these are essentially identical projects conducted by the same participant. The project cost includes the

cost of a baseline UPS, a comprehensive cooling system as described by the CA baseline code, baseline commissioning, and baseline controls and monitoring. Subtracted from the project cost is the actual construction cost of the installed UPS, the installed cooling system, actual commissioning costs and the cost of the installed controls and monitoring.

Navigant focused on the claimed added cost for commissioning and controls and monitoring, which exceeded the project level claimed cost. During a telephone interview with the participant, Navigant asked if the installed system had caused the participant to install more robust controls or monitoring systems, or if there was more commissioning involved as compared to a traditional chilled water system with CRAH units. The participant indicated there were no changes in controls or monitoring compared to a traditional system, and further, there was “probably less commissioning” required since the installed system was simpler than a traditional baseline system. Navigant concluded that both the installed cost for controls and monitoring as well as the installed cost of commissioning is a baseline cost, i.e., zero incremental cost for these items. Subtracting out the influence of these items in the overall cost analysis results in incremental savings, i.e., a negative cost. However, Navigant is not convinced all costs were covered in the analysis, as a result, Navigant assigned an incremental cost of zero for all three projects.

3.3 Process Evaluation Findings

The process evaluation review found the program has been successful in meeting its 2017 energy savings goals. This success is tempered somewhat by the limited number of participating customers and Solution Providers in the program. The program is not broadening the range of participating customers, or meeting the ancillary goal of making the program available to data centers of different sizes. The evaluation determined the number of Solution Providers, completed projects, measures, and unique customers have all decreased in comparison to the previous years as illustrated in Table 3-6.

Table 3-6. Historical Participation Metrics

Metric	2014	2015	2016	2017
Projects	36	46	40	11
Unique Customers	23	32	15	8
Measures	53	62	42	15
Solution Providers	19	27	12	5

Source: AEP Ohio Data Center tracking data

Consistent with 2016, the evaluation finds the Data Center Program goals of 16.58 GWh in energy savings and 1.48 MW of demand savings was exceeded through the contribution of three very large projects from a single participant, totaling 27.16 GWh and 3.3 MW savings (*ex ante*). Additionally, the quantity of completed 2017 measures continues to be 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 provided in each of the following subsections.

To increase participation from smaller customers and projects, the Data Center Program adjusted the 2017 program year incentive structure, reducing incentive amounts of very large projects. The change, intended to increase available incentive funding for smaller projects, reduced the incentive per/kWh

savings amount from \$0.07 to \$0.035 for incentive amounts exceeding \$120,000. Based on the continued dominance of program activity by just three very large projects, the program is planning to reduce the \$0.07 incentive cap to \$100,000 for program year 2018. Table 3-7 illustrates the program year 2017 change, and the anticipated program year 2018 change.

Table 3-7. Data Center Program Incentive Changes

Measure Type	2016 All Projects	2017 ≤ \$120,000	2017 > \$120,000	2018 ≤ \$100,000	2018 > \$100,000
Virtualization	\$0.06	\$0.06	\$0.03	\$0.06	\$0.03
Non-Virtualization	\$0.07	\$0.07	\$0.035	\$0.07	\$0.035

Source: Navigant interview with Data Center Program Manager

The evaluation did not identify changes in Data Center Program outreach or marketing to encourage participation or awareness across smaller projects, customers, or Solution Providers.

The 2017 Data Center Program process evaluation included detailed interviews with AEP Ohio program and marketing managers; and the implementation contractor. Additionally, Navigant interviewed the outreach implementer staff, in their role as overall outreach coordinator and manager of the central application inbox for the majority of AEP Ohio's business sector programs. Program tracking databases were analyzed to identify implementation trends and data quality. No participant surveys were conducted for the 2017 process evaluation.

The remainder of this section presents these findings in more detail, including:

- Marketing Efforts and Program Awareness
- Program Requirements
- Barriers to Participation
- Customer Enrollment Process
- Incentive Payment Process
- Program Tracking Data Review
- Verification and Due Diligence

3.3.1 Marketing Efforts and Program Awareness

Due to the unique needs of data centers, their specialized technologies and Data Center Program staff, AEP Ohio has identified a need to approach this market with an equally specialized market approach. To fill this need, a specific program to serve the unique needs of data centers 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 as 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's site may not actually be an AEP Ohio customer.

3.3.1.1 Solution Providers

Outreach in recent years has focused on direct contact activities conducted by AEP Ohio Account Representatives. The tracking data suggest virtually all 2017 participants learned of the Data Center Program through their Account Representatives. According to the tracking data, there were no 2017 projects referred from a customer's contractor, or an AEP Ohio Solution Provider.

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. Although the implementation contractor indicates weekly meetings are occurring with Solution Providers, we see no evidence of this effort as illustrated in the significant drop in projects, measures, and Solution Provider participation shown in Table 3-6.

Despite the unique nature of Data Center technologies and customer staff, most Data Center Program Solution Provider management occurs through the cross-cutting AEP Ohio Solution Provider initiative. The program relies on the cross-cutting annual Solution Provider meeting, newsletters, alerts and communications to encourage identification and prioritization of Data Center projects. Communications are not targeted to the Data Center professional contractors who are closest to the data centers and managers of AEP Ohio's customers. Data Center Program Solution Providers are not compensated for their participation in the program, or project referrals.

In and of themselves, regular meetings, newsletters, alerts and formal communications are excellent methods to engage Solution Providers. However, these should be viewed as single tactics within a larger, comprehensive strategy of Solution Provider engagement and management. For the Data Center Program, this strategy should be tailored to meet the needs of Data Center professionals, and the unique technologies, projects, and customer Data Center staff managers.

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 customer participation and project 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.

Consistent with 2016, the decrease in 2017 program participation (quantity of projects, unique customers, measures, and Solution Providers) contrasts with previous 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.

From the Solution Providers interviewed as part of the 2015 evaluation, each enrolled at least one project in the program, and 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 all of 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 effort be supplemented with a broader outreach and communications campaign, to build awareness of the program and opportunities to reduce energy use in Data Center operations.

3.3.1.2 Program Material

Navigant reviewed program materials provided by AEP Ohio including program management documentation, such as procedure manuals and the database dictionary; and customer-facing documents, including the application forms and promotional materials. A summary of documents reviewed is provided in

Table 3-8.

