

2021 Virginia Commercial & Industrial Program EM&V Report

Volume I of II

Prepared for:
Appalachian Power Company

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Prepared by:



ADM Associates, Inc.

3239 Ramos Circle
Sacramento, CA 95827
916.363.8383

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1. Introduction

Under contract with Appalachian Power Company (herein referred to as the “Company” or “APCo”), ADM Associates, Inc., (herein referred to as “the Evaluation Team”) performed evaluation, measurement and verification (EM&V) activities to confirm the energy savings (kWh) and demand reduction (kW) realized through the energy efficiency and demand response programs that the Company implemented in Virginia during 2021. This report details the EM&V activities and findings relating to programs the Company offered in the commercial and industrial (C&I) sector.

This chapter provides a brief description of the C&I programs offered by the Company, a summary of evaluation findings, and information regarding the organization of the report.

1.1. Program Year 2021 Commercial and Industrial Program Offerings

The Company offered three energy efficiency programs during program year 2021 (PY2021). A brief description of each program is provided below.

C&I Lighting Program: The C&I Lighting Program was designed to generate energy savings for all non-residential customers through the use of high efficiency lighting. Customers receive incentives for the installation of approved energy efficiency equipment. Incentive amounts are calculated using a five cents per kWh formula which references annual hours of operation by building type according to the Mid-Atlantic TRM. The incentive could not exceed 30% of the project’s total cost.

C&I Standard Program: The C&I Standard Program generates energy savings through the installation of non-lighting energy saving measures including compressed air, industrial motors, refrigerator equipment, kitchen equipment, and HVAC equipment. The program provided an incentive of \$0.12/kWh saved and capped incentives at 30% of the total project cost.

Small Business Direct Install Program: The Small Business Direct Install (SBDI) Program provides small businesses with a no-cost energy assessment and direct install measures including screw-in LED light bulbs and energy saving low-flow showerheads faucet aerators, and pre-rinse sprayers. Incentives of \$0.15/kWh saved were offered for additional lighting and refrigeration measures. The program was open to small businesses with peak monthly demand of 200 kW or less.

Program evaluation findings are summarized in the following sections. The evaluation findings refer to expected and realized as well as gross and net impacts. For the purposes of this report, these impacts are defined as:

Expected Impacts: Energy savings (kWh) and peak demand (kW) reduction estimates based on customer participation in PY2021, before program evaluation activities.

Realized Impacts: Energy savings (kWh) and peak demand (kW) reduction estimates for PY2021 developed through the Evaluation Team's evaluation, measurement and verification (EM&V) activities.

Gross Impacts: Changes in energy consumption/demand that result directly from program-promoted actions regardless of the extent or nature of program influence on these actions.

Net Impacts: The portion of gross impacts that is directly attributable to the actions of the Company's energy efficiency and/or demand response programs.

The evaluation of the Company's programs complies with the rules for evaluation, measurement, and verification (EM&V) set forth in Case No. PUR-2017-00047.

Table 1-1 Compliance with Case No. PUR-2017-00047 EM&V Rules

<i>Subsection</i>	<i>Requirement</i>	<i>Response</i>
20VAC5-318-40 (A)	<p>In all filings required by 20VAC5-318-30, the sources of all data or estimates used as inputs for proposed DSM measures or programs, in descending order of preference, shall be:</p> <ol style="list-style-type: none"> 1. Utility-specific data; 2. Virginia-specific data if utility-specific data is unavailable or impracticable. When Virginia-specific data is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable; 3. Data from non-Virginia jurisdictions or sources, if neither utility-specific data nor Virginia-specific data is available or practicable: <ol style="list-style-type: none"> a. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable. b. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why Virginia-specific data is unavailable or impracticable as well as the sources of all data, to include: <ol style="list-style-type: none"> (1) Titles, version numbers, publication dates, and page numbers of all source documents, as appropriate; and (2) An explanation as to why, in the utility's assessment, use of this data is appropriate. 	<p>The methods used to evaluate program impacts is provided in the methodology sections of each program chapter of this report and in the site-level reports presented in Volume II. The methods comply with the order of preferred data inputs cited in code 20VAC5-318-40 (A). Primary data may be supplemented by secondary data to facilitate cost efficient allocation of EM&V resources. Titles, version numbers, publication dates, and page numbers of all source documents are cited, as appropriate.</p>
20VAC5-318-40 (B)	<p>EM&V reports shall include relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.</p>	<p>The program chapters describe the methodologies used to estimate savings for the program measures and include citations of relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.</p>

