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

VOLUME VI

APPENDICES O - Q

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APPENDIX O

NAVIGANT

CONTINUOUS ENERGY IMPROVEMENT PROGRAM

2017 Evaluation Report

Prepared for:

AEP OHIO

AEP OHIO®

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EXECUTIVE SUMMARY

This report presents the results of the 2017 evaluation of the AEP Ohio Continuous Energy Improvement (CEI) program. The Executive Summary provides a high-level description of the program, key impact and process findings, and recommendations for future program improvements. Detailed methodology and findings are contained in the body of the report, with supplemental data included in the accompanying appendices.

ES.1 Program Summary

The CEI Program provides training for commercial and industrial customers on how to view energy consumption at their facilities in a holistic manner, and identify no cost/low cost opportunities to reduce energy use. Through this training, participants learn to apply behavioral principles of continuous energy improvement and to implement strategic energy management practices. These practices can reduce energy use at an individual site anywhere from three to five[1] percent with little or no financial investment from the customer.

Over the years, the program included several cohorts[2], or groups of participants, who began the program in roughly the same calendar year.

At the time of the 2015 program design, the Ohio Public Utilities Commission (PUCO) approved the CEI Program through 2016. AEP Ohio did not receive approval for the CEI 2017 program year until December 2016 making it difficult to recruit new participants. Therefore, AEP Ohio formed an Alumni group made up of previous participants for the 2017 program year. An incentive of $0.02 incentive per kWh saved is provided to participants for the entire time-period. Table ES-1 summarizes Program Year 2017.

Table ES-1. CEI 2017 Program Summary

	2017 Program Goals	2017 Program, Reported
Program Budget	$2,500,000	$2,248,746
***Ex Ante* Energy Savings (MWh)**	19,770	24,644
***Ex Ante* Demand Savings (MW)**	0.402	3.378

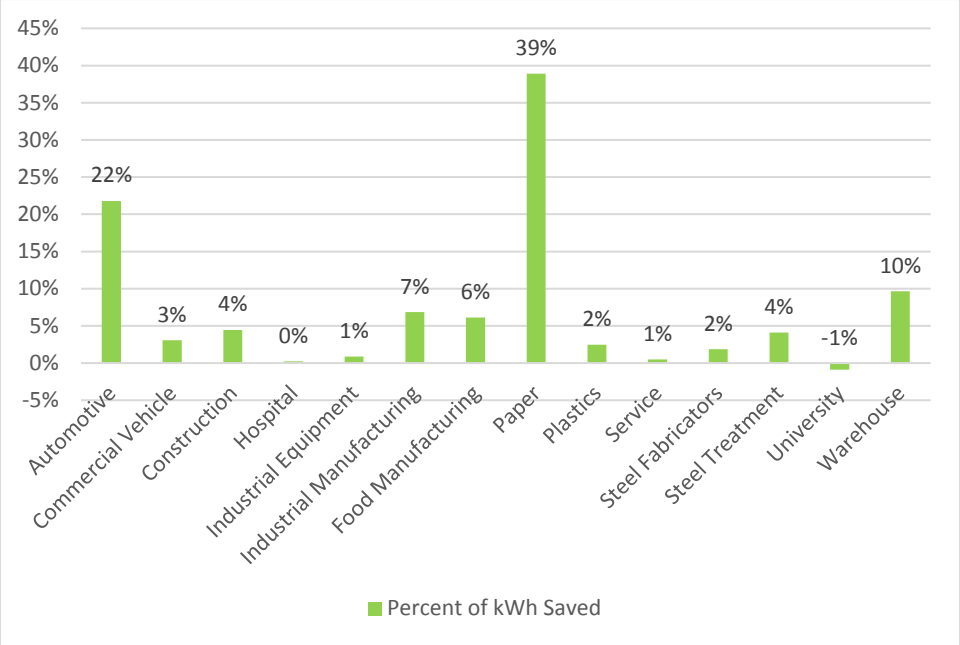
Source: Energy Efficiency / Peak Demand Reduction (EE/PDR) Portfolio 2017 to 2020 Evaluation Plan, September 27, 2017.

Figure ES-1 shows energy savings by economic sector. In 2017, five sectors (Paper, Automotive, Warehouse, Industrial Manufacturing and Food Manufacturing) accounted for approximately 83 percent of the reported electrical energy savings. The remaining energy savings is distributed in small amounts, four percent or less, across the nine other sectors.

[1] https://www.aepohio.com/global/utilities/lib/docs/save/business/programs/AEPOhio/2018/AE5633-Fact%20Sheet-Business-Programs_r_CEI_nc.pdf

[2] Navigant uses the term “cohort” here and throughout this report to mean a group of participants who began participating in the CEI Program at about the same point in each calendar year. Each cohort is comprised of multiple participants of varying counts.

Figure ES-1. 2017 *Ex Ante* Electric Energy Savings by Economic Sector



Source: Navigant review of CEI tracking database.

ES.2 Data Collection Activities

As part of the impact study, the evaluation team completed an engineering review on all project files and models associated with the participating customers in 2017. During this review, Navigant analyzed the provided energy models to ensure that savings was clearly associated with CEI activities. The analysis included:

- Recreating all regression models to ensure that they were properly aligning to the provided variable data.
- Checking all changes in energy use associated with capital projects and equipment additions to ensure that they were not claimed as CEI Savings.
- Reviewing all rational for data point exclusion within the model and checking the impact of these activates.
- Reviewing all variable data points in the post condition in order to identify any data points that would be considered outliers.
- Identifying any short term or long term activates that may have been affecting the energy model. This could include temporary equipment malfunctioning or long-term process changes. Evaluation staff estimated the impact for these activates and accounted for them within the energy models.

No on-site verification or site-specific interviews were completed this year as a part of the evaluation. Navigant reviewed energy models for both energy and demand savings for each site.

ES.3 Key Impact Findings and Recommendations

As summarized in Table ES-2, the verified electricity savings significantly exceeded the 2017 targets of 19.77 GWh and .402 MW coincident demand reduction. The *ex post* energy and summer coincident demand savings are 25,549 MWh/year and 2.754 MW respectively. The realization rate for energy savings is 1.04, while the demand savings realization rate is 0.82.

Table ES-2. 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)	19,770	24,644	25,549	1.04	129%
Coincident Peak Demand Reduction (MW)	0.402	3.378	2.754	0.82	685%

Source: Navigant Analysis

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: Navigant observed site operation changes during the measurement period that required consideration for removal of some data points due to outlier variables. Variables were considered outliers if these were 110 percent and above the maximum, or 90 percent and below the minimum of the baseline range for a given variable. In some cases, the removal or inclusion of these variables were not well justified and Navigant disagreed with the handling of these data points.

> **Impact Recommendation 1:** The implementer should provide clear explanation for why a point is removed in both the baseline and measurement period model. If a data point is having a repetitive occurrence year after year, it should be removed in both or neither periods.

Impact Finding 2: Some models appeared to be mishandling the impact of capital projects occurring in the baseline. Some capital projects occurred late in the baseline periods and would have not been properly captured by the model. In these cases, Navigant decided to include the energy impact of these measures or equipment in the post period

> **Impact Recommendation 2:** The impact of capital projects occurring late in the baseline period which may not have been fully completed before the end of the baseline period should be directly accounted for in the post period. This would be done the same way the capital project is being accounted for in the post period.

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 Key Process Findings and Recommendations4.2.

Process Finding 1: While the CEI Program has exceeded its goals over the past three years, engaging new participants from smaller facilities with less than three GWh of consumption may become more difficult as the program ages. Historically the traditional barrier for the CEI Program has been the time commitment of three to five hours a week for the Energy Champion.

> **Process Recommendation 1a:** Conducting a non-participant survey to assist in identifying other additional barriers may help AEP Ohio design the program to meet the needs of smaller customers.
>
> **Process Recommendation 1b:** Working with the Energy Advisors, identify the customers with high participation in the Process Efficiency and Efficient Products programs who may have implemented all identified financially feasible equipment upgrades, yet still have internal energy reduction goals. These customers may welcome a low-cost/no cost solution for their energy reduction.
>
> **Process Recommendation 1c:** Develop a CEI "light" program. This concept is a continuation of one mentioned by the Program Coordinator, where AEP Ohio would provide the energy model to the customer with minimal required workshops. Like other customer's models, this model would be supported and reviewed by the Implementation Contractor. The focus of the training could be on the Nine Energy Wasters and controls.

Process Finding 2: Navigant did not conduct participant interviews this year, but has for other utilities, and found many strategic energy management commercial customers are using controls and energy management systems (EMS) to help lower their overall energy consumption. Successful EMS projects ensure advanced controls are programmed and go above and beyond what was being done previously. This is accomplished by customers documenting their existing control strategy and how the new EMS will change these strategies. In addition, EMS programmers train site staff on how to properly use the EMS to prevent the undoing of advanced control strategies.

> **Process Recommendation 2**: Encourage CEI participants to consider applying to the Efficient Products for Business/Process Efficiency Programs to add an Energy Management System (EMS). An EMS will help customers adjust their buildings usage based on their needs and comfort. For customers with existing management systems, a commissioning incentive can be provided to ensure buildings are operating optimally. A secondary benefit of EMS systems is the ability to reduce load during peak hours, assisting AEP Ohio in meeting its demand reduction goals.