Table 3-8. Summary of 2017 Data Center Program Materials

Document	Description
2018 AEP Ohio Data Center Program Application	10-page application, external facing
AEP Ohio Eligible Measures	16-page Data Center Program measure specifications, external facing
AEP Ohio DCEE Lit	6-page Data Center Program overview, external facing
AEP Ohio DCE Manual	4-page Data Center project manual, internal facing; focused on check request procedures
PM Measure File Checklist	9-page Data Center Program database dictionary, internal facing
Audit - XXXX 10312016	56-page, customer specific ASHRAE Level II facility Data Center audit (9/30/2016)

Source: AEP Ohio

Program materials provide an inconsistent message regarding pre-application requirements, and in some cases, encourage application after project completion. Program staff express a goal to require project pre-applications, in part to manage program budget, but also to review project plans with a goal of identifying additional opportunities to diversify the measure mix. Pre-applications have the potential to deliver enhanced customer service to participants, including confirmation of energy savings estimates, identification of additional energy saving opportunities, and validation of contractor recommendations.

- **2017_AEPOhio_Data Center Program_Application:** Page 3 of the application form states “Submitting a Pre-Approval Application to determine qualification and reserve program funds for a project is required”. This statement is contradicted on the next page of the same form, which provides instructions to submit the application either with, or without, the pre-approval step.
- **AEP Ohio DCEE Lit:**

- Page 1 references “*Generous Incentives: Every type, any stage,*” and “*Whether your Data Center is on the drawing board, in the process of being built, or up to 6-months past completion, our incentives cover up to 50% of project costs...*”
- Page 3 and page 5 both define customer eligibility as: “Project applications must be received within 180 days of project completion.” There is no mention of pre-application, or the benefits the pre-application could bring the customer.
- Contradicting customer eligibility information appears on the same pages (3 and 5). Post installation savings verification is described as: “The final application must be submitted within 30 days of project completion.”

The “AEP Ohio Eligible Measures” document provides Data Center measure specification for 30 measures. Other than appearing to be an external facing document, the target audience is unclear. The measures are not prioritized for customers or Solution Providers, and the descriptions do not summarize why a customer should implement any of the measures over another. The measures are not provided with benefit descriptions, and typical savings are not provided. While the measures include exhaustive M&V requirements, the 30 measures listed over 16 pages are not presented in an order to easily navigate (there is no table of contents; measures are not listed alphabetically). The measures do not include product level specifications (i.e., efficiency rating requirements). The measure titles listed on the AEP Ohio Eligible Measures document are not consistent with the measures listed in the AEP Ohio DCEE Lit document.

Table 3-9 compares the measures listed in both documents, and where there are overlaps and omissions between the two documents.

Table 3-9. Comparison of Measure Terminology Between Documents

AEP Ohio Eligible Measures	AEP Ohio DCEE Lit (p.4)
Chiller Measures	
Chiller Sequencing	Chiller Replacements or Optimization
Chilled Water and Condenser Water Temperature Resets	
VFD's for Chillers	
Cooling Tower Measures	Cooling Tower Replacements or Optimization
Compressor Measures	Compressor Replacements or Optimization
Condenser Measures	Condenser Replacements or Optimization
Pump Measures	Pump Replacements or Optimization
Motor Horse Power Reduction	Motor Horse Power Reduction
Evaporative Coolers Measures	Evaporative Coolers
Air Side Economizer Measures	Air Side Economizers
VFD's for Chilled Water Pumps	VFD's for Pumps
VFD's for Condenser Water Pumps	
Fan Measures	VFDs for Supply Fan Motors
VFD's for Supply Fan Motors	
Electronically Commutated Motors (ECM) for Fans	Electronically Commutated Motors (ECM) for Fans
Wired or Wireless Sensors	Wired or Wireless Sensors
Control System Integration	Control System Integration
Airflow Management Measures	Airflow Management Measures
In-Rack or In-Row Cooling Equipment	In-Rack or In-Row Cooling Equipment
Uninterruptible Power Supply	Uninterruptible Power Supply
Power Distribution Unit	Power Distribution Unit
Generator Block Heater Pump	Generator Block Heater Pump
<i>No reference</i>	Server Virtualization
<i>No reference</i>	Server Refresh
<i>No reference</i>	Mainframe Consolidation
<i>No reference</i>	Storage Consolidation
<i>No reference</i>	Storage Refresh
<i>No reference</i>	Efficient IT Growth
<i>No reference</i>	Data Center Relocation
Water-Side Economizer Measures	<i>No reference</i>
Humidification Equipment Measures	<i>No reference</i>
VFD's for Return Fan Motors	<i>No reference</i>
Server and Storage Optimization	<i>No reference</i>
Decommissioning / Consolidation / Relocation	<i>No reference</i>
Air Side Reset Strategies	<i>No reference</i>

Source: Navigant analysis

Customer-facing documents do not illustrate the financial benefits of making energy efficiency investments in their data centers. The AEP Ohio DCEE Lit document includes case study examples with customer project costs and AEP Ohio incentives in dollars. However, project savings are shown in kWh, and there is no discussion of measure lifetimes. Similarly, the Audit - XXXX 10312016 document illustrates measure opportunities with only a simple pay back analysis, which does not take into consideration measure lifetimes or return on investment. To encourage businesses to make financial investment decision to reduce energy costs, case study examples should represent savings in dollars, and include the return on investment (ROI) based on measure lifetime.

The Audit - XXXX 10312016 document illustrates the Data Center Program's effort to provide enhanced customer service. The ASHRAE Level II Audit described is a detailed analysis of retrofit opportunities within a customers' data center. Navigant notes of the five measures identified, none were IT specific; rather these were all lighting or data center cooling measures. None of the identified measures met program payback criteria for incentives. Because of this, next steps for the customers' engagement with the Data Center Program are ambiguous, creating a lost opportunity to generate savings or garner customer goodwill from AEP Ohio's investment in project analysis.