<i>Subsection</i>	<i>Requirement</i>	<i>Response</i>
		Additional information is provided in the site-level reports presented in Volume II.
20VAC5-318-40 (C)	EM&V reports shall include measure-level estimates of kilowatt, kilowatt-hour, dekatherm, and pipeline capacity savings as appropriate. An estimate that has been adjusted for free-ridership as well as an estimate that has not been adjusted for free-ridership should be included as appropriate.	The cost-effectiveness analysis file submitted with the EM&V report presents measure-level estimates of peak kW and kWh energy savings.
20VAC5-318-50 (A)	EM&V of approved DSM measures or programs should be consistent with and contrasted to the preliminary EM&V plan set forth in the filings for approval of such measures or programs or as otherwise specified in a commission order approving such measures or programs. The commission recognizes that each utility has unique characteristics, and new or modified energy efficiency measures are constantly being developed. As such, alternative methodologies may be included in reporting provided that sufficient supporting documentation and explanation of appropriateness of alternative methodologies is provided.	The EM&V reports detail any deviations from the approach submitted in the EM&V plan set forth in the filings and the reasons for that deviation.
20VAC5-318-50 (B)	EM&V reports of existing measures or programs shall utilize utility-specific data or other data in conformance with 20VAC5-318-40 A when updating the analysis of the cost effectiveness of each measure, program, or portfolio as appropriate and practicable. EM&V reports of existing measures or programs shall include the information required by 20VAC5-318-40 B and C.	The EM&V report includes this information.
20VAC5-318-50 (C)	Any changes to or variances from originally approved measure-level inputs and assumptions shall be documented and explained, and the impact of such changes on original cost/benefit estimates for DSM programs or measures shall be quantified.	The EM&V report presents cost effectiveness analysis based on the expected savings estimates to characterize the discrepancy between the benefits resulting from the expected estimates and the ex post estimates. The presentation of savings results includes discussion of the reasons for differences between the expected savings and ex post savings estimates.
20VAC5-318-50 (D)	EM&V reports shall describe the methodologies by which the measured data was collected, including at a minimum: 1. The sampling plan; and 2. Statistical calculations upon which the reported data is based when applicable.	The sampling approach is presented in the methodology section of the program chapters.
20VAC5-318-50 (E)	EM&V reports for ongoing DSM measures or programs shall include an explanation of eligibility	The program chapters provide a description of the program that includes information on the measure

<i>Subsection</i>	<i>Requirement</i>	<i>Response</i>
	requirements for each rate schedule to which the measures or programs are being offered.	or program eligibility requirements as provide by the Company.
20VAC5-318-50 (F)	EM&V reports for ongoing DSM measures or programs shall include a comparison of the measured annual measure or program savings estimates to the annual usage of the average rate schedule usage and eligible customer in each rate schedule to which the measures or programs is being offered. A comparison to originally approved estimated savings for the measures or programs that were approved by the commission shall also be provided. This will include a calculation of the expected savings as a percentage of the annual usage of the average rate schedule usage and eligible customer as appropriate and practicable.	The program chapters present a table for each program and rate class, based on data provided by the Company, that summarizes the following information: Program Name, Rate Schedule, Total kWh Savings, Number of Participating Customer Accounts, Average kWh Savings per Customer Account, and Average Consumption per Account for the Rate Schedule
20VAC5-318-50 (G)	<p>EM&V reports for ongoing DSM measures or programs shall include a description of the controls undertaken by the utility to verify proper installation of the measures or programs, as appropriate. Additionally, utilities shall require the contractors and subcontractors that will be implementing the measures or programs, if applicable and practicable, to record details of serviced or replaced equipment, to include at a minimum:</p> <ol style="list-style-type: none"> 1. Nameplate efficiency ratings; 2. Serial numbers; and 3. Model numbers. <p>This information will be made available to commission staff upon request.</p>	<p>The program chapters include the following information as provided by the Company or otherwise determined through the evaluation effort:</p> <ol style="list-style-type: none"> 1) a description of program installation quality controls. 2) a description of equipment specification data recorded by the program.
20VAC5-318-50 (H)	EM&V reports should include actual costs incurred by the utility and each EM&V contractor for (i) the development of the most recent EM&V plan and (ii) the administration of EM&V activities for the reporting period.	Unless otherwise noted, where applicable, costs presented in the cost effectiveness analysis chapter of the EM&V report are inclusive of actual costs incurred by the utility and each EM&V contractor for the development of the most recent EM&V plan and the administration of EM&V activities for the reporting period.

1.2. Summary of Data Collection

Table 1-2 summarizes survey data collection activities that supported the PY2021 evaluation of the Company's C&I programs.

Table 1-2 Summary of Participant Survey Data Collection

<i>Program Name</i>	<i>Number of Completed Surveys</i>
C&I Lighting Program	13
C&I Standard Program	4
Small Business Direct Install Program	0

1.3. Impact Evaluation Findings

The Evaluation Team performed EM&V activities for each of the C&I programs offered by the Company during PY2021.