1. INTRODUCTION AND PURPOSE OF STUDY

This section provides a description of the AEP Ohio Continuous Energy Improvement (CEI) Program, as well as the objectives of the 2017 evaluation.

The role of the CEI Program is to train commercial and industrial customers how to implement strategic energy management practices and apply the principles and practices of continuous energy improvement. The goal of the training is to reduce the participant's site level energy use by three to five[3] percent with little or no financial investment. The CEI Program provides the tools, coaching, training structure, and resources necessary to achieve these energy savings. AEP Ohio staff collaborates with the implementation contractor (CLEAResult) to deliver the CEI Program across AEP Ohio's service territory.

Specifically, the CEI Program includes the following features:

- Coaching assistance, tools, and templates to support customer employees to meet plant and corporate cost savings targets
- Custom statistical models for each customer to measure and manage energy intensity
- An Energy Coach and technical resources to help customers identify and implement energy saving opportunities
- A structured support group of local companies that share best practices and provide team support, encouragement, and accountability

The original CEI Program, designed in January of 2013, supported AEP Ohio's largest industrial customers (e.g., those consuming greater than 10 GWh annually). In May of 2013, AEP Ohio expanded the program to include customers using greater than three GWh. This change impacted all cohorts beyond cohort 1. In late 2014 and early 2015 AEP Ohio formed cohorts 5-8, these new cohorts included large commercial sites including hospitals and universities. In 2016 and 2017, Cohorts 9 and 10 were formed out of previous participating customers that wished to continue to develop their internal CEI programs by identifying new opportunities and maintaining previously identified opportunities.

1.1 Evaluation Objectives

This report presents the findings from the impact and process evaluations of the AEP Ohio Continuous Energy Improvement Program (CEI) for 2017.

The impact evaluation sought to determine if there were any changes occurring that effected the overall energy use of the site by researching the following questions:

1. What were the realization rates and what were primary factors driving the realization rates? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
2. What are the verified (*ex post*) gross energy and peak demand savings from the program?
3. Did the program meet the energy and peak demand savings goals? If not, why not?
4. What are the benefits, costs, and cost-effectiveness of the program?

[3] https://www.aepohio.com/global/utilities/lib/docs/save/business/programs/AEPOhio/2018/AE5633-Fact%20Sheet-Business-Programs_r_CEI_nc.pdf

The evaluation team did not conduct participant surveys for the 2017 program year. However, interviews with the program manager and the implementation contractor were conducted to determine the effectiveness of the following aspects on the success of the program:

Marketing and Participation

1. Does the marketing effort appropriately meet current and future program participation goals?
2. Does the program outreach effectively increase awareness of program opportunities?
3. How often does program outreach occur?
4. Are the messages included within program outreach clear and actionable?
5. What are the key interests and motivations for potential and actual participants beyond the financial incentive offered?
6. What are the key barriers to participation in the program?

Program Effectiveness and Satisfaction

1. What improvements could be made to create a more effective program and to help increase energy and peak demand impacts?
2. What is the status of implementing recommendations/issues identified in previous evaluations?
3. How do the findings in the current year's evaluation compare to previous evaluations?
4. Are participants and providers satisfied with the programs?
5. Have implementation changes effectively increased satisfaction and/or participation?

Administration and Delivery

1. Is program administration functioning effectively?
2. Are there any problems with program delivery?
3. Are program tracking systems adequate? Are program tracking systems consistently maintained? Do program tracking systems contain all data required to support AEP Ohio supervision, program tracking, and evaluation?
4. Are program procedures documented and followed?
5. Are verification procedures implemented in a manner consistent with program design?
6. Is the implementation contractor meeting a key performance indicator?

Specific process evaluation questions are summarized in Section 2.2 (Key Evaluation Questions) and Section 3.3 (Process Evaluation Findings).

1.2 Evaluation Methods

Program impacts for the 2017 CEI Program were evaluated in terms of electric energy and peak demand savings. All completed projects were reviewed for both the program energy and demand savings.

The *ex post* energy and demand savings of the sampled projects were determined by an engineering review of the project files as well as an engineering review of the *ex ante* energy models provided for each site. Summer coincident peak savings are determined by separate energy models provided by the implementer. The models were reviewed along with all other program documentation for each site.

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
In-depth Telephone Interviews	AEP Ohio Program staff	Process Evaluation
	Implementer staff	Process Evaluation
Project File Review	All completed projects	Impact Evaluation
Tracking Data Review	All program participants	Impact Evaluation

2. METHODOLOGY

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

2.1 Overview of Approach

The evaluation was driven by three overarching objectives: (1) quantify electric energy and coincident summer peak 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.

Evaluation Questions. Established key evaluation questions as part of developing the 2017 Evaluation Plan with AEP Ohio staff.

Tracking Data Review. Reviewed the program tracking data collected by the implementation contractor and provided to the evaluation team by AEP Ohio.

Review of Marketing Activities. Reviewed the overall marketing activities and approach as implemented by the implementation contractor.

Review of Participation. Reviewed program participation by building type, program path, completion date, and geographic location.

Primary Data Collection. Performed primary data collection, including in-depth interviews with program staff and the implementation team and a file review for all projects.

Methods Used to Analyze Impact Data. Navigant quantified energy and coincident summer peak demand reduction savings by reviewing project files. File reviews included review of the detailed engineering models for both the demand and energy savings, and review of detailed site reports. For each model, Navigant recreated the baseline multi regression model that estimates site energy use and carefully account for any other changes that were occurring on site that were outside of the CEI program.

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 worked with AEP Ohio to identify key evaluation questions regarding the 2017 CEI Program. The overarching question to be addressed: did any changes occur that affected the overall energy use of the site?

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. CEI 2017 Evaluation Questions

Research Objective	Information Sources: Database & Engineering Model Review	Information Sources: 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 (*ex post*) savings divided by program-reported (*ex ante*) savings.)	√	-
3. What are the values for program benefits and costs and the associated estimate for program cost effectiveness?	√	-
4. Were there any changes occurring that were affecting the overall energy use of the site?	√	
Process Questions		
1. What are the key motivators for and barriers to increased energy efficiency in CEI for different customer segments	-	√
2. What customer market segments or types of projects participate in the program?	-	√
3. How did customers become aware of the program?	-	√

2.3 Tracking Data Review

Program tracking data is critical for determining the impacts of the CEI Program. A copy of the program tracking data collected by the implementation contractors was provided by AEP Ohio to the evaluation team. The evaluation team reviewed all fields recorded on the application forms and key data fields in the database were reviewed to identify missing, incomplete, or inconsistent data. The data collected was also reviewed to identify any additional information that would be helpful in evaluating program performance. The evaluation team did not assess whether the tracking system was adequate for regulatory prudency reviews or corporate requirements.

2.4 Review of Marketing Activities

Marketing collateral, application forms and other materials available from the AEP Ohio website were reviewed by the evaluation team. Additional marketing materials were requested from AEP Ohio and the

implementation contractors. Information on marketing, communications and outreach efforts was also obtained from both AEP Ohio and the implementation contractors.

2.5 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. Interviews were conducted by telephone to provide flexibility to the respondents' schedules.

2.6 Methods Used to Analyze Impact Data

Reported savings for the CEI Program are from project-specific calculations. AEP Ohio bases its calculations on energy models created from pre-project data and collected post-project energy usage. Typically, these models use two years of energy usage data, along with production data, weather data, or other factors that could affect site energy usage. Navigant then compared the model to site usage after the beginning of the CEI Program. Savings results from any differences in energy usage.

Navigant reviews the tracking data to ensure that it aligns with the site savings as reported in each individual site report. If there is misalignment Navigant evaluation staff follow up with AEP Ohio and the evaluator to resolve the issues.

2.6.1 Impact Sample of Project Files

All sites were reviewed (a complete census), thus no project sample was required.

2.6.2 Ex Post Energy Savings Calculation

The impact evaluation of cohorts 9 and 10 was the primary research tool used to estimate the energy savings from the CEI Program. Navigant conducted a site-specific impact evaluation using engineering models and analysis, including:

1. Adopting the International Performance Measurement and Verification Protocol (IPMVP) option C–billing/metered data regression as the main method of site-level impact evaluation, since the CEI Program contains primarily behavioral-based changes.

2. Updating participant's energy models using collected data, including program tracking data and supporting documentation (project specifications, invoices, etc.), utility billing and interval data, and telephone conversations with onsite staff.

3. Reviewing the energy models and their results to ensure they meet industry-standard statistical criteria for robustness, uncertainty, and fit for the program year. These statistical standards include: an overall fit of an R^2 of 0.75, individual variables should show a t-stat of greater than 2.0 to be considered statistically significant and the total number of variables as compared to the total number of data point should be limited to one to six to not over fit the model. In addition, variable values in the post period are compared to the baseline to ensure that they do not deviate too greatly beyond the range established in the baseline period. For models not meeting these

criteria, or if there is significant degradation in statistical robustness since the baseline period, Navigant recommends model adjustments based on collected data prior to evaluation.

4. Compiling the results and findings from the 2017 evaluation of all participants in cohorts 9 and 10, and using the aggregate results to inform any recommendations for structuring models for future cohorts.

5. Due to the difficulty of collecting the information required to estimate EUL for behavior based programs such as CEI, Navigant did not determine EUL in 2017. Effective useful life (EUL) for the CEI program was calculated in the 2016 evaluation to be five years and is applied to CEI projects in 2017.