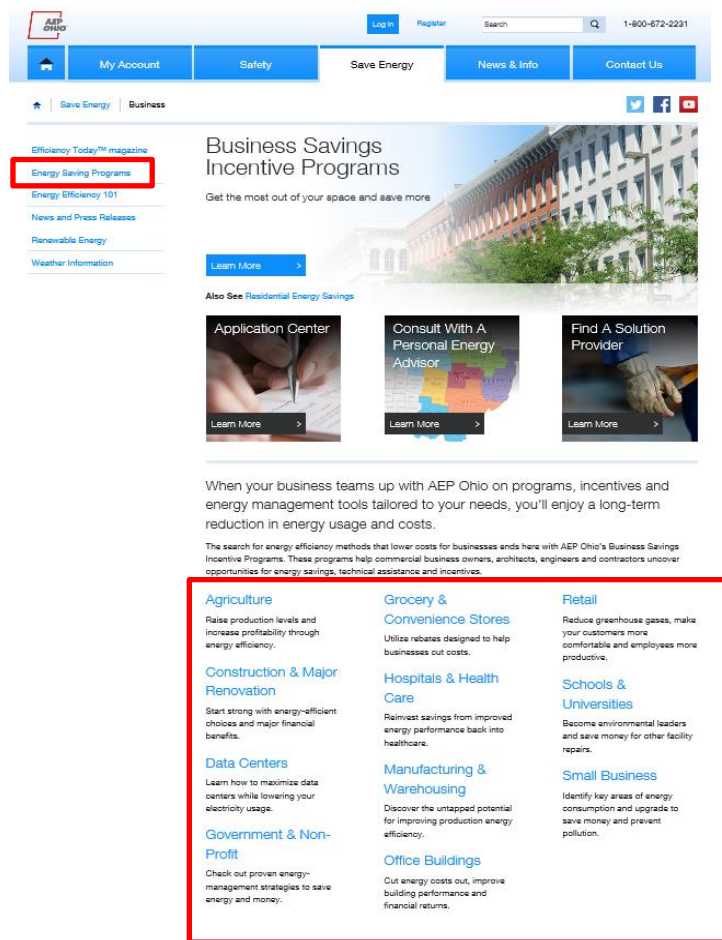
3.3.1.3 Program Website

AEP Ohio Account Representatives are the primary customer outreach mechanism for current Data Center Program projects. Program staff indicate one of the roles Account Managers and Energy Advisors play is assisting customers to identify which program best suits their needs, and with completing the program application forms. This is consistent across AEP Ohio's programs serving large commercial customers.

Figure 3-10. Business Savings Incentive Programs

Conversely, the overall marketing objective for AEP Ohio's portfolio of commercial programs is to drive customers to the AEP Ohio website. This objective conflicts with a cross-cutting finding for AEP Ohio's commercial programs: there is no overarching tool or document on the website to guide customers to the best program to meet their needs. Additionally, commercial program web pages are difficult to find (requiring 5-6 clicks through residential program pages). The ramifications for the Data Center Program is customers may not be aware of the program, or when it may be appropriate for them.

From the AEP Ohio home page, it takes three clicks to access the 'Business Savings Incentive Programs' page.¹² Two of these three steps take the customer through residential pages: 'Save Energy' (residential), 'Rebates and Programs' (residential), and finally, 'Business'. On the Business page, customers seeking information about energy efficiency opportunities have two broad options: self-select a market type most closely aligned with their business, or select 'Energy Saving Programs' from the side bar menu as shown in Figure 3-10.



Source: AEP Ohio website

1. **Market Type:** Customers self-selecting a market type have the option to choose 'data center'. However, most customers eligible for Data Center Program services likely view their business primarily as one of the other categories first. Non-Data Center market options take customers to a summary page discussing efficiency options for their selected business type, offering two next steps options: (1) contact a Solution Provider or (2) link to the 22-page pdf application for Efficient Products for Business, Process Efficiency, and Self-Direct.

These market pages are unlikely to drive Data Center projects: Solution Providers, as previously discussed, are not a prioritized outreach mechanism for the Data Center Program (none of the 2017 projects were sourced by a Solution Provider). The 22-page application form is only for the three programs referenced, and does not reference the Data Center Program.

Limited program information is available on the Data Center market page¹³. There is a link to one of the two-page program brochures (pdf), and a link to the Data Center application form. For

¹² <https://aepohio.com/save/business/>

¹³ <https://aepohio.com/save/business/programs/DataCenters.aspx>

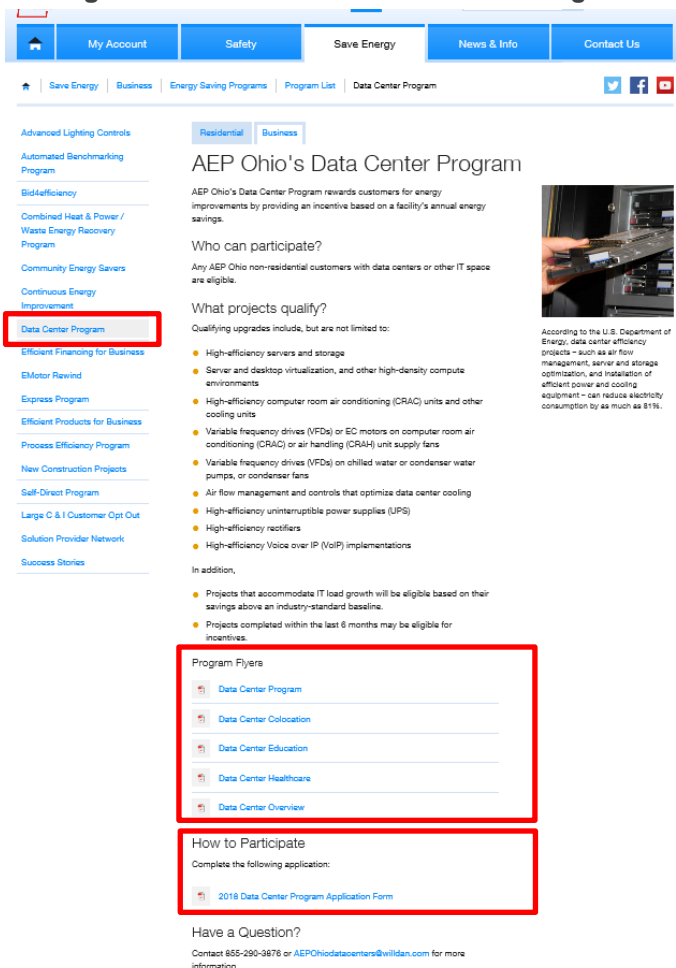
customers needing more information, this page suggests contacting a Solution Provider (again, not a prioritized outreach method for the Data Center Program).

2. **Energy Savings Programs:** Customers choosing this option from the “Business Savings Solutions Page”¹⁴ are brought to the “Energy Savings Programs”¹⁵ page, where the same list of market types is displayed in a list format. The side-bar menu changes slightly on this page, offering customers a choice of “Program List”

Clicking “Program List”, customers are presented with the “Efficient Products for Business” page¹⁶ describing details of that program. The side-bar menu has changed again, now presenting a list of 17 program options to choose from (although not all are programs: “Solution Providers” and “Success Stories” are included in this list). Customers are not offered an explanation for how to choose which program may best serve their needs.