As shown in Table 1-3, the Company's C&I programs achieved gross realized energy savings of 43,594,409 kWh, with a gross realization rate of 78%. The C&I programs achieved net realized energy savings of 40,478,813 kWh, with a portfolio-level net-to-gross ratio of 93%.

As shown in Table 1-4, Company's C&I programs achieved gross realized peak demand reductions of 2,375.03 kW, with a gross realization rate of 65%. The C&I programs achieved net realized peak demand reductions of 1,954.23 kW, with a portfolio-level net-to-gross ratio of 82%.

Table 1-3 Summary of C&I Portfolio Energy Savings

<i>Program Name</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kWh Savings</i>	<i>Net-to-Gross Ratio</i>	<i>Net Lifetime kWh Savings</i>
C&I Lighting Program	16,448,721	14,924,758	91%	11,865,183	80%	173,996,276
C&I Standard Program	673,770	546,502	81%	496,604	91%	6,032,895
Small Business Direct Install Program	10,475,975	47,096	0%	40,973	87%	526,772
Opt Out	28,076,053	28,076,053	100%	28,076,053	100%	28,076,053
C&I Portfolio Totals	55,674,520	43,594,409	78%	40,478,813	93%	208,631,997

Table 1-4 Summary of C&I Portfolio Peak Demand Impacts

<i>Program Name</i>	<i>Ex Ante kW Savings</i>	<i>Gross Ex Post kW Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kW Savings</i>	<i>Net-to-Gross Ratio</i>
C&I Lighting Program	2,906.55	2,279.35	78%	1,870.88	82%
C&I Standard Program	78.47	85.00	108%	74.60	88%
Small Business Direct Install Program	676.25	10.68	2%	8.76	82%
Opt Out	-	-	N/A	-	N/A
C&I Portfolio Totals	3,661.28	2,375.03	65%	1,954.23	82%

1.4. Process Evaluation Findings

A process evaluation was not performed for the C&I programs in 2021 because these programs will be implemented by a new implementation contractor in 2022. The customer satisfaction findings are summarized below.

C&I Lighting Program

Findings:

- **Participant survey feedback was positive.** All survey respondents that had questions of program staff were satisfied with the timeliness and thoroughness of their responses. Additionally, all participants reported satisfaction with the program overall.

C&I Standard Program

- **Participant survey feedback was positive.** All survey respondents that asked program staff questions were very satisfied with the timeliness and thoroughness of their responses. Additionally, all participants reported satisfaction with the program overall.

1.5. Cost Effectiveness Evaluation Findings

The following cost effectiveness tests were performed for the programs: Total Resource Cost (TRC) test, Program Administrator Cost Test (PACT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A test score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The test results for each program are presented in Table 1-5. For reference, for the Small Business Direct Install Program, supplemental test results are presented that are inclusive of PY2021 costs and benefits as well as costs of benefits of the program during PY2022 – PY2026, discounted to PY2021 net present value (NPV).

Table 1-5 Summary of Benefit-Cost Ratios – PY2021

<i>Program</i>	<i>Program Administrator Cost Test</i>	<i>Total Resource Cost Test</i>	<i>Ratepayer Impact Measure</i>	<i>Participant Cost Test</i>
C&I Lighting Program	6.34	4.48	0.47	14.50
C&I Standard Program	0.57	0.43	0.26	2.84
Small Business Direct Install Program	0.04	0.05	0.04	56.34
Small Business Direct Install Program (PY2021 + NPV Projected PY2022 - PY2026)	1.95	1.77	0.97	1.94

1.6. Organization of the Report

This report is divided into two volumes providing information on the impact, process, and cost effectiveness evaluation of the Company's portfolio of C&I programs implemented in Virginia during the 2021 program year. Volume I is organized as follows:

- Chapter 2: C&I Lighting Program
- Chapter 3: C&I Standard Program
- Chapter 4: Small Business Direct Install Program
- Chapter 6: Cost Effectiveness Evaluation

See report Volume II for chapters presenting results from site-visits, data collection instruments and survey results.

2. C&I Lighting Program

2.1. Program Description

The C&I Lighting Program was designed to generate energy savings for all non-residential customers through the use of high efficiency lighting. Customers receive incentives for the installation of approved energy efficiency equipment. Incentive amounts are calculated using a five cents per kWh formula which references annual hours of operation by building type according to the Mid-Atlantic TRM. The incentive could not exceed 30% of the project's total cost. Expected kWh savings are shown in Table 2-1. There were 144 projects completed in the program during the 2021 program year that resulted in expected savings of 16,448,721kWh.