Navigant was provided energy models to all sites participating in the CEI Program. The team used data from these models, as well as other site-specific information, to identify operating characteristics of the facility both pre- and post-program implementation. Participants must adjust the energy models to reflect any changes to the site's processes impacting energy consumption due to CEI Program activities to ensure proper savings estimates. The changes that could affect model savings include:

- Changes in hours of operation
- Changes in number of employees
- Changes in production
- Any capital measures installed at the site implemented through other energy efficiency programs offered by AEP Ohio, or from other outside parties

For each site, Navigant reviewed and updated the provided engineering models. Navigant staff generally followed the process below for this review:

Step 1. Navigant recreated the provided energy models to ensure these aligned with the provided data.

Step 2. Navigant confirmed the model savings calculations accounted for all capital projects.

Step 3. Navigant identified and accounted for any short-term effects that were not a result of CEI Program influence.

Step 4. Navigant made additional adjustments to the provided model as needed, such as accommodating outliers and ensuring savings reflected the correct number of time periods.

2.6.3 Realization Rates Calculation Method

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

Equation 1. Realization Rates

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

Where:

E = the electric energy savings or peak demand reduction for all projects at each site

2.7 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 CEI 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 CEI 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.

3. DETAILED EVALUATION FINDINGS

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

3.1 Program Activity

The 2017 program year represents the 4th year of operation for the CEI Program.

Over the years, the program included several cohorts[4], or groups of participants, who began the program in roughly the same calendar year.

- The first set of cohorts (cohorts 1 through 4) began the program in 2013 and completed it in 2016.
- The second set of cohorts (cohorts 5 through 8) began the CEI Program in either late 2014 or 2015, and completed their first year in mid-2016.
    - In 2016, AEP Ohio adjusted the CEI Program from a three-year to a one-year program structure.
- AEP Ohio did not receive approval for the CEI 2017 program year until December 2016, making it difficult to recruit new participants. Therefore, AEP Ohio formed an alumni group made up of previous participants for the 2017 program year.
    - A demand goal of 402 kW was added in 2017; the actual *ex ante* demand reduction achieved far surpassed this goal achieving 3,378 kW or 840%.

Over the years, the program has become more inclusive of smaller industrial sites and large commercial sites. Navigant expects this trend to continue and encourages the program to adapt its training and tools to fit customer needs.

Total *ex ante* electricity savings reported for the program amounted to 24,644 MWh (Table 3-1), which is 56% lower than in 2016 which was 55,949 MWh. The lower energy reduction reflects the smaller number of participant in this year versus previous years, 23 versus 89 last year. This smaller number of participants was due to the timing of plan approval and limited the utilities options to recruit new participants into the program. The new cohorts were an alumni group of participants who made major energy reductions in previous years, but these sites were able to find additional savings opportunities this program year as well. Establishing an *ex ante* demand goal for 2017 helped the program focus its efforts on demand reduction and achieve 3.38 MW, or 193% of last year's reduction of 1.75 MW. The total amount of incentives was much less in 2017 due to the lower incentive rate. Overall, $501,415 in incentives were provided to participating customers, or about 18 percent of last year's total.

[4] Navigant uses the term "cohort" here and throughout this report to mean a group of participants who began participating in the CEI Program at about the same point in each calendar year. Each cohort is comprised of multiple participants of varying counts.

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

	2017 Program	2016 Program
Total Incremental Participant Cost	$0.00	$0.00
Amount of Incentives	$501,415	$2,751,228
Ex Ante Energy Savings Reported to Program (MWh)	24,644	55,949
Ex Ante Demand Savings Reported to Program (MW)	3.38	1.75

Source: Navigant Analysis

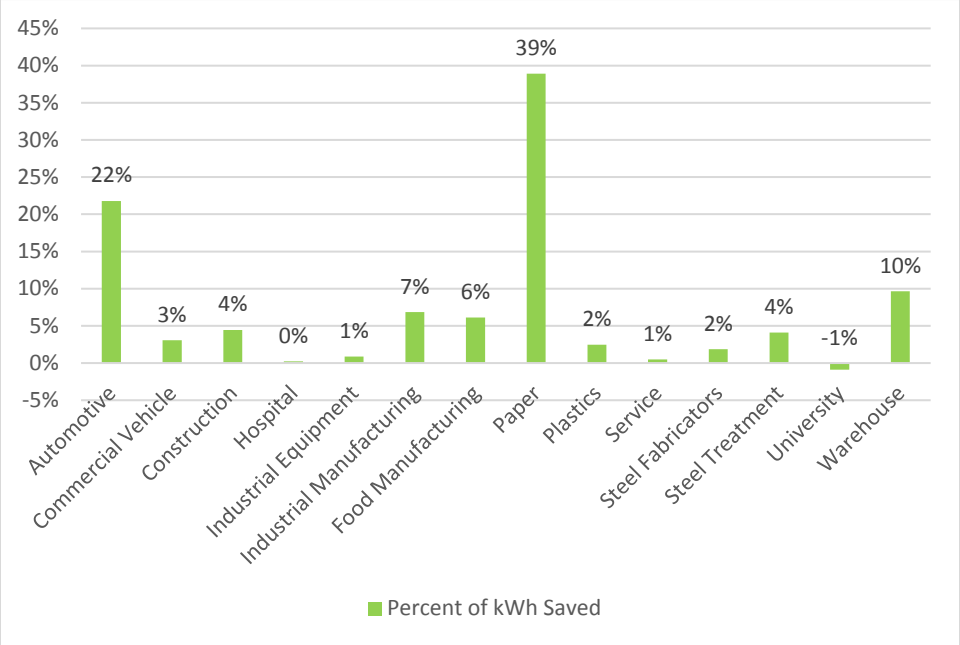
Table 3-2 shows the *ex ante* energy savings by economic sector. In 2017, five economic sectors (Paper, Automotive, Warehouse, Industrial Manufacturing and Food Manufacturing) accounted for approximately 83 percent of the reported electrical energy savings. The balance of the program savings was distributed in small amounts, 4 percent or less, across the nine other sectors. Figure 3-1 shows the *ex ante* energy savings by economic sector.

Table 3-2. 2017 Program Activity by Economic Sector

Economic Sector	*Ex Ante* Savings			
	Energy (kWh/year)		Demand (kW/year)	
Automotive	5,372,916	21.8%	1,295.8	38.4%
Commercial Vehicle	759,330	3.1%	703.4	20.8%
Construction	1,099,728	4.5%	47.3	1.4%
Hospital	51,553	0.2%	(0.3)	0.0%
Industrial Equipment	212,688	0.9%	(80.7)	-2.4%
Industrial Manufacturing	1,688,080	6.8%	(86.7)	-2.6%
Food Manufacturing	1,505,366	6.1%	383.7	11.4%
Paper	9,590,083	38.9%	1,090.1	32.3%
Plastics	603,795	2.5%	32.2	1.0%
Service	125,342	0.5%	(21.5)	-0.6%
Steel Fabricators	463,662	1.9%	79.6	2.4%
Steel Treatment	1,012,011	4.1%	(416.6)	-12.3%
University	(219,569)	-0.9%	21.6	0.6%
Warehouse	2,379,371	9.7%	330.4	9.8%
Total	**24,644,356**	**100%**	**3,378.3**	**100%**

Source: Navigant review of the CEI tracking database

Figure 3-1. Energy Savings by Economic Sector, 2017 Program



Source: Navigant review of the CEI 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 CEI Program. Annual electricity savings were calculated using the data collected through document reviews.

3.2.1 Summary of Impact Findings

The *ex post* energy and summer coincident demand annual savings for 2017 are 25,549 MWh and 2.754 MW respectively. This result exceeded the 2017 goal of 19,770 MWh savings and 0.402 MW coincident demand reduction. The realization rate for energy savings was found to be 1.04, while the demand savings realization rate was found to be 0.82. These results are shown in Table 3-3.

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

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)	19,770	24,644	25,549	1.04	129%
Coincident Peak Demand Reduction (MW)	0.402	3.378	2.754	0.82	685%

Source: Navigant analysis

3.2.2 Driving Factors of Realization Rate

While the majority of sites achieved realization rates of 75 percent or higher, several sites had realization rates well below or well above 100 percent. Variable realization rates for program cohorts were a result of:

- Site operation changes during the measurement period that required consideration for removal of some data points due to outlier variables. Variables were considered outliers if these were 110 percent and above the maximum, or 90 percent and below the minimum of the baseline range for a given variable. In some cases, the removal or inclusion of these variables were not well justified and Navigant disagreed with the handling of these data points.
- Site operation changes during the measurement period that required the removal of some data points due to short-term or long-term changes occurring at the site. The team identified these changes on a site-by-site basis, which included the shutdown of major equipment, long-term equipment malfunction, or short-term production changes that affected the overall energy usage.
- The mishandling of the impact of capital projects occurring in the baseline. Some capital projects occurred late in the baseline periods and would not have been properly captured by the model. In these cases, Navigant decided to include an additive in the post period to account for the impact of these measures.
- *Ex ante* calculations including the removal of certain data points because these were outliers or otherwise were not properly annualized.

Table 3-4 presents the site level results for the sample of participants used in the impact evaluation. The order of the sites is in the same order of the provided tracking data but names have been removed to uphold customer confidentiality.