Customers seeking Data Center measures may select “Data Center”, linking to “AEP Ohio’s Data Center Program” web page¹⁷ shown in Figure 3-11. This page offers additional detail about the program, lists energy efficiency opportunities, and links to five different educational brochure pdfs’. The web page does not promote one of the key program benefits: technical assistance to identify opportunities and complete the application form. Customers interested in participating are instructed to complete the program application. If customers have questions, they are directed to the implementation contractor:
AEPOhiodatacenters@willdan.com.

Figure 3-11. AEP Ohio’s Data Center Program



Source: AEP Ohio website

In summary, where one of the key objectives in raising awareness of AEP Ohio’s commercial programs is to drive customers to the website, the website does not promote Data Center projects as a possibility for many customers. There is no overarching presentation of how customers should choose which AEP Ohio program service might best meet their needs, or description of the services provided by Energy Advisors to assist customers identify and prioritize their opportunities. For customers specifically seeking Data Center information, it can take six clicks reach the Data Center Program page, as illustrated in Table 3-10.

¹⁴ <https://aepohio.com/save/business/>

¹⁵ <https://aepohio.com/save/business/programs/>

¹⁶ <https://aepohio.com/save/business/programs/PrescriptiveProgram.aspx>

¹⁷ <https://aepohio.com/save/business/programs/DataCenterProgram.aspx>

Table 3-10. Steps to Reach Data Center Program web page

Action	Landing Page
Go to AEP Ohio Home Page	https://www.aepohio.com/
Click "Save Energy"	https://www.aepohio.com/save/residential/ "Rebates & Savings Programs" (NOTE: This is a <i>residential</i> page)
Click "Rebates and Savings Programs"	https://www.aepohio.com/save/residential/programs/ "Incentive Programs For Residents"
Click "Business"	https://www.aepohio.com/save/business/ Business Savings Incentive Programs
Click "Energy Savings Programs"	https://www.aepohio.com/save/business/programs/ Energy Saving Programs
Click "Program List"	https://www.aepohio.com/save/business/programs/PrescriptiveProgram.aspx Efficient Products for Business
Click "Data Center Program"	https://www.aepohio.com/save/business/programs/DataCenterProgram.aspx AEP Ohio's Data Center Program

Source: Navigant analysis

3.3.2 Program Requirements

In 2017, the only substantive change made to the Data Center Program was in requiring project pre-application, allowing program technical staff the opportunity to recommend additional measures. The tracking database shows three project applications were submitted between one week and five months after project completion. An additional project application was submitted just 11 days before project completion, suggesting the program goals of incorporating additional measures was not relevant. The evaluation team observes applications for all 2017 projects were received on or before mid-August 2017, therefore, the 2016 evaluation recommendations were not yet implemented.

Program staff indicated some customers are challenged to meet program requirements, including projects rejected because these did not meet payback requirements (one- to seven-year payback). The program tracking database only includes completed projects; rejected projects are not included. As a result, the evaluation team has not assessed the number of projects rejected or reasons for rejection. Including rejected applicants in the database would provide the Program Manager's perspective into how customers and projects are managed through the entire project process, and identify points for the program to improve communications and services to reduce customer rejection.

Staff also indicate some customers are unaware of the incentive cap at 50 percent of incremental project costs. While hitting this cap would not reject an application, it has the potential to harm AEP Ohio's relationship with those customers, and act as a disincentive to further participation.

As discussed previously, program awareness may be a significant barrier to project enrollment. With the program achieving its goals from just three very large projects, program managers are not motivated to reach out to smaller size customers. While this barrier may not be critical to AEP Ohio given the program's overall success with very large projects, this strategy leaves the program at risk of not achieving goal if one of those large projects fails to complete. A strategy to engage more diversified project sizes will mitigate some of the program risk of relying on a small number of large projects.

3.3.3 Barriers to Participation

Customer time to manage energy efficiency projects is a key project implementation barrier identified by program staff. Staff recognize most business customers do not have staff to actively manage the range of energy efficiency projects defined by AEP Ohio. These activities include identifying and prioritizing energy efficiency opportunities, developing scope of work, managing contractor bids and managing the actual project installation (including any business disruptions during installation). None of these activities includes determining which AEP Ohio program may best serve the customer's needs, completing the application form, or submitting required documentation to receive their incentive.

The Data Center Program recognizes these barriers, and offers technical assistance to customers to overcome these barriers. Implementation staff view these services as key to the program's success, and report participating customers appreciate these services. However, program services are not promoted through the program materials; customers will only learn of the services available to overcome key implementation barriers after engaging with the 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.

Navigant found no significant issues with the enrollment and approval process. In part, this reflects the fact that program staff provide considerable technical support to participants in completing program applications and supporting 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 project may be freed up.

The average elapsed time between the project completion and issuing the incentive is 107 days, or three and a half months. This time period seems quite long, however, there is no indication in the tracking database when the program received the complete set of project information required to pay the incentive, including any required metering. While the elapsed time is improved over 2016's average of

139 days, the time is still significantly more than the suggested four to six weeks listed on the program documentation between project completion and incentive payment.

Navigant recommends adding new data fields to the database to differentiate between when the application and all required information has been completed from the inspection, and when the project is approved for payment. This functionality will allow actual incentive payment processing time to 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. This may be accomplished by adding or otherwise clarifying 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 previously discussed, the tracking data does not include a field to indicate when all the project information required to approve the application has been received.

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. A tracking data recommendation for clarifying project completion date to more accurately monitor the time between completion and incentive payment was made in the previous Incentive Payment section.

Program tracking data is maintained by the implementation contractor and shared securely with AEP Ohio via a secure FTP. Navigant's 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.

All 2017 projects included complete data for analysis of key dates including: Application Submitted, Enrollment Date, Measure Install Date, Project Completed, Site Visit Date, Invoice Date, and Incentive Paid. The evaluation team notes some fields were not fully populated for all applications. Fields with incomplete data include Pre-Application Submittal Date, Account Representative, Segment, and Base Measure Attributes 2. While the lack of a pre-application submittal date would appear to indicate a pre-application was not collected, a blank is not definitive, as it is possible a pre-application was conducted, but not entered in the data base.