Table 2-1 Ex Ante kWh Savings

<i>Number of Projects</i>	<i>Total Ex Ante kWh Savings</i>
144	16,448,721

2.1.1. Program Eligibility Requirements

The C&I Lighting program is available to non-residential accounts served by the Company. Customers that meet one or more of the following conditions are not eligible for the program:

- ❑ Customers served under the Public Authority or Commonwealth of Virginia tariffs (e.g., non-jurisdictional accounts); and
- ❑ Customers who opted out of the Company's energy efficiency programs as of July 1, 2018.

Qualifying projects must be installed in a facility in the Company's service territory and must be fully installed. All projects must comply with state, federal, and local code requirements.

The following projects are not allowed:

- ❑ Projects that have received incentives from another Company program;
- ❑ Projects that involve fuel switching;
- ❑ On-site electricity generation;
- ❑ Gas-driven equipment; and
- ❑ Used or rebuilt equipment.

2.1.2. Summary of Savings by Eligible Rate Schedule

Table 2-2 compares average participant ex post net energy savings with the average energy usage of accounts for each applicable eligible rate schedules. The table also presents average participant account-level net ex post energy savings as a percentage of average participant baseline (2020 calendar year) energy usage.

Table 2-2 Summary of Savings by Eligible Rate Schedule¹

Rate Schedule Class	Total Net Ex Post kWh Savings	Number of Participating Accounts	Average Participant Account-Level Net Ex Post kWh Savings	Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage
200	7,710,226	149	51,746	47,126	109.81%	7.26%
300	4,154,957	12	346,246	16,719,909	2.07%	4.74%

2.2. Data Collection

2.2.1. Verification of Measures

This section discusses the sampling plan and procedures used to verify the measures installed through the C&I Lighting Program. The evaluation team used onsite visits and telephone interviews to collect project data for estimating project savings.

2.2.1.1. Sampling Plan

Data used to estimate the gross savings achieved through the C&I Lighting Program were collected for samples of projects completed during the period January 2021 through December 2021. Data provided by the implementation contractor and utility showed that during the 2021 program year, there were 144 projects completed under the program that resulted in expected savings of 16,448,721kWh annually.

Inspection of data on kWh savings for individual projects provided by the implementation contractor indicated that the distribution of savings was generally positively skewed, with a relatively small number of projects accounting for a high percentage of the estimated savings. A sample design for selecting projects using a stratified random sampling method was used that took such skewness into account and allowed savings to be determined with ± 10 percent relative precision (or better) at the 90 percent confidence level. For the C&I Lighting Program, the actual precision achieved for the sample was ± 9.7 percent.

Sampling for the collection of program M&V data accounted for the M&V effort occurring in real time during program implementation. Completed projects accumulate over time as the program is implemented, and sample selection was thus spread over the program year as projects are completed. The timing of sample selection was contingent upon the timing of the completion of projects during the program year.

¹ The variable *Average Rate Schedule Account-Level kWh Usage* is calculated as the average annual kWh usage of all customer accounts for each schedule, excluding program-ineligible customers who opted out of paying for the costs of energy efficiency programs as of July 1, 2019. The variable *Average Participant Baseline Account-Level kWh Usage* is calculated as the average energy use of program participants for a given rate schedule during 2019, not accounting for any accounts for which a full year of 2019 data was unavailable.

2.2.1.2. Population Statistics and Expected Savings

Table 2-3 shows the number of projects, expected energy savings, and sampling statistics, by stratum, of the program sample.

Table 2-3 Population Statistics Used for Sample Design

	<i>Stratum 5</i>	<i>Stratum 4</i>	<i>Stratum 3</i>	<i>Stratum 2</i>	<i>Stratum 1</i>	<i>Totals</i>
Strata boundaries (kWh)	> 890000	200000 - 890000	100000 - 200000	50000 - 100000	< 50000	
Number of projects	4	11	14	28	87	144
Total kWh savings	6,049,428	4,427,344	2,112,103	1,996,435	1,863,411	16,448,721
Average kWh Savings	1,512,357	402,486	150,865	71,301	21,419	2,158,427
Std. dev. of kWh savings	723,798	200,069	25,973	13,828	13,583	977,251
Coefficient of variation	0.48	0.5	0.17	0.19	0.63	
Final sample	4	4	2	4	13	27

As shown in Table 2-4, the sample projects for the C&I Lighting Program account for approximately 52% of total expected kWh savings.

Table 2-4 Sampled Projects Expected Savings by Stratum

<i>Stratum</i>	<i>Sample Expected Savings</i>	<i>Total Expected Savings</i>
Stratum 1	6,049,428	6,049,428
Stratum 2	1,492,087	4,427,344
Stratum 3	311,387	2,112,103
Stratum 4	311,494	1,996,435
Stratum 5	308,861	1,863,411
Total	8,473,257	16,448,721

2.2.1.3. Verification Data Collection Procedures

The Evaluation Team used onsite visits and telephone interviews to collect data from a sample of projects for use in calculating savings impacts.