Table 3-4. Site Level Results and Realization Rates for the 2017 Participant Sample

Site	*Ex Ante* Energy Savings (kWh)	*Ex Post* Energy Savings (KWh)	kWh Site Level Realization Rate	*Ex Ante* Energy Savings (kW)	*Ex Post* Energy Savings (KW)	kW Site Level Realization Rate
A	1,505,366	1,505,366	100%	383.7	383.7	100%
B	2,379,371	2,446,613	103%	330.4	330.4	100%
C	1,012,011	1,012,011	100%	-416.6	-416.6	100%
D	-43,910	-47,799	109%	31.9	37.8	118%
E	29,523	33,772	114%	1.9	1.9	100%
F*	95,819	95,819	100%	-23.4	-23.4	100%
G	70,170	70,170	100%	-19.5	-19.5	100%
H	9,590,083	10,575,165	110%	1090.1	540.0	50%
I	759,330	217,395	29%	703.4	615.5	88%
J	857,851	880,791	103%	-131.7	-131.7	100%
K	41,158	20,049	49%	25.0	24.0	96%
L	1,099,728	823,713	75%	47.3	47.3	100%
M	463,662	527,411	114%	79.6	79.6	100%
N	383,971	434,185	113%	45.7	45.7	100%
O	-165,691	-211,068	127%	-0.1	-9.4	9362%
P	783,994	783,994	100%	140.1	140.1	100%
Q	212,688	212,688	100%	-80.7	-80.7	100%
R	201,833	201,833	100%	256.3	256.3	100%
S	2,092,637	2,092,637	100%	385.2	385.2	100%
T	51,553	93,428	181%	-0.3	18.2	-6054%
U	1,602,292	2,136,389	133%	646.0	646.0	100%
V	-216,817	-216,817	100%	-35.3	-35.3	100%
W	1,688,080	1,696,591	101%	-86.7	-86.8	100%
X	149,654	165,574	111%	6.0	6.0	100%
Total or Weighted Average	**24,644,356**	**25,549,910**	**104%**	**3,378.3**	**2,754.3**	**82%**

**This was a separate model that was associated with site E resulting in 24 models that were reviewed.*
Source: Navigant impact evaluation and program tracking database

Site B

The Navigant model reviewer added the two excluded baseline weeks back in because the justification for removing these was limited and did not clearly explain why these were excluded. The data variations

could have occurred as part of normal variations at the site, and overall usage was not so high as to exceed ten percent over the modeled value.

Site D
The Navigant model reviewer added excluded baseline weeks back in to baseline period because:

1. Any variation in occupancy around holidays should occur during holidays.
2. There was no clear construction period corresponding to the 5/23 date, which should have affected only that week.
3. Demand savings was adjusted based on new energy model coefficients.

Site E
The Navigant model reviewer re-incorporated all excluded weeks into the baseline model because these lacked a clear reason for removal. All of the weeks were excluded for having energy use significantly different than others, but there is no unusually large deviation in the values shown for energy use compared to adjacent weeks. Additionally, the report states the site could not provide any reason for variations during those weeks. Changes to the energy model did not affect demand.

Site H
The model exclusions are generally well justified, but the post period only covered 331 days. Navigant adjusted savings to represent a full year by adjusting savings to represent a 365-day year. Excluded days due to construction and other activities are reasonable, but result in less than a full calendar year of savings. Site construction resulted in removal of data points in the kWh model but was not reflected in the demand savings model. Once the construction was accounted for in the demand savings, the realization rate dropped due to the exclusion of these data points.

Site I
Some baseline capital projects (chiller projects) were reported as not fully commissioned. Since these were commissioned in the late summer of 2016, the savings will first show up in Year One and not the baseline period. The impact of these projects should be removed from Year One savings to avoid double counting the prescriptive/custom program savings.

Site J
The energy model report states they tested several capital projects in the baseline models and did not find statistical significance. Two of these projects (both lighting) were installed only two weeks before the end of the baseline period and would not be detected as significant in the model. The savings for these projects should be subtracted from the Year One savings to avoid double counting the prescriptive/custom program savings. Navigant tested other capital projects and confirmed no significance. The timing of the lighting retrofits is at the transition between baseline and Year One, and require adjustments to the model. The baseline period was shortened by four weeks (100 records vs. 104) to accommodate installation and reporting delay.

Site K
The energy model report removed two outliers in the baseline period because the "actual energy use was high" (>10,000 kwh more than the model). Yet, at the same time there are six records in the post period with absolute savings more than 10,000 kWh (net 25,000 kWh increased savings) not treated as outliers. The Navigant model reviewer did not find any of the data to be exceptional and included all data in the baseline and Year One. Humidity as an independent variable does not have a clear rationale and has a

relatively high p-value. High winter relative humidity does not impact energy the same way high summer relative humidity does. The model reviewer removed the humidity variable from the model. Energy model revisions caused a slight change to demand savings.

Site L
One capital project (variable speed air compressor) was completed at the very end of the baseline period and would not show up in the model. The savings from this project must be removed from the program Year One savings to avoid double-counting with the prescriptive/custom program. No model was provided for demand savings. The report asserts a conservative value of 47.3 kW for shutting off two 100 HP grinders (each 30% loaded). The estimate is reasonable.

Site M
One outlier was identified in the post condition which was not flagged by the implementer. The production in December was more than 20 percent below the minimum production in the prior two years, and was 30 percent lower than the prior two Decembers. Removing the data point as an outlier is recommended. Resulting savings is adjusted to represent annual savings.

Site N
There are four problematic data points in the post condition. Three are less than 90 percent of the minimum and one was more than 110 percent of the parameter maximums in the baseline. The Navigant model reviewer removed the impact of outlier records as these affect non-linear variables. Once these points were removed, the final saving was calculated proportionally to a full year.

Site O
Two outliers were identified in the post condition by the implementation contractor. Similar records were removed from the baseline data for the same reasons, and it is reasonable to do the same for post-condition data. Once these points were removed, the final saving was calculated proportionally to a full year.

Site T
The energy model report identified issues regarding boiler servicing problems that affected the model savings but did not remove the impact of these issues from the *ex post* model. Navigant removed those data points affected by the identified issues, and the final saving was calculated proportionally to a full year. These issues occurred during the demand savings period and Navigant removed the impact of these issues from the demand model.

Site U
The energy model report correctly identified three months that were having issues and needed to be removed from the model, but did not annualize the *ex ante* savings.

Site W
The Navigant model reviewer identified two outliers in the provided energy model. Both values were more than 20 percent lower than the baseline minimum. Once these outliers were removed, the Navigant team scaled resulting savings to 12 months. It is unclear whether production decreases would affect demand. Weekend or third shift production decreases do not affect demand, therefore, the estimates of demand may understate savings.

Site X
Forty-seven weeks were included in the *ex ante* savings calculation. The Navigant modeling reviewer adjusted the savings to 52 weeks. Demand model production adjustments appear to be due to an added production line, which should operate during peak hours.

3.3 Process Evaluation Findings

Due to the late 2016 approval of AEP Ohio's 2017 CEI Program, AEP Ohio was not able to recruit new participants for the 2017 program year. Rather, previous participants were invited to join an alumni group to identify and implement new measures at their facilities and receive the $0.02kWh incentive.

In-depth interviews with the AEP Ohio Program Coordinator and the implementer were conducted to identify any changes to the program design and delivery, as well as reasons behind the energy savings achieved in 2017. A major change to the program was the addition of a demand reduction goal of 402 kW for the 2017 program year. There were no participant surveys conducted for this evaluation.

3.3.1 Marketing Efforts and Program Awareness

With limited time to restart the program, AEP Ohio was not able to market the program to new commercial and industrial customers consuming three GWh or more annually. To keep the program active, AEP Ohio contacted former participants of the program who were already aware of the program and its benefits, and formed two alumni groups. Having existing knowledge of the program accelerated these participants' efforts in identifying and implementing energy savings measures resulting in 24,644 MWh of energy savings.

While AEP Ohio was not able to market and promote the program to its customers for the 2017 program year, Navigant conducted a program material review to support AEP Ohio's future efforts. In this review, inconsistencies were found regarding the savings and eligibility requirements between the various pieces. As the CEI Program expands to a greater audience, consistency and clarity in the information given will become more important in AEP Ohio's program recruitment.

The amount of savings a participant could realistically achieve was stated differently between the materials. In the CEI Fact Sheet the National Electric Manufacturers Association estimate of 15% to 30% conflicts with AEP Ohio's breakdown of program advantages of 5% to 15% (which are also stated in the CEI FLYER Cohort 13 piece). In the AEP Ohio CEI flyer, the flyer states savings of 3% to 5%. It's important for a participant to have a consistent and realistic perspective of the potential savings.

3.3.1.1 Program Website

As previously discussed, the CEI Program uses a direct outreach approach to promote the program with its largest customers, and there is no indication the website is a key method for engaging AEP Ohio's largest customers. However, as the consumption threshold lowers and more commercial customers are engaged, it may benefit the program to be easily found and have a presence on AEP Ohio's website.

When searching the website for the CEI Program, it is very difficult to find the program:

- Customers needed to know what they were looking for to locate the program web page.
- The site does not provide customers with a matrix or map of the available programs, or which one might best meet their needs. As such, strategic energy management or the program name, Continuous Energy Improvement, needs to drive clicks.
- Navigating the website; after six clicks, customers must choose from a combined list of 17 technologies or programs.