Analysis revealed multiple project steps where project processing took longer than the four to six weeks indicated on marketing materials between project completed and incentive payment. The evaluation team made the following observations:

- Application Submitted and Enrollment date were identical.
- Measure Installation Date and Project Completed date were identical for seven of the projects. Of the remaining four projects:
 - One is reported as Project Completed 90 days before Measure Installed.
 - One is reported as Project Completed 90 days after Measures Installed, two were Project Completed over seven months after Measures Installed (7 months and 12 months).
- Project Completed and Site Visit Date are identical for all projects.
- Time elapsed between Site Visit Date and Invoice Date averaged 71 days. Four projects exceeded six weeks, with the longest at seven and a half months.

- Time elapsed between Project Completed and Incentive Paid averaged 107 days. The shortest elapsed time was 45 days, the longest was 292 days, or almost 10 months.

Navigant recommends adding new data fields to the database to differentiate between when the application and all required information has been completed from the inspection, and when the project is approved for payment. This functionality will allow actual incentive payment processing time to 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. This may be accomplished by adding or otherwise clarifying 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.

The evaluation team found inconsistencies between the tracking data and the project files. Table 3-11 summarizes the inconsistencies for the sampled projects where Navigant had project files to inspect. The Total Incentive field in the tracking data appears to be consistent with initial estimates of project incentives, since that field matches the reservation letter given in the New Construction project files. The Project Incentive field in the tracking data appears to be the final incentive given in the tracking data, as it matches in most cases both the incentive rate times the energy savings and the reserved incentive in the project files. In the case of the virtualization project, the Project Incentive in the tracking data did not match the \$119,959 in the reserved incentive. \$119,959 is the correct incentive when multiplying the *ex ante* savings of 1,999,317 kWh times the \$0.06/kWh incentive rate for virtualization projects. The evaluation team notes one of the sampled projects included a scanned copy of the incentive check in the project files.

Table 3-11. Incentives in Tracking Data vs. Project Files for Sampled Projects

Project Description	Tracking Total Incentive	Tracking Project Incentive	Project Reservation Letter	Project Reserved Incentive	Project Scanned Check
New Construction 1	\$420,780	\$372,757	\$420,780	\$372,757	None
New Construction 2	\$420,780	\$400,429	\$420,780	\$400,430	None
New Construction 3	\$420,780	\$357,401	\$420,780	\$357,402	None
Virtualization	\$249,915	\$78,482	None	\$119,959	None
Rack Cooler	\$30,570	\$30,570	None	\$30,570	\$30,570
Containment	\$6,090	\$6,090	None	\$6,090	None

Source: Ohio Data Center tracking data and AEP Ohio Data Center project files

Four of the remaining five projects not sampled have a sensible incentive in the Project Incentive field. These were the correct product of energy savings multiplied by the incentive rate, \$0.07/kWh, except for virtualization projects, which have a rate of \$0.06/kWh. One project was described as a, "Server virtualization and grid refresh." Assuming there was non-zero energy savings from the virtualization, the incentive rate for this measure should have been \$0.06/kWh, but the project was fully incentivized at \$0.07/kWh.

In the measures tracking data, there is only one row for each project, which would indicate all the projects only had one measure. Some projects had multiple measures, like the containment project, which had a hot-aisle containment measure and a new floor tile measure. In the project files, measures are listed separately in the implementer Summary tab of the final calculations worksheet. These measures should be listed separately in the measures tracking database as well.

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.

In addition to the incentive inconsistencies noted in the previous section, the evaluation team notes the three large new construction projects were all updates of program year 2016 Data Center projects that have already reached the incentive threshold for the lower incentive rate of \$0.035/kWh. These projects should have been given an incentive of \$0.035/kWh for the entirety of their 2017 savings and not \$0.07/kWh for the first \$120,000.

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. Administrative procedures are in place to ensure information submitted to the program is processed and recorded in the project tracking database.

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 analysis and 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 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 cooling systems for data centers.

From past discussions with the implementation contractor, Navigant understands 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.

No significant disputes were reported to have occurred during 2017. 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 Data Center Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-12 summarizes the unique inputs used in the TRC test.

Table 3-12. Inputs to Cost-Effectiveness Model for the AEP Ohio Data Center Program

Item	Input
Measure Life	18
Projects	11
Ex Post Annual Energy Savings (kWh)	27,799,482
Ex Post Coincident Peak Savings (kW)	3,189
Third Party Implementation Costs	\$820,966
Utility Administration Costs	\$191,510
Utility Incentive Costs	\$1,376,962
Incremental Participant Cost	\$5,084,461

Source: Navigant review of AEP Ohio cost effectiveness model

Based on these inputs, the TRC ratio is 3.1 and the Data Center Program passes the TRC test. Table 3-13 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 3-13. Cost Effectiveness Results for the Data Center Program

Test Results for Data Center Program	Benefit/Cost Ratio
Total Resource Cost	3.1
Participant Cost Test	4.7
Ratepayer Impact Measure	0.8
Utility Cost Test	7.9

Source: Navigant review of AEP Ohio cost effectiveness model

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 2017 Data Center 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.

Impact Finding 1: When analyzing Data Center realization rates (RR) by strata, large projects have better RR and less observable errors. The medium-sized projects contain too many verification correction points.

Impact Recommendation 1a: Continue the thorough review process present on the largest projects.

Impact Recommendation 1b: Apply some of the best practices used on the largest projects to the medium-sized projects so that less errors occur.

Impact Finding 2: One of the sampled projects had project files that did not match the tracking data on energy savings. While the project files appear to be complete indicating the tracking data is incorrect, it is also possible new information was available that updated the savings and the project file was not the latest. Additionally, multiple sampled projects had discrepancies between the project file effective useful life (EUL) and the tracking data EUL.

Impact Recommendation 2: Add a final quality check to all completed projects to indicate the most up to date project file is uploaded and that energy savings, coincident demand reduction, effective useful lifetime, and incremental cost agrees between the project file and the tracking data.

Impact Finding 3: There is a virtualization project, with nearly two GWh of *ex ante* savings, where no direct measurements were obtained for either the baseline or post-retrofit conditions. Even though savings were estimated to be nearly 15 percent of the participant's utility bill, no billing analysis was conducted.

Impact Recommendation 3a: For measures with more than 500 MWh in savings, make every effort to obtain critical savings measurements prior to issuing an incentive. Load factor on servers is one example of a critical measurement as it has a direct impact on savings.