When projects were selected for the M&V sample, the Evaluation Team notified the Company and the implementation contractor. This notification also served as a request to the implementation contractor for any documentation relating to the projects. This list included the company name, unique program number, expected savings estimate, and other information relative to the site visit and evaluation effort.

Staff accomplished three major tasks during the onsite visits and interviews:

- First, they verified the implementation status of all measures for which customers received incentives. They verified that the energy efficiency measures were indeed installed, that they were installed correctly and that they still functioned properly.
- Second, they collected the physical data needed to analyze the energy savings that have been realized from the installed improvements and measures. Data were collected using a form that was prepared specifically for the project in question after an in-house review of the project file.
- Third, they interviewed the contact personnel at a facility to obtain additional information on the installed system to complement the data collected from other sources.

ADM collected monitoring data for certain sites to gather more information on the operating hours of the installed measures. Monitoring was conducted at sites where it was judged that the monitored data would be useful for further refinement and higher accuracy of savings calculations. Monitoring was not considered necessary for sites where project documentation and the on-site or telephone interview allowed for sufficiently detailed calculations.

2.2.2. Participant Survey

The Evaluation Team surveyed program participants to collect data to estimate the net savings of the program.

The Evaluation Team contacted a census of unique customers to complete the survey in September 2021 and again in December 2021. Table 2-5 summarizes the data collection effort.

Table 2-5 Summary of C&I Lighting Survey Effort

<i>Survey Mode</i>	<i>Survey Time Frame</i>	<i>Number of Customers Contacted</i>
Online	September 2021	48
Online	December 2021	20
Total Survey Completes		13

2.3. Estimation of Ex Post Gross Savings

This section addresses the estimation of gross kWh savings and peak kW reductions resulting from measures installed in facilities of customers that obtained incentives under the C&I Lighting Program during the period January 2021 through December 2021. Section 2.3.1 describes the methodology used for estimating gross savings. Section 2.3.2 presents the results from the effort to estimate savings for a sample of projects.

Volume II of commercial EM&V reporting contains specific methodologies for estimating gross savings and savings estimation results for each sampled project.

2.3.1. Methodology for Estimating Gross Savings

The methodology used for estimating gross savings is described in this section. The methodology used to estimate savings deviated from the preliminary EM&V plan set forth in the program filing. The preliminary EM&V plan stated that the Evaluation Team would perform on-site visits to verify

measure installations and instead, the Evaluation Team verified the installed measures through both telephone interviews and onsite visits.

2.3.1.1. Review of Documentation and Measure Attributes Tracked

After the samples of projects were selected for the program, the program implementation contractor provided documentation pertaining to the projects. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort. The program records project specific details for the commercial programs in various project documents. The documents include measure spec sheets, invoices, and spreadsheets.

If there was uncertainty regarding a project, or apparently incomplete project documentation, the Evaluation Team contacted the implementation contractor to seek further information to ensure the development of an appropriate project-specific M&V plan.

Table 2-6 presents information on the equipment specification data tracked by the program. In addition to the information tracked in program data, the program tracks detailed measure specific information, which includes efficient/baseline lamp type, efficient/baseline lamp connected load, efficient/baseline lamp quantity, building type, and space conditioning equipment in the lighting calculators and other supporting documentation.

Table 2-6 Gross Impact Attributes Tracked by Program – C&I Lighting

<i>Measure</i>	<i>Attributes Tracked</i>
Lighting Measures	Project ID
	Expected Savings

2.3.1.2. Procedures for Estimating Savings from Measures Sampled through the C&I Lighting Program

The typical M&V method used in the evaluation of this program is application of a lighting evaluation model that references data on new equipment and baseline of lighting equipment and hours-of-use data from interviews with staff at the participating location. Project-specific information on savings calculation is contained in Volume II. Gross impact evaluation results in two estimates of gross savings for each sample project: an expected gross savings estimate (as reported in the project documentation and program tracking system) and the verified gross savings estimates developed through the M&V procedures employed by the Evaluation Team. The Evaluation Team developed estimates of gross savings by applying a ratio estimation procedure in which achieved savings rates (i.e., realization rates) estimated for the sample projects were applied to the expected savings.

Energy savings realization rates² were calculated for each project for which on-site data collection and engineering analysis were conducted. Sites with relatively high or low realization rates were further analyzed to determine the reasons for the discrepancy between expected and realized

² The savings realization rate for a project is calculated as the ratio of the achieved savings for the project (as measured and verified through the M&V effort) to the expected savings (as determined through the project application procedure and recorded in the tracking system for the program).

energy savings. This information for such sites is included in site-level M&V analyses presented in Volume II.