3.3.2 Program Requirements

Originally designed for large industrial customers with energy use over 10 GWh, the CEI Program has adjusted its requirements to meet the needs of AEP Ohio customers and the program. As the market for large industrials became saturated, AEP Ohio lowered the consumption requirement to 3 GWh and began including large commercial facilities, such as hospitals and universities in the program.

Once enrolled, participant sites are asked to provide a resource to be the Energy Champion for the site. The energy champion spends approximately four to five hours per week on CEI activities, such as attending training, identifying and implementing energy efficiency measures and building an onsite Energy Team. The Energy Team consists of the Executive Sponsor and co-workers who can influence the use of energy throughout the facility.

While the first program year of participation helps participating facilities identify low cost/no cost opportunities and equipment upgrades, the program's purpose is to develop long-term practices that will provide energy savings beyond the initial year.

3.3.3 Barriers to Participation

While the CEI Program has exceeded its goals over the past three years, engaging new participants from smaller facilities with less than three GWh of consumption may become more difficult as the program matures. Historically from the perspective of the industrial customer, the traditional barrier for the CEI Program has been the time commitment of three to five hours a week for the Energy Champion.

However, as the CEI program brings in more participants from the commercial sector, identifying other additional barriers through a non-participant survey may help AEP Ohio design the program to meet the needs of smaller customers. While keeping their energy bill low is a priority for the small commercial customer, their main focus is on their business and they may not fully understand the benefits energy conservation can bring. Targeting the messaging to these customers may help them realize additional benefits such as lower maintenance costs and improved comfort.

3.3.4 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. The tracking data for this program is straightforward since CEI calculates savings using whole building data and does not track individual measures. Navigant reviewed claimed *ex ante* savings in the tracking data for each site and compared it to the provided site level documentation. Energy savings reported in the tracking data aligned with site level documentation for every site included in the CEI program.

3.3.5 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. Verification inspections are 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 judgment and have been resolved without issue. In most instances, program staff 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 the 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 CEI Program. Cost effectiveness is assessed using the Total Resource Cost (TRC) test. Table 3-5 summarizes the unique inputs used in the TRC test.

Table 3-5. Inputs to Cost-Effectiveness Model for the AEP Ohio CEI Program

Item	Input
Measure Life	5
Projects	37
Ex Post Annual Energy Savings (kWh)	25,549,910
Ex Post Coincident Peak Savings (kW)	2,754
Third Party Implementation Costs	$1,489,818
Utility Administration Costs	$257,512
Utility Incentive Costs	$501,415
Incremental Participant Cost	$0

Source: Navigant impact evaluation and program tracking database

Based on these inputs, the TRC ratio is 2.3 and the CEI Program passes the TRC test. Table 3-6 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-6. Cost Effectiveness Results for the CEI Program

Benefit-Cost Test	Benefit/Cost Ratio
Total Resource Cost	2.3
Participant Cost Test	18.6
Ratepayer Impact Measure	0.5
Utility Cost Test	2.3

Source: Navigant impact evaluation

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 CEI 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: Navigant observed site operation changes during the measurement period that required consideration for removal of some data points due to outlier variables. Variables were considered outliers if these were 110 percent and above the maximum, or 90 percent and below the minimum of the baseline range for a given variable. In some cases, the removal or inclusion of these variables were not well justified and Navigant disagreed with the handling of these data points.

> **Impact Recommendation 1:** The implementer should provide clear explanation for why a point is removed in both the baseline and measurement period model. If a data point is having a repetitive occurrence year after year, it should be removed in both or neither periods.

Impact Finding 2: Some models appeared to be mishandling the impact of capital projects occurring in the baseline. Some capital projects occurred late in the baseline periods and would have not been properly captured by the model. In these cases, Navigant decided to include the energy impact of these measures or equipment in the post period.

> **Impact Recommendation 2:** The impact of capital projects occurring late in the baseline period which may not have been fully completed before the end of the baseline period should be directly accounted for in the post period. This would be done the same way the capital project is being accounted for in the post period.

Impact Finding 3: The models provided to Navigant included *ex ante* calculations with the removal of certain data points because these were outliers or otherwise, but were not properly annualized.

> **Impact Recommendation 3:** If data is removed for any reason in the post period, the savings should be annualized to represent a complete 12-month period.

Impact Finding 4: Site operation changes during the measurement period required the removal of some data points due to short-term or long-term changes occurring at the site. The Navigant CEI team identified these changes on a site-by-site basis; these included the shutdown of major equipment, long-term equipment malfunction, or short-term production changes that affected the overall energy usage.

> **Impact Recommendation 4:** The impact of any event that occurs and affects the CEI savings should be explained and accounted for, if possible. These events could include the temporary malfunction of equipment or any changes of operation that can be readily measured.

Impact Finding 5: Effective useful life for CEI used in the cost effectiveness review is five years which is consistent to what was calculated in the 2016 evaluation. It is difficult to collect the information required to

estimate effective useful life for behavior based programs such as CEI and it was not updated during this evaluation.

> **Impact Recommendation 5:** Navigant recommends continued use of the five-year effective useful life to estimate cost effectiveness for this program.

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: While the CEI Program has exceeded its goals over the past three years, engaging new participants from smaller facilities with less than three GWh of consumption may become more difficult as the program ages. Historically the traditional barrier for the CEI Program has been the time commitment of three to five hours a week for the Energy Champion.

> **Process Recommendation 1a:** Conducting a non-participant survey to assist in identifying other additional barriers may help AEP Ohio design the program to meet the needs of smaller customers.
>
> **Process Recommendation 1b:** Working with the Energy Advisors, identify customers with high participation in the Process Efficiency and Efficient Products programs who may have implemented all identified financially feasible equipment upgrades, yet still have internal energy reduction goals. These customers may welcome a low-cost/no cost solution for their energy reduction.
>
> **Process Recommendation 1c:** Develop a CEI "light" program. This concept is a continuation of one mentioned by the Program Coordinator, where AEP Ohio would provide the energy model to the customer with minimal required workshops. Like other customer's models, this model would be supported and reviewed by the Implementation Contractor.

Process Finding 2: Navigant did not conduct participant interviews this year, but has for other utilities and found many strategic energy management commercial customers are using controls and energy management systems (EMS) to help lower their overall energy consumption. Successful EMS projects ensure advanced controls are programmed and go above and beyond what was being done previously. This is accomplished by customers documenting their existing control strategy and how the new EMS will change these strategies. In addition, the EMS programmers train site staff on how to properly use the EMS to prevent the undoing of advanced control strategies.

> **Process Recommendation 2**: Encourage CEI participants to consider applying to the Efficient Products for Business/Process Efficiency Program to add an Energy Management System (EMS). An EMS will help customers adjust their buildings usage based on their needs and comfort. For customers with existing management systems, a commissioning incentive can be provided to ensure buildings are operating optimally. A secondary benefit of EMS systems is the ability to reduce load during peak hours, assisting AEP Ohio in meeting its demand reduction goals.

Process Finding 3: During the review of program materials, inconsistencies were found in savings and eligibility requirements between the various pieces. As the CEI program expands to a greater audience,

consistency and clarity in the information given will become more important in AEP Ohio's program recruitment.

> **Process Recommendation 3:** Review and update all program materials for consistency in the information provided.

Process Finding 4: When searching AEP Ohio's website for the CEI program, it is very difficult to find the program.

> **Process Recommendation 4:** AEP Ohio's home page should offer options for both the residential and commercial customer, and once selected, an easily followed pathway to the program offerings which best fit the customer's needs.

APPENDIX A. AEP OHIO 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?

AEP Ohio Program Manager Interview Guide – CEI Specific Questions

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.

Energy Savings Calculations

1. Did you continue to provide modeling support to sites after they have completed the program?

    a. **[If yes]** Does this include making updates to the model to reflect major changes at a facility?

2. If a participating site experienced major change in their energy team, were they allowed to rejoin the group (such as losing their champion/sponsor)?

3. Are Sites encouraged to continue to collect variable data after the twelve months of training to accurately reflect the energy savings?

4. Is AEP Ohio continuing to gather data on the sites after they have completed their training year?

Training Workshops

5. Does the training for new cohorts recognizes the differences between the industrial and commercial sectors and present topics differently for each participant group? *[Such as differences in the major energy-consuming end-uses between the sectors, where commercial buildings tend to upgrade lighting and HVAC equipment, while industries tend to focus on process-related upgrades and air compressors. This may require separate training sessions with the various audiences.]*

6. Does the program provide two tiers of training based on the participating companies' levels of expertise and technical knowledge?

7. Does each business type have adequate representation to allow for networking?

8. Once a participant has completed the program, does the program continue to support the customer's modeling efforts? *[Having an accurate understanding of its facilities usage will help the customer maintain and improve upon their savings.]*

APPENDIX B. IMPLEMENTATION CONTRACTOR IN-DEPTH INTERVEW 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?

AEP Ohio Implementation Contractor Interview Guide – CEI specific Questions

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.

Energy Savings Calculations

1. Are the savings calculation based on an annual (12 month) basis even if the program participation goes beyond 12 months?

2. Once all post data is collected, does the implementer review the post period data to look for invalid data points, irregular site operation and other unaccounted-for site changes?

3. Are data points that are not valid in the post period (either above 110 percent of the maximum or below 90 percent of the minimum removed when calculating annualized savings? Or, if there is a significant number of invalid data points, does the implementer provide clear reasons why data points should be included in the post period?