Impact Recommendation 3b: For IT measures exceeding 500 MWh in savings where critical savings measurements are not possible, log power use through the PDU or UPS to compare baseline consumption to post-retrofit consumption. Normalize for any load growth. Collect at least two to four weeks of post-retrofit data before closing the project.

Impact Recommendation 3c: For measures with more than 500 MWh in savings, where critical savings measurements are not possible, isolation through the PDU or UPS is not possible, and savings at the project level is greater than five percent of the utility bill, conduct a billing analysis using 15-minute interval data comparing the baseline to the post-retrofit condition. Conduct interviews of the participant detailing energy changing modifications happening at the site outside of the energy efficiency project and quantify such modifications. Normalize data for outside weather conditions, load

growth, and any other independent variable affecting savings. Collect at least one month of post-retrofit data before closing the project and paying any incentive.

Impact Recommendation 3d: Any project whose *ex ante* savings exceeds ten percent of the utility bill should analyze billing data comparing baseline to the post-retrofit. If the billing analysis does not confirm the project savings, investigate the reasons. Any project with more than one GWh in savings with less than ten GWh of annual electricity use should reserve and not release incentives until one month of post-retrofit billing data can be analyzed.

Impact Finding 4: Two of the sampled projects frequently converted from imperial to metric units and from COP efficiency to kW/ton efficiency. In the many conversions, the project files confused load kW with cooling system power kW, resulting in substantial errors.

Impact Recommendation 4a: Keep custom engineering calculations as simple and straightforward as possible. Do not make several layers of conversions when one conversion will do.

Impact Recommendation 4b: Cooling load at data centers is calculated by determining the power delivered to the UPS or the power delivered to the IT equipment. The cooling load is in units of kW. Since the power driving the cooling equipment is also in kW, COP or SCOP is a convenient efficiency factor where one simply measures the power delivered to the UPS or IT equipment in kW and then divides that number by the measured power to the cooling system in kW to determine the COP. There is no need to convert the cooling load to tons, and no need to express the efficiency in terms of kW/ton.

Impact Finding 5: ASHRAE 90.1 Table 6.8.1 K – Air Conditioners and Condensing Units Serving Computers Rooms lists SCOP baseline values for CRAC units using test procedure ANSI/ASHRAE 127, which requires all ancillary equipment including outside heat rejection equipment to be measured. When the implementation contractor used these SCOP values, it did not account for outside condensing unit power or any pumping power that may be required.

Impact Recommendation 5: When using ASHRAE 90.1 Table 6.8.1 K, make sure to account for all associated energy consuming equipment.

Impact Finding 6: One smaller project did not normalize cooling system performance to weather data and instead took a simple average of logged performance. On larger projects, this is customarily weather normalized.

Impact Recommendation 6: When using logged data that is temperature dependent, always perform a regression analysis of the performance relative to weather, regardless of the project size. Compute savings relative to normal weather using TMY3 data.

Impact Finding 7: Projects with direct IT savings also calculate interactive effects with the cooling system. When the existing cooling system performance is unknown, the implementation contractor assumes ASHRAE 90.1 Table 6.8.1 K SCOP values for the system performance. These SCOP values represent a minimum allowable efficiency per the ASHRAE 90.1 energy code. Typical cooling system performance generally exceeds the ASHRAE 90.1 values, especially at larger data centers, therefore, the *ex ante* interactive effects are unrealistically high.

Impact Recommendation 7a: For measures where the interactive effects exceed 500 MWh of savings, measure the system performance even if logging equipment needs to be deployed.

Impact Recommendation 7b: The implementation contractor should develop a set of conservative cooling system efficiencies, relative to the size of the data center, to use for calculating interactive

effects when the cooling system performance is unknown. Values should be reviewed and approved by Navigant and AEP Ohio.

Impact Finding 8: Multiple sampled projects did not calculate coincident demand reduction relative to the utility peak period, which is June, July and August between the hours of 3-6 PM on non-holiday weekdays.

Impact Recommendation 8a: If the cooling system has a temperature dependence, cooling savings has to be relative to the peak hours, even on small projects.

Impact Recommendation 8b: Ensure all projects which use an hourly bin analysis use the correct AEP Ohio coincident peak period.

Impact Finding 9: One smaller project contained a calculation error where the excel cell reference was shifted one column from the correct value.

Impact Recommendation 9: Even on small projects, conduct peer reviews of engineering calculations to avoid numerical errors.

Impact Finding 10: One smaller project contained a calculation error where the demand reduction was inexplicably multiplied by a factor of 12. Data center energy use is generally more consistent year-round than other types of buildings, resulting in an energy to demand ratio around 8,760.

Impact Recommendation 10a: Even on small projects conduct peer reviews of engineering calculations to avoid numerical errors.

Impact Recommendation 10b: All projects should check the ratio of energy savings to demand reduction to insure the ratio is in the “ballpark” of 8,760. Where the ratio is far from 8,760, investigate the reasons to make sure no errors occurred.

Impact Finding 11: The rack cooler project used an EUL of five even though the chiller drove the EUL and the agreed upon EUL for chillers is 20 years. The containment project used a lifetime of five years, even though the established precedent is 15 years.

Impact Recommendation 11a: Reviewers should check assumed EUL applied to each measure. Senior engineers should be able to determine the major piece of equipment driving the EUL determination.

Impact Recommendation 11b: The implementation contractor should review its appendix and update the agreed upon measure EUL values with Navigant and AEP Ohio.

Impact Finding 12: The large new construction projects, which will be updated annually for the next several years, had a project incremental cost analysis highly dependent on incremental cost relative to commissioning and monitoring systems. An interview with the participant revealed the commissioning and monitoring incremental cost is zero. When Navigant removed the commissioning and monitoring costs from the analysis, the project incremental cost became negative. Also, other costs listed were not well defined, adding confusion to the cost calculation. Despite possibly having a negative incremental cost, the new construction projects are not standard baseline solutions for cooling a data center, and do save considerable energy relative to conventional Data Center cooling.

Impact Recommendation 12: Soft or non-material costs need to be validated and documented as above and beyond baseline procedures. All cost line items need to be well defined and understood by the implementation contractor.

Impact Finding 13: The virtualization project cost analysis did not include all the servers installed.

Impact Recommendation 13: Implementation contractor project reviews should include checking the incremental cost analysis for errors, such as not capturing all of the equipment installed.