Lighting measures examined include retrofits of existing fixtures, lamps and/or ballasts with energy efficient fixtures, lamps and/or ballasts. These types of measures reduce demand, while not affecting operating hours. Any proposed lighting control strategies were examined – these include the addition of energy conserving control technologies such as motion sensors or daylighting controls. These measures typically involved a reduction in hours of operation and/or lower current passing through the fixtures.

Analyzing the savings from lighting measures required data for retrofitted fixtures on baseline and post-installation wattages and hours of operation.

Project specific information was used to develop hours of use and heating cooling interaction factors (HCIF) for analyzing lighting savings.

- Hours of operation were determined from metered data collected after measure installation for a sample of fixtures or sourced from on-site or telephone interviews with facility managers. Metered data was collected by using Time-of-Use (TOU) data loggers to monitor a sample of “last points of control” for unique usage areas in the sites where lighting efficiency measures were installed. Usage areas were defined to be those areas within a facility that were expected to have comparable average operating hours.
- Savings from lighting measures in conditioned spaces were factored by the region-specific, building type-specific HCIF, calculated by Evaluation Staff, in order to calculate total savings attributable to lighting measures, inclusive of impacts on HVAC operation.

Energy savings realization rates were calculated for each project site for which on-site data collection and engineering analysis/building simulations are conducted. Sites with relatively high or low realization rates were further analyzed to determine the reasons for the discrepancy between expected and realized energy savings. This information for such sites was included in site-level M&V analyses presented in Volume II.

Each stratum-level realization rate was applied to all other (non-sampled) ex post savings values within each stratum. The sum of these values produced the annual realized energy savings for the program.

2.3.1.3. Procedures for Estimating Peak Demand Savings

The peak period for this program is defined as hours 3:00 pm to 6:00 pm, Monday through Friday. Peak demand savings for the program year are calculated using a ratio estimation procedure. Peak savings for sampled projects in each stratum were summed and divided by total kWh savings within the same stratum to produce a stratum-level realization rate (ratio). Each stratum-level realization rate was applied to all other (non-sampled) ex post savings values within each stratum. The sum of these values produced the estimated annual peak demand reduction for the program.

2.3.2. Results of Gross Savings Estimation

To estimate gross kWh savings and peak kW reductions for the program, data were collected and analyzed for a sample of projects. The data were analyzed using the methods described in Section 2.1 to estimate project energy savings and peak kW reductions and to determine realization rates for the program. The results of the analysis are reported in this section.

2.3.2.1. Gross Ex Post kWh Savings

The realized gross kWh savings of the C&I Lighting Program during the period January 2021 through December 2021 are summarized by sampling stratum in Table 2-7. Project-level realization rates are displayed in Table 2-8. Overall, the achieved gross savings of 14,924,758 kWh were equal to 91% of the expected savings.

Table 2-7 Sample Expected and Gross Realized kWh Savings by Sample Stratum

<i>Stratum</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>
Stratum 1	6,049,428	5,309,812	88%
Stratum 2	1,492,087	1,522,395	102%
Stratum 3	311,387	280,938	90%
Stratum 4	311,494	275,170	88%
Stratum 5	308,861	236,771	77%
Total	8,473,257	7,625,085	90%

Table 2-8 Expected and Gross Realized kWh Savings by Project

Stratum	Program Number	Ex Ante kWh Savings	Gross Ex Post kWh Savings	Project Gross Realization Rate
1	EA-0000694572	2,338,482	2,068,710	88%
1	EA-0000694881	1,900,971	1,528,792	80%
1	EA-0000749024	918,227	925,780	101%
1	EA-0000566528	891,748	786,530	88%
2	EA-0000786014	527,243	514,800	98%
2	EA-0000756887	378,287	378,287	100%
2	EA-0000763317	369,613	424,391	115%
2	EA-0000566363	216,944	204,917	94%
3	EA-0000769787	177,555	192,895	109%
3	EA-0000564347	133,832	88,043	66%
4	EA-0000773209	90,326	71,211	79%
4	EA-0000759565	78,208	92,245	118%
4	EA-0000770672	72,461	41,216	57%
4	EA-0000749984	70,499	70,499	100%
5	EA-0000764598	46,131	24,157	52%
5	EA-0000610682	43,060	42,392	98%
5	EA-0000626451	36,451	13,219	36%
5	EA-0000610661	34,508	41,869	121%
5	EA-0000626450	33,847	11,216	33%
5	EA-0000757803	30,915	25,810	83%
5	EA-0000763421	21,764	11,402	52%
5	EA-0000787528	20,135	29,723	148%
5	EA-0000783992	16,779	16,792	100%
5	EA-0000769170	11,509	11,509	100%
5	EA-0000225998	8,612	1,861	22%
5	EA-0000784236	4,109	5,780	141%
5	EA-0000614804	1,041	1,041	100%
All Non-Sample Projects		7,975,464	7,299,673	92%
Total		16,448,721	14,924,758	91%

2.3.3. Results of Peak Savings Estimation

The realized gross peak kW reductions of the C&I Lighting Program during the period January 2021 through December 2021 totaled 2,279.35 kW.