4. Does the implementer provide clear explanations for invalid data points, irregular site operation and other un-accounted for site changes?

5. Does the implementer calculate and remove the impact from additional equipment or long-term changes to operations?

6. Does the implementer carefully review all changes to ensure proper allocation of savings to the CEI Program or to other factors; and, review all measures and ensure each measure is eligible for the program, and remove savings from the model for those measures deemed ineligible.

7. Does the implementer adjust the calculation methodology and apply the adjustments to the post-period demand usage and not to the final demand savings?

8. Does the implementer calculate the relative impact of each variable in the demand calculation, using the provided kWh energy models for each site to understand the relative impact each variable had on the kWh energy use at the site?

Training Workshops

9. Does the training for new cohorts recognizes the differences between the industrial and commercial sectors and present topics differently for each participant group? Such as differences in the major energy-consuming end-uses between the sectors, where commercial buildings tend to upgrade lighting and HVAC equipment, while industries tend to focus on process-related upgrades and air compressors. This may require separate training sessions with the various audiences.

10. Does the program provide two tiers of training based on the participating companies' levels of expertise and technical knowledge?

11. Does each business type have adequate representation to allow for networking?

12. Once a participant has completed the program, does the program continue to support the customer's modeling efforts; having an accurate understanding of its facilities usage will help the customer maintain and improve upon their savings.

APPENDIX P

NAVIGANT

TRANSMISSION AND DISTRIBUTION AND INTERNAL SYSTEM EFFICIENCY IMPROVEMENTS Program

2017 Evaluation Report

Prepared for:

AEP Ohio

AEP OHIO®

A unit of American Electric Power

April 23, 2018

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1. PROGRAM DESCRIPTION

AEP Ohio's Transmission and Distribution and Internal System Efficiency Improvements Program (load loss reduction program) is targeted to transmission and distribution (T&D) facilities that are candidates for efficiency improvements, typically in concert with other benefits, such as increased capacity or reliability performance. For most of these projects, T&D savings are achieved when lines and equipment are replaced with similar facilities producing lower line and equipment losses. For example, replacing smaller, high resistance wire with larger wire with lower resistance is commonly referred to as reconductoring. Physical losses accrue in the form of heat losses. When heating losses are high due to loading equipment above normal ratings for extended periods of time, equipment can be damaged or experience premature loss of life.

Loss reduction also is achieved when new lines are added and existing lines reconfigured, lines are converted to operate at a higher voltage (resulting in lower current needed to supply the same amount of load); feeder power factor is improved, and low loss devices are installed, such as highly-efficient transformers. T&D efficiency benefits accrue via lower peak demand and reduced energy losses. Because losses are proportional to the square of the load served, the percent reduction in peak demand losses are higher than the percent reduction in energy losses.

AEP Ohio's T&D loss reduction program for projects placed in service during 2017 focuses on several of the following measures listed (not all are necessarily implemented in any given year). The methodology AEP Ohio employed to derive demand and energy loss savings is presented in the following sections. Table 3-1 lists the Ohio TRM evaluation protocols[1] AEP Ohio applies to each of the categories.

- Line reconductoring (distribution, subtransmission and transmission)
- New substations and circuits (distribution, subtransmission and transmission)
- Voltage conversion
- Power factor improvement (via capacitor banks, regulators and load-tap changers)
- Feeder reconfiguration
- Load transfers and phase balancing

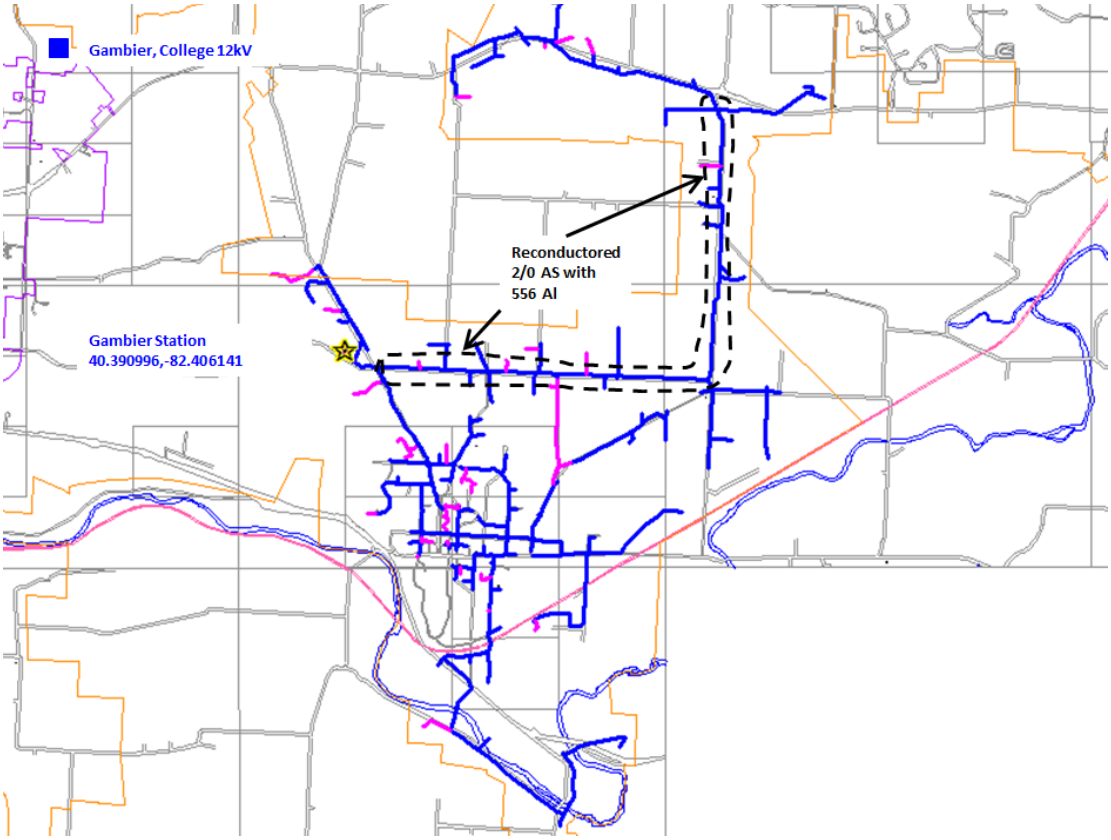
The items previously listed commonly are referred to as loss reduction programs, and include both load and no-load losses. Some electrical equipment, such as transformers, produce load and no-load losses. Load losses vary as the amount of current increases or decreases. No-load losses are independent of load, and occur during all hours the device is in service. No-load losses typically occur only on equipment requiring inductive current (magnetizing current) to operate, such as transformers and motors. Loss reduction programs sometimes may include the replacement of equipment with high no-load losses with devices with lower no-load losses. The load reduction savings AEP Ohio estimated for the aforementioned programs do not appear to include any projects focusing mostly on reduction of no-load losses, which is common among utilities.

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

2. METHODOLOGY

AEP Ohio estimated load loss reduction amounts using tools and methods commonly employed to accurately predict peak and energy savings. These efforts include use of a comprehensive and detailed distribution feeder load flow simulation model (CYMDist) and network transmission load flow models (PSS/E) to estimate loss savings at the time of the feeder peak. The CYMDist and PSS/E models are commonly used by power industry professionals and each applies a level of rigor sufficient to accurately predict losses for transmission and distribution facilities.[2] The accuracy of the model results is highly dependent on model inputs and assumptions. AEP Ohio provided Navigant with distribution model loss output tables and electrical diagrams illustrating the upgrades and changes made for each feeder, with before and after loss summaries, thereby ensuring loss estimates are based on net loss savings. A typical line segment of a representative feeder targeted for loss savings is illustrated in Figure 2-1.

Figure 2-1. Example Project Diagram: Gambier Station, College Circuit – Reconductor Approximately 3 miles of Primary Distribution



In this example, major sections of the circuit were reconductored from 2/O AS to 556 AL, a significant increase in conductor size. The reconductoring reduced net peak loss savings from 117 kW to 76 kW, a 35 percent decrease (several other projects achieved similar percent decreases in line losses).

[2] The loss reduction projects cited by AEP Ohio include distribution lines, typically 15 kV class and below. Projects also include higher rated distribution and transmission lines rated 23 kV, 34.5 kV, 69 kV, 138 kV and 345 kV. Lines rated 34.5 kV, 69 kV and 138 kV often operate radially, but may be configured in a network arrangement, particularly 138 kV. Lines rated 345 kV are almost always operated in a network configuration.

Peak demand losses are derived by conducting load flow studies with and without the upgrade, with the difference in losses between the two cases equal to the net loss savings. AEP Ohio provided copies of model results and feeder maps confirming AEP Ohio's distribution planning personnel included a high level of detail in the CYMDist feeder model for each of the loss reduction programs previously listed. The peak load loss savings AEP Ohio derived for each of the projects listed are consistent with the percent savings Navigant has determined in its own studies of similar upgrades for utility distribution systems, as well as results we have reviewed from projects developed by other utilities.