Impact Finding 14: The rack cooler project had a baseline cost of zero when it should have captured the cost of a baseline cooling system, such as air cooled CRAC units. The implementation contractor clearly stated a new baseline CRAC system would have needed to be installed if the rack coolers were not installed.

Impact Recommendation 14: Check every project to determine if a baseline cost should be subtracted from the project cost. Project reviewers should check for this error.

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. Customer outreach does not drive program awareness to increase Data Center Program participation. Application forms are generally completed by program staff due to application complexity and customer time constraints. The range of participating Solution Providers and customers with data centers of different sizes continues to decrease.

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

Process Finding 1: The program is overly reliant on a few very large projects to meet energy savings goals. This approach significantly reduces the number of customers the program can serve and could expose AEP Ohio to significant risk if a project does not materialize, or complete in each year. To compensate, the program has adjusted the 2017 incentive structure to increase incentive funding available for smaller projects; however due to the size of the largest projects, the savings from smaller projects was not sufficient to invest in additional projects or program outreach.

Process Recommendation 1: Institute an annual per project incentive cap, or shift projects above a certain incentive level to Bid4Efficiency. Consider a phased-in approach over several program years to gradually decrease the large project incentives in relation to increase program support from Solution Providers. However, new incentive caps should not affect customers already participating even if projects span several years.

Process Finding 2: The three large new construction projects had already met the incentive threshold to apply the reduced incentive rate of \$0.035/kWh based on incentives provided in 2016. Consider continuing at the lower tier for additional projects that are considered phases of the original project.

Process Recommendation 2a: For projects split up into multiple program years, the incentive rate structure could be based on the combined incentive of all years. If the incentive structure has changed from one year to the next, the current incentive should be the total incentive due the project for all years minus any previously paid incentives.

Process Recommendation 2b: Revise Terms and Conditions to incorporate the intent of Process Recommendation 2a.

Process Finding 3: According to the tracking data, a virtualization and grid refresh project was incentivized at \$0.07/kWh for the entire project when the virtualization measure should have been paid at \$0.06/kWh.

Process Recommendation 3a: Install quality checks to insure incentives are paid at the correct rate.

Process Recommendation 3b: Consider updating the server refresh measure incentive to match the virtualization incentive rate of \$0.06/kWh.

Process Finding 4: Solution Providers are not actively engaged by the Data Center Program or encouraged to identify and deliver Data Center projects to AEP Ohio. 2017 saw a further decrease in the number of projects, unique customers, and Solution Providers as compared with recent years. In 2017, virtually none of the Data Center customers reported learning of the program from a Solution Provider. Some of this reduction can be traced directly to 2017 program budget restrictions, caused by the size of the three largest projects. However, many customers rely on third-party contractors to manage their data centers. These contractors should be leveraged to identify energy efficiency opportunities and promote the AEP Ohio Data Center Program. Promotional activities for Solution Providers are not tailored to the unique needs of data center measures, projects, or customer staff representatives.

Process Recommendation 4: Expand efforts to establish a network of Data Center Program Qualified 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 complete projects for AEP Ohio.

Process Finding 5: Despite the unique nature of Data Center technologies and customer staff, most Data Center Program Solution Provider management occurs through the cross-cutting AEP Ohio Solution Provider initiative. Communications are not targeted to the Data Center professional contractors. Data Center Program Solution Providers are not compensated for their participation in the program, or project referrals. Although the implementation contractor indicates weekly outreach meetings are occurring with Data Center Solution Providers, we see no evidence of this effort as illustrated in the significant drop in projects, measures, and Solution Provider participation.

Process Recommendation 5a: Reexamine the outreach process to solution providers. Attempt to gain an understanding of the low efficacy of past outreach efforts. Consider an outreach strategy that tailors to the unique nature of Data Center Solution Providers. Deliver a clear value proposition illustrating contractor participation benefits, ongoing technical and program trainings, routine Solution Provider engagement, and management of individual projects.

Process Recommendation 5b: Consider conducting a Data Center Solution Provider survey to better understand how to conduct marketing and outreach to the population.

Process Finding 6: Program materials do not provide clear and consistent messaging to encourage a customer or Solution Provider to act.

- a. Customer-facing documents do not consistently prioritize pre-application. The application form indicates pre-application is required, but then contradicts this by providing a process to apply without the pre-approval. The documents (Application Form and program brochures) provide contradictory expectations for when an application needs to be received. Three of the eleven project applications were received after their project was completed.

Process Recommendation 6a: Institute consistent program policies and customer-facing messaging indicating pre-applications are required for the Data Center Program.

- b. Program materials do not promote the technical services designed to overcome key project barriers of a customer's available time for project implementation.

Process Recommendation 6b: Consider promoting technical services that support customers to identify and prioritize projects, and manage the application process, including completing application forms.

- c. It is not clear who the Intended audience is, for the 'AEP Ohio Eligible Measures' document, or how they would use the document. The list of measure names is inconsistent with the AEP Ohio DCEE Lit document.

Process Recommendation 6c: Ensure measure names in each document are consistent. Develop a target market audience definition for each document being developed to guide messaging.

- d. Customer-facing documents do not provide customers with the financial benefits of making energy efficiency investments in their data centers.

Process Recommendation 6d: To encourage businesses to make financial decisions, case studies should include savings in dollars, and include the Return on Investment (ROI) calculated with the lifetime of the measure.

- e. Next steps for customer engagement with AEP Ohio are not described in the ASHRAE Level 2 Audit example provided. While none of the measures identified in the audit example meet program requirements, the report does not offer any technical assistance to leverage its investment in the report.

Process Recommendation 6e: When conducting an ASHRAE Level 2 Audit AEP Ohio should investigate leveraging the investment made in providing technical support to the customer. AEP Ohio may be able to claim savings for recommended measures, even if the measures do not qualify for incentives.

Process Finding 7: The AEP Ohio website does not promote Data Center projects as a possibility for many customers. There is no overarching presentation of how customers should choose which AEP Ohio program service might best meet their needs, or description of the services provided by Energy Advisors to assist customers identify and prioritize their opportunities. For customers specifically seeking Data Center information, it takes six clicks reach the Data Center Program page.

Process Recommendation 7: Consider updating the website to reduce the steps to reach key pages and broadly serve two main objectives:

- a. Clear path for new customers: Provide a high-level overview of the various programs available. Promote AEP Ohio's customer support including technical assistance to identify and prioritize projects, and managing the application process.
- b. Easy access to pertinent program details: Create a simple path for returning and otherwise knowledgeable Data Center stakeholders to access application forms, incentive amounts, program and measure specifications.