2.4. Estimation of Ex Post Net Savings

2.4.1. Procedures Used to Estimate Net Savings

The basic challenge in net savings analysis is determining what part of gross savings achieved by program participants can be attributed to the effects of the program. The savings induced by the program are the "net" savings that are attributable to the program.

Net savings may be less than gross savings because of free ridership impacts, which arise to the extent that participants in a program would have adopted energy efficiency measures and achieved the observed energy changes even in the absence of the program. Free riders for a program are defined as those participants that would have installed the same energy efficiency measures without the program.

The goal of the net-to-gross analysis was to estimate the impacts of energy efficiency measures attributable to the C&I Lighting Program that were net of free ridership. That is, because the energy savings expected by free riders are not induced by the program, these savings should not be included in the estimates of the program's actual impacts. Without adjustment for free ridership, some savings that would have occurred naturally would be attributed to the program. The measurement of the net impact of the program requires estimation of the marginal effect of the program over and above the "naturally occurring" patterns for installation and use of energy efficient equipment.

Information collected from a sample of program participants through a customer survey was used for the net-to-gross analysis. Appendix C contained in Volume II of the EM&V Report provides a copy of the survey instrument.

2.4.1.1. Procedures used to Estimate Free Ridership

Three factors were considered to determine what percentage of savings may be attributable to free ridership. The three factors were:

- Plans and intentions of firm to install a measure even without support from the program;
- Influence that the program had on the decision to install a measure; and
- A firm's previous experience with a measure installed under the program.

For each of these factors, rules were applied to develop binary variables indicating whether or not a participant's behavior showed free ridership. These rules made use of answers to questions on the decision maker survey questionnaire.

The first factor required determining if a participant stated that his or her intention was to install an energy efficiency measure even without the program. The answers to a combination of several questions were used with a set of rules to determine whether a participant's behavior indicates likely free ridership. Two binary variables were constructed to account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered “yes” to the following two questions: “Did you have plans to install energy efficient [Measure/Equipment] at the location before participating in the program?” and “Would you have gone ahead with this planned installation even if you had not participated in the program?”
- The respondent answered “definitely would have installed” to the following question: “If the financial incentive from the program had not been available, how likely is it that you would have installed energy efficient [Measure/Equipment] at the location anyway?”
- The respondent answered “no, program did not affect timing of purchase and installation” to the following question: “Did you purchase and install energy efficient [Measure/Equipment] earlier than you otherwise would have without the program?”
- The respondent answered “no, program did not affect level of efficiency chosen for equipment” in response to the following question: “Did you choose equipment that was more energy efficient than you would have chosen had you not participated in the program?”

The second, less restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered “yes” to the following two questions: “Did you have plans to install energy efficient [Measure/Equipment] at the location before participating in the program?” and “Would you have gone ahead with this planned installation even if you had not participated in the program?”
- Either the respondent answered “definitely would have installed” or “probably would have installed” to the following question: “If the financial incentive from the program had not been available, how likely is it that you would have installed energy efficient [Measure/Equipment] at the location anyway?”
- Either the respondent answered “no, program did not affect timing of purchase and installation” to the following question: “Did you purchase and install energy efficient [Measure/Equipment] earlier than you otherwise would have without the program?” or the respondent indicated that that while program information and financial incentives did affect the timing of equipment purchase and installation, in the absence of the program they would have purchased and installed the equipment within the next two years.
- The respondent answered “no, the program did not affect level of efficiency chosen for equipment” in response to the following question: “Did you choose equipment that was more energy efficient than you would have chosen had you not participated in the program?”

The second factor required determining if a customer reported that a recommendation from a program representative or past experience with the program was influential in the decision to install a particular piece of equipment or measure.

The criterion indicating that program influence may signify a lower likelihood of free ridership is that either of the following conditions is true:

- The respondent answered “very important” to the following question: “How important was previous experience with the program in making your decision to install energy efficient [Measure/Equipment] at the location?”
- The respondent answered “yes” to the following question: “Did a program representative recommend that you install energy efficient [Measure/Equipment] at the location?” and “probably would not have” or “definitely would not have” to the question: “If the program representative had not recommended that you [implement the project], how likely is it that you would have done it anyway?”

The third factor required determining if a participant in the program indicated that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure is considered to have a likelihood of free ridership.

The criteria indicating that previous experience may signify a higher likelihood of free ridership are as follows:

- The respondent answered “yes” to the following question: “Before participating in the program, had you installed any equipment or measure similar to energy efficient [Measure/Equipment] at the location?”
- The respondent answered “yes” to the following question: “Has your organization purchased any significant energy efficient equipment in the last three years at the location?” and answered “yes” to the question: “Did you install any of that equipment without applying for a financial incentive through an energy efficiency program?”