To derive energy loss savings, AEP Ohio employs the following formula, which Navigant supports as a reasonable and accurate approach (the resulting value of the calculation within the bracket is defined as the Loss Factor). This equation has been vetted and accepted within the utility industry for decades.

$$Energy\ Loss\ Savings = Peak\ Loss\ Savings * (C_1*LF + C_2*LF^2) * 8760$$

Where LF is the feeder load factor, and C1 and C2 are coefficients derived using methods outlined in published industry literature. C_1 and C_2 for AEP Ohio are 0.1 and 0.9, respectively.[3]

The loss factor for the preceding formula typically is between 0.30 and 0.50. The loss factor AEP Ohio used to derive 2017 energy loss savings is 42.02 percent. The results of AEP Ohio's loss reduction program are presented in subsequent sections of this report.

[3] The Energy Loss Savings formula and values used by AEP Ohio were obtained from an internal report titled "AEP Ohio Power Company 2015 Analysis of System Losses", revised 10/2016. This report compiled the results of system loss investigations conducted during 2015 by Management Applications Consulting, Inc. for CSPCO and OPCO. This study also included derivation of the C1 and C2 coefficients. The load factor for AEP Ohio Power Company is 63% obtained from the 2015 Analysis of System Losses and subsequently updated in October 2016.

3. DETAILED FINDINGS

Table 3-1 summarizes the peak demand and energy reductions for AEP Ohio in 2017. Results are presented separately for distribution and transmission assets. Similar to prior years, 2017 reported loss savings are higher for transmission facilities. Table A-2 (Appendix) presents reported demand and energy loss savings for specific T&D projects AEP Ohio placed in service during 2017.

Table 3-1. Peak Demand and Energy Reductions

	Number of Projects	Peak (kW)	Energy (kWh)
Distribution	13	652	2,400,850
Transmission	15	7,900	29,079,500
TOTAL	**28**	**8,552**	**31,480,350**

3.1 Distribution Loss Savings

Navigant's review confirmed AEP Ohio's composite peak demand savings of approximately 652 kW for distribution is reasonable and consistent with the level of savings associated with the 13 projects summarized above and listed individually in Table A-2 (Appendix). This conclusion is supported by the type of projects included in the AEP Ohio loss reduction program and the methods AEP Ohio employed to derive these savings. Navigant notes the amount of peak demand savings increased by about 152 kW from those reported in 2016 (a 30% increase). A similar increase occurred for energy savings, with about 560,000 kWh greater savings than 2016. The average demand and energy savings per distribution project in 2017 increased by about 30 percent compared to projects completed in 2016. AEP Ohio reports the modest increase in 2017 was due to the large number of reconductoring projects completed in 2017.

Navigant's review confirms the peak demand and energy reductions are reasonable given the scope of each upgrade. Further, similar to most electric utilities, most distribution projects are implemented to address capacity shortages or improve reliability or operating flexibility, with loss reduction as an ancillary benefit - major upgrades typically are not justified on loss reduction benefits alone. For example, most projects are line reconductoring; that is, replacing smaller wire with larger wire. However, the amount of wire replaced typically is a relatively small percent of the total miles of conductor on the feeder, which accounts for the relatively small amount of loss savings as a function of total feeder load. However, because distribution feeder losses typically are less than five percent of total feeder demand, the reduction that AEP Ohio cites for each project represents significant savings.

3.2 Transmission Loss Savings

The magnitude of total loss savings (7,900 kW at peak) associated with transmission level is based on the combined savings associated with fifteen projects or line segments resulting in loss savings. The 2017 transmission peak loss savings is 6,000 kW higher than 2016, a 316 percent increase. Table A-2 (Appendix) lists specific transmission projects and upgrades placed into service in 2017. Notably, the number of transmission projects nearly doubled compared to 2016 (15 versus 7). The average demand reduction per project almost doubled, from 271 kW to 527 kW of savings per project. The average energy savings per project increased from 1,000,000 kWh in 2016 to about 2,000,000 kWh in 2017. AEP Ohio reports the increase in transmission loss savings was due to a larger amount of funds spent on capacity projects (e.g. reconductoring and voltage conversions) in 2017, versus mostly reliability projects in 2016. Reliability upgrades typically produce few, if any, loss savings.

Similar to prior years, the magnitude of transmission demand and energy loss savings is greater than distribution. This finding is not unusual, as major transmission upgrades often result in substantial line loss savings, as the amount of power delivered per line mile is much higher than distribution lines. Navigant views AEP Ohio's transmission peak loss savings as consistent with the level of loss reduction achieved by other utilities implementing upgrades comparable with those listed in Table A-2. Similar to distribution, transmission upgrades usually are implemented to improve performance and increase capacity transfer capability, with loss reduction as an added benefit.

Navigant's conclusions are supported by the review of AEP Ohio's project details and the analysis AEP Ohio prepared for each project, each of which confirms the level of rigor applied to transmission level projects also is consistent with methods employed by electric utilities and transmission system operators. Further, the analysis AEP Ohio used to derive transmission energy savings is consistent with methods used by many electric utilities. Most importantly, AEP Ohio Transmission Planning reports it performed detailed network load flow studies to estimate transmission loss savings.[4] Based on the amount of transmission network load and types of upgrades outlined in Table A-2, Navigant concludes AEP Ohio's reported peak and energy loss savings are reasonable and accurate.

[4] The loss savings for transmission projects were derived on a composite basis for AEP Ohio, as it was necessary to conduct network load flow studies with all upgrades and modifications in service. Thus, the transmission projects are not mutually exclusive in terms of their combined impact on the transmission network, as the resultant line loadings will vary as the network is changed. Thus, the loss savings associated with each project, if modeled individually, are not additive.

Appendix A. T&D PROJECT TYPES

Table A-1 lists the T&D project types from the Draft Ohio TRM. Note some project categories used in prior years did not apply in 2017 as no projects were undertaken. For example, no mass plant retrofit or large customer connection projects were completed in 2017.

Table A-1. T&D Project Types

Ohio TRM T&D Project Types
1. Mass Plant Replacement and Expansion Analysis Protocol
2. Conductor Analysis Protocol
3. Large Customer Connection Analysis Protocol
4. Mass Plant Retrofit Analysis Protocol
5. Substation Transformer Analysis Protocol
6. System Reconfiguration Analysis Protocol
7. Voltage Conversion Analysis Protocol

Table A-2 lists the project name, scope, whether the project was either Transmission (T) or Distribution (D), the type of project in terms of the Ohio TRM designations, the peak demand reduction (kW) and the annualized loss reduction (kWh).

Table A-2. AEP Ohio T&D Projects

	Project	Scope	TRM Project Type	Peak Reduction (kW)	Annualized Loss Reduction (kWh)	Transmission or Distribution (T or D)
1.	4KV Conversion - Coshocton Station, Dehart Circuit - Converted approximately 2,875 kVA from 4kV to 12kV. The load was transferred to two adjacent circuits and one circuit was retired. This provided an overall loss reduction of 58.04 KW.	Voltage Conversion	7	58.0	213,640	D
2.	Reconductor - Torrey Station, Dueber Avenue Circuit - Reconductored approximately 1 mile of three phase primary consisting of 2 AA with 556 AL conductor. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	34.3	126,070	D
3.	Reconductor - Flag City Station, West Circuit - Reconductored approximately 9,700 feet of three phase primary consisting of 2 AA with 556 AL conductor. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	2.1	7,660	D
4.	Reconductor - East Sparta, Waynesburg Circuit - Reconductored approximately 3,000 feet of three phase primary consisting of 4 CU with 556 AL conductor. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	0.7	2,500	D
5.	Reconductor - Circleville Station, Southeast Circuit - Replaced the double circuit upon itself consisting of 4/0 AS and 336 AS with 556 AL. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	5.4	19,910	D
6.	Reconductor - Elk Station, Zaleski Circuit - Reconductored 1/0 AA and 4/0 AA three phase primary conductor with approximately 15,600 feet of 556 AL. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	144.7	532,740	D

	Project	Scope	TRM Project Type	Peak Reduction (kW)	Annualized Loss Reduction (kWh)	Transmission or Distribution (T or D)
7.	Reconductor - Ginger Station, North Circuit - Changed tap from A-phase to C-phase. This resulted in an annualized loss reduction of 70.38 MWhs.	Reconductoring	2	19.1	70,380	D
8.	Reconductor - Ginger Station, South Circuit - Reconductored approximately 7,000 feet of three phase primary consisting of 2 ACSR with 556 AL conductor. This improved the conductor ampacity to 730 amps per phase.	Reconductoring	2	24.1	88,860	D
9.	Reconductor - Buckskin Station, Greenfield Circuit - Relocated and reconductored #2 ACSR with 4/0 AA. This increased the conductor ampacity to 410 amps per phase.	Reconductoring	2	204.5	752,640	D
10.	Reconductor - Slate Mill Station, Bourneville Circuit - Reconductored approximately one mile of 1/0 three phase overhead primary with 556 AL conductor. This increased the conductor ampacity to 730 amps per phase.	Reconductoring	2	65.8	242,350	D
11.	Reconductor - Gambier Station, College Circuit - Approximately three mile of three phase 2/0 AS primary was reconductored with 556 AL conductor. This increased the conductor ampacity to 730 amps per phase.	Reconductoring	2	40.9	150,400	D
12.	Alleviate Overload - Anchor Hocking Station, Cedar Circuit to Lancaster Station, Northwest Circuit - Load transfer of 250 KW from Anchor Hocking/Cedarhill Circuit to Lancaster/Northwest Circuit resulting in a net megawatt hour energy savings of 4.79 MWhs.	System Reconfiguration	6	1.3	4,790	D
13.	Reconductor - Clinton Station, F-2909 Circuit - Reconductored approximately 10,000 feet of three phase overhead primary consisting of 336 Al and 4/0 Cu with 556 AL conductor. This increased the conductor ampacity to 730 amps per phase.	Reconductoring	2	51.3	188,910	D