Process Finding 8: Five of the six project files reviewed as part of the impact sample did not include a scanned image of the incentive check. The scanned image helps to confirm the proper incentive was paid.

Process Recommendation 8: Include scans of the incentive check in all project files.

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.

Tracking Database Finding 1: The program tracking database only includes completed projects; rejected projects¹⁸ are not included. As a result, the evaluation team has not assessed the number of projects rejected, or reasons for rejection. Including rejected applicants in the database would provide the Program Coordinator's perspective into how customers and projects are managed through the entire project process, and identify points for the program to improve communications and services to reduce customer rejection.

Tracking Database Recommendation 1: Consider including rejected program applicants in the tracking database, along with the reason for rejection.

Tracking Database Finding 2: The average elapsed time between the project completion and issuing the incentive is 107 days, or three and a half months. This time period seems lengthy, 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, including any required metering.

Tracking Database Recommendation 2: Add new data fields to the database to differentiate between when the application and all required information has been completed from the inspection, and when the project is approved for payment. This functionality will allow actual incentive payment processing time to be properly tracked and monitored. This may be accomplished by adding or otherwise clarifying 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 previously discussed, the tracking data does not include a field to indicate when all the project information required to approve the application has been received.

Tracking Database Finding 3: The tracking data has several incomplete fields, including Pre-Application Submittal Date, Account Representative, Segment, and Base Measure Attributes 2. While the lack of a pre-application submittal date could indicate a pre-application was not collected, a blank entry is not definitive.

Tracking Database Recommendation 3: Ensure all data fields are filled out for each project before closing the project or add a binary (0 or 1) field. For example, if no pre-application was completed, enter NPA for "no pre-application" or have a binary field for pre-application completed, 0 or 1.

Tracking Database Finding 4: In the measures tracking data, there is only one row for each project which would indicate all the projects only had one measure. The project files do separate measures in the implementer Summary tab of the final calculations worksheet, and multiple 2017 projects had more than one measure.

¹⁸ Rejected projects would include cancelled projects as well as projects that suffer from other issues like not meeting payback criteria or missing proper documentation.

Tracking Database Recommendation 4: Modify the measures tracking database so there is a separate entry for each measure listed in the implementer Summary tab of the final calculations worksheet.

Tracking Database Finding 5: While the recording of business types has improved significantly in 2017 compared with previous years, the economic sectors are not adequately described in all cases, causing the evaluation team to recharacterize some of the economic sector designations.

Tracking Database Recommendation 5: Instead of reporting economic sector, ask for the SIC/NAICS segments at a two-digit level in the application and report it in the tracking data.

Tracking Database Finding 6: Project files are well organized. Project summaries are provided giving the reader a high-level overview of the project and clear documentation for numerical input sources. Complex equations are broken down in the excel format so that one can determine how savings were derived.

Tracking Database Recommendation 6: Continue the practices of providing project summaries, clear documentation, and an excel format that breaks down complex equations.

Tracking Database Finding 7: The virtualization project provided a clear timeline of the retrofit start and end date. This information assisted the billing analysis ultimately used in verifying the project impact on savings.

Tracking Database Recommendation 7: For all projects, provide a timeline of equipment installation or site control changes that resulted in energy savings, so savings can be correlated with utility data.

APPENDIX A. PROGRAM MANAGER INTERVIEW GUIDE

September 15, 2017

AEP Ohio

Process Evaluation of 2016 [PROGRAM NAME] 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 Ohio 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 [PROGRAM NAME ABBREVIATION] 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 2017 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 (Table A-1.

Table A-1. 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?
- 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?
- Follow up if not addressed in response:* Has AEP Ohio 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 [PROGRAM NAME] 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 B. IMPLEMENTATION CONTRACTOR INTERVIEW GUIDE

October 13, 2017

AEP Ohio

Process Evaluation of 2016 [PROGRAM NAME] Programs

Interview Guide: Implementation Contractor

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. Please describe key changes to the program since last year?
 - a. Can you describe the impact these changes have had on program performance?
3. How many people (in terms of FTE's) in your organization are working on the [PROGRAM NAME ABBREVIATION] Program?

PROGRAM PROCESS

4. Can you describe for me the **key steps or processes** for the [PROGRAM NAME] program (including the Whole Building path and CLEAResult's responsibilities for prescriptive program intake)?
5. 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?
6. What are the 2017 program targets? (For both the Whole Building and Prescriptive paths)?
 - a. Do you expect them to be met?
7. What other key performance indicators do you use to measure the performance of the program?
8. 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?)
9. For participants participating in the LEED process, how have the changes implemented last year affected participation and project performance?
10. 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?

11. Have any projects which applied under the prescriptive path transferred to the whole-building path? How was this transfer handled?

OUTREACH AND MARKETING

12. 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?
13. 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)?
14. Describe any recognition provided for participating buildings or design teams? (i.e. certificate or plaque)

INTERACTION WITH MARKET DESIGN TEAMS

15. 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?
16. Are any market segments under represented (or not represented) through the program? Are there any concerns about underrepresented markets?
17. What proportion of projects proceed with essentially the level of energy efficiency initially proposed on the program application?
18. How often do you meet with the design teams either in person or by web meeting, to review project designs?
19. How do participant needs vary by sector or design method? (Design-build, design-bid-build, build to lease, build to own).
20. 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?
21. Have customers indicated they have any issues with program requirements or documentation?

22. 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

23. 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?
24. 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?)
25. 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?
26. 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?
27. How many participants drop out of the program before project completion? Why? What impact has the design incentive had on drop-outs?
28. Can you describe the quality control procedures in place to ensure complete information is obtained, and accurate information is entered into the database?
29. Site inspections and verifications (Table A-2).

Table A-2. 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?		

30. 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

31. 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

32. What have been the key challenges in implementing the program in the past year?
33. What steps have you taken to overcome these challenges?
34. 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?
35. Is there an opportunity for a future tenant in a [PROGRAM NAME] design project to provide input into the energy efficiency measures being considered?

PROGRAM REQUIREMENTS

36. 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

37. 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.

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Case No(s). 18-0835-EL-EEC

Summary: Annual Report - Ohio Power Company submits the 2017 Portfolio Status Report pursuant to Rule 4901:1-39-05(C), Ohio Administrative Code
(Part 5 of 6) electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company