Project	Scope	TRM Project Type	Peak Reduction (kW)	Annualized Loss Reduction (kWh)	Transmission or Distribution (T or D)
14. Biers Run - Circleville 138 kV 18.9 miles 1590 ACSR	Reconductoring	2	inc[5]	inc	T
15. Harrison - Circleville - Scippo - Scioto Trail - Tuscany - Delano 138 kV line rebuild, 33.8 miles total mostly 1590 ACSR, some 1234 ACSR. Ross transformer replaced with 90 MVA 138-69kV transformer	Reconductoring Substation Transformer	2, 5	inc	inc	T
16. Tidd - Gable 138 kV line rebuild. 5.8 miles with 6-wired 1234 ACSS/TW 'Yukon' conductor	Reconductoring	2	inc	inc	T
17. Sparta Switch - East Sparta 23kV to 69kV conversion. Convert 1.25 miles of 23kV circuit to 69kV. Conductor is 1033 ACSR 'Curlew'	Voltage Conversion Reconductoring	7, 2	inc	inc	T
18. Convert Freebyrd-Stone Plant Switch-South Cadiz from 69kV to 138kV. 3.7 miles of 1033 ACSR 'Curlew' conductor.	Voltage Conversion Reconductoring	7, 2	inc	inc	T
19. Bane-Augusta-West Summitville-Summitville 23kV to 69kV conversion. Convert 5.4 miles of 23kV circuit to 69kV. Conductor is 556 ACSR 'Osprey'.	Voltage Conversion Reconductoring	7, 2	inc	inc	T
20. Rebuild the Corner - Parkersburg 138 kV line (6.36 miles) with the conductor size 1033 ACSR 54/7 Curlew.	Reconductoring	2	inc	inc	T
21. Poston - Lick rebuild 3.6 miles with the conductor size 1233.6 ACSR/TW Type 13 Yukon.	Reconductoring	2	inc	inc	T
22. New Cole 345/138 kV 675 MVA station tapping the Beatty-Hayden 345kV circuit. New 11.0 mile 138 kV circuit from Cole to Hayden with the conductor size 1590 ACSR 45/7 Lapwing . New 138kV switch station at Sumac with two new 0.1 mile 138kV lines to Amlin with the conductor size 954 ACSR 45/7 Rail.	System Reconfiguration	6	inc	inc	T
23. New Clouse 138/69 kV 130 MVA station and Clouse 138 kV extension West 0.1 miles of 1033 ACSR 54/7 and Clouse 138 kV extension East 0.1 miles of 1033 ACSR 54/7.	System Reconfiguration Reconductoring	6, 2	inc	inc	T

[5] All transmission values assigned "inc" appear on a consolidated basis in Table 3-1. Transmission losses are derived on a total system basis as opposed to individual projects.

Project	Scope	TRM Project Type	Peak Reduction (kW)	Annualized Loss Reduction (kWh)	Transmission or Distribution (T or D)
24. Rebuild 40kV as 69kV and loop Nautlius into 69kV from Blair to Trabue (7.7 miles) with 1033 ACSR 54/7 Curlew.	Voltage Conversion Reconductoring	7, 2	inc	inc	T
25. Rebuild 16.71 miles of the Poston - Hocking 138 kV circuit with 1033 ACSR 54/7.	Reconductoring	2	inc	inc	T
26. Calcutta - North Wellsville 69 kV rebuild. 6.4 miles with1234 ACSR/TW conductor. Note that 1.0 mile is double-circuit 69kV (shared with North Wellsville-Second Street 69kV circuit.	Reconductoring	2	inc	inc	T
27. Install new West End Fostoria 138/69 kV 90 MVA transformer #6.	Substation Transformer	5	inc	inc	T
28. Yager 138/69 kV station. New 200 MVA 138-69kV transformer. Step down to existing AEP 69kV circuit. Yager-Leesville 138kV circuit: 4.0 miles of 1033 ACSR 'Curlew'.	Substation Transformer Reconductoring	5, 2	inc	inc	T

APPENDIX Q

AEP Ohio Utility Energy Efficiency Savings Summary

1 Incremental Savings from Programs in Year 2017

	Ex Ante Gross Savings			Realization Rate		Actual Expenditures			Participation		Weighted Program Measure Life	TRC Test Ratio	PAC Test Ratio	Notes
	A	B	C	D	E	F	G=F/A	H=F/C	I	J	K=C/A	L	M	
	First Year Annual Energy Savings	First Year Peak Demand Savings	Lifetime Savings	Energy Savings (Ex PostGross/Ex Ante Gross)	Demand Savings (Ex Post Gross/Ex Ante Gross)	Program Costs	Ex Ante First Year Cost Per First Year Annual Savings (F/(A*1000))	Ex Ante First Year Cost per Lifetime Savings (F/(C*1000))	Participation Number	Description (Units Description is provided in the PSR)	Years	By Program	By Program	
	MWh	MW	MWh	%	%	$	$/kWh	$/kWh				C/E Ratio	C/E Ratio	
Residential Programs														
Efficient Products	106,783	19.2	1,861,653	99%	99%	11,895,315	0.11	0.0064	2,802,645	Units	17	4.5	6.5	
Intelligent Home & DR	0	0.0	0	N/A	N/A	3,044,307	-	-	8,511	Participants	0	0.0	0.0	
Appliance Recycling	18,388	2.9	147,104	100%	100%	2,112,443	0.11	0.0144	12,880	Participants	8	3.2	3.2	
Home Energy Reports	76,229	9.9	76,229	96%	96%	1,355,835	0.02	0.0178	550,209	Participants	1	2.2	2.2	
Residential New Homes	5,299	2.8	133,086	100%	100%	2,212,839	0.42	0.0166	1,762	Participants	25	1.7	3.4	
Manu. New Homes	35	0.0	621	N/A	N/A	397,072	11.51	0.6394	5	Participants	18	0.1	0.1	
e^3 *smart* SM	2,973	0.4	41,027	111%	117%	913,366	0.31	0.0223	25,000	Units	14	1.9	1.9	
Community Assistance	6,050	0.9	100,717	96%	100%	6,280,112	1.04	0.0624	4,397	Participants	17	0.7	0.7	
Total Residential	**215,755**	**36.1**	**2,360,438**			**28,211,289**	**0.13**	**0.01**	**3,405,409**		**11**	**3.1**	**3.8**	
Business Programs														
Efficient Products for Bus.	150,141	23.9	1,353,820	105%	95%	14,651,071	0.10	0.01	2,141	Projects	9	1.3	4.2	
Process Efficiency	46,464	4.9	892,060	105%	76%	3,761,196	0.08	0.00	62	Projects	19	1.3	8.6	
Bus. New Construction	44,687	7.2	625,619	96%	105%	4,162,824	0.09	0.01	129	Projects	14	2.1	6.5	
Express	9,296	1.2	125,741	101%	112%	2,142,310	0.23	0.02	422	Projects	14	1.4	2.5	
Self Direct	6,533	0.9	92,215	97%	98%	807,221	0.12	0.01	63	Projects	14	0.8	3.8	
Demand Response	0	0.0	0	N/A	N/A	-	-	-	0	Projects	0	0.0	0.0	
Retro-Commissioning	4,740	0.0	23,700	63%	100%	790,973	0.17	0.03	19	Projects	5	0.7	1.0	
CEI	24,644	3.4	98,577	104%	82%	2,248,746	0.09	0.02	37	Projects	4	1.8	1.8	
Data Center	31,180	4.1	537,346	89%	78%	2,389,439	0.08	0.00	11	Projects	17	1.4	8.8	
Combined Heat & Power	0	0.0	0	N/A	N/A	515,086	-	-	0	Projects	0	0.0	0.0	
Total Business	**317,685**	**45.6**	**3,749,079**			**31,468,865**	**0.10**	**0.01**	**2,973**		**12**	**1.5**	**5.3**	
Other Programs														
Education & Training	0	0.0	0			225,438			0		0			
Targeted Advertising	0	0.0	0			2,764,408			0		0			
Research & Development	0	0.0	0			1,688,058			0		0			
Community Energy Savers	0	0.0	-			-			0		0			
Total Other	**0**	**0.0**	0			**4,677,905**			0					
Portfolio Total	**533,440**	**81.7**	**6,109,517**			**64,358,060**	**0.12**	**0.01**	**3,408,382**		**11**	**1.7**	**4.1**	

2 Information Relative to Statutory Targets for Year 2017

3 year baseline retail normalized (mercantile, weather, opt-out, etc.) sales. (MWh)	38,529,489
2017 Annual Benchmark Target (%)	1.00%
2017 Savings (MWh)	533,440
2017 T&D & Gridsmart (MWh)	35,384
2017 Achievement (%)	148%

3 Banked Savings in Year 2017

2017 Excess Savings Banked Toward Future Compliance (MWh)	125,736
Total Banked Savings Remaining After 2017 (MWh)	1,365,802

4 Opt Out - Three year baseline in 2017

Total Opt Out load (MWh)	5,089,794

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