The four sets of rules just described were used to construct four different indicator variables that address free ridership behavior. For each customer, a free ridership value was assigned based on the combination of variables. With the four indicator variables, there were 12 applicable combinations for assigning free ridership scores for each respondent, depending on the combination of answers to the questions creating the indicator variables. Table 2-9 shows these values.

Table 2-9 Free Ridership Scores for Combinations of Indicator Variable Responses

Indicator Variables				Free Ridership Score
Had Plans and Intentions to Install Measure without the Program? (Definition 1)	Had Plans and Intentions to Install Measure without the Program? (Definition 2)	The Program had influence on Decision to Install Measure?	Had Previous Experience with Measure?	
Y	N/A	Y	Y	100%
Y	N/A	N	N	100%
Y	N/A	N	Y	100%
Y	N/A	Y	N	67%
N	Y	N	Y	67%
N	Y	N	N	33%
N	N	N	Y	33%
N	Y	Y	Y	33%
N	Y	Y	N	0%
N	N	N	N	0%
N	N	Y	N	0%
N	N	Y	Y	0%

The free ridership assessment also included questions on the participants financial ability to pay for the measures. These questions were used to assess the consistency of the responses to the questions used to score free ridership.

Responses were considered inconsistent if the respondent indicates that they were not financially able to install the equipment, but state that they have plans to install the equipment and would have installed it without the program incentive.

Specifically, a response was considered inconsistent if the following criteria are met.

- The respondent answered “No” to the question “Would you have been financially able to install the equipment or measures without the financial incentive from the [Program Name]?”
- The respondent answered “Yes” to the question “To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?”
- The respondent answered “Yes” to the question “Did you have plans to install the measure before participating in the program?”
- The respondent answered “Yes” to the question “Would you completed the [MEASURE] project even if you had not participated in the program?”

Respondents that provide inconsistent responses were asked the following consistency-check question:

- Previously you said that your organization had plans to complete the project and would have completed it if you had not participated in the program. You also said that your organization would not have been financially able to install the equipment without the program incentive.

In your own words, can you explain the role that the financial incentive played in your decision to complete this project?

In the event of an inconsistent response, a researcher reviewed the response provided to the question. As part of this review, the researcher may determine whether the available information justifies modifying the free ridership score calculated in accordance with the algorithm outlined below. The free ridership score calculated in accordance with the algorithm outlined below may be revised in instances in which there are significant apparent inconsistencies between responses provided by the decision maker or in cases in which the responses are apparently invalidated by other information regarding the project. In some cases, in which the decision maker responses are apparently inconsistent, the researcher may drop the sample point. Information on any modifications to the free ridership score along with associated rationale and references to supporting data will be presented in EM&V reporting.

2.4.1.2. Procedures used to Estimate Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents were asked whether or not they implemented any additional energy saving measures for which they did not receive a program incentive. Respondents that indicated that they did install additional measures were asked two questions to assess whether or not the savings are attributable to the program. Specifically, respondents were asked:

- “How important was your experience with the [PROGRAM] in your decision to implement this Measure, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important?”
- “If you had not participated in the [PROGRAM], how likely is it that your organization would still have implemented this measure, using a 0 to 10 scale, where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?”

The energy savings associated with the measure are considered attributable to the program if the average of the rating for the first question, and 10 – the rating for the second question, is greater than five. This represents a binary attribution threshold, where savings from spillover measures are either found to be 100% attributable to the program, or 0% attributable to the program.

2.4.2. Results of Net Savings Estimation

The procedures described in the preceding section were applied to responses from a sample of project decision makers to estimate free ridership rates and net-to-gross ratios for the C&I Lighting Program for the period January 2021 through December 2021.

Program realized net energy savings totaled 11,865,183 kWh. The net to gross ratio for the program is 80%.

Table 2-10 C&I Lighting Program Realized Net Energy Savings

<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kWh Savings</i>	<i>Net-to-Gross Ratio</i>	<i>Net Lifetime kWh Savings</i>
16,448,721	14,924,758	91%	11,865,183	80%	173,996,276

The realized net peak demand reductions are summarized for the C&I Lighting Program in Table 2-11.

Table 2-11 C&I Lighting Program Realized Peak kW Reductions

<i>Ex Ante kW Savings</i>	<i>Gross Ex Post kW Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kW Savings</i>	<i>Net-to-Gross Ratio</i>
2,906.55	2,279.35	78%	1,870.88	82%

2.5. Process Evaluation

A process evaluation was not performed for the C&I lighting program. The following sections summarize the program data tracking and quality control procedures and customer satisfaction responses provided in the survey used to estimate the net program impacts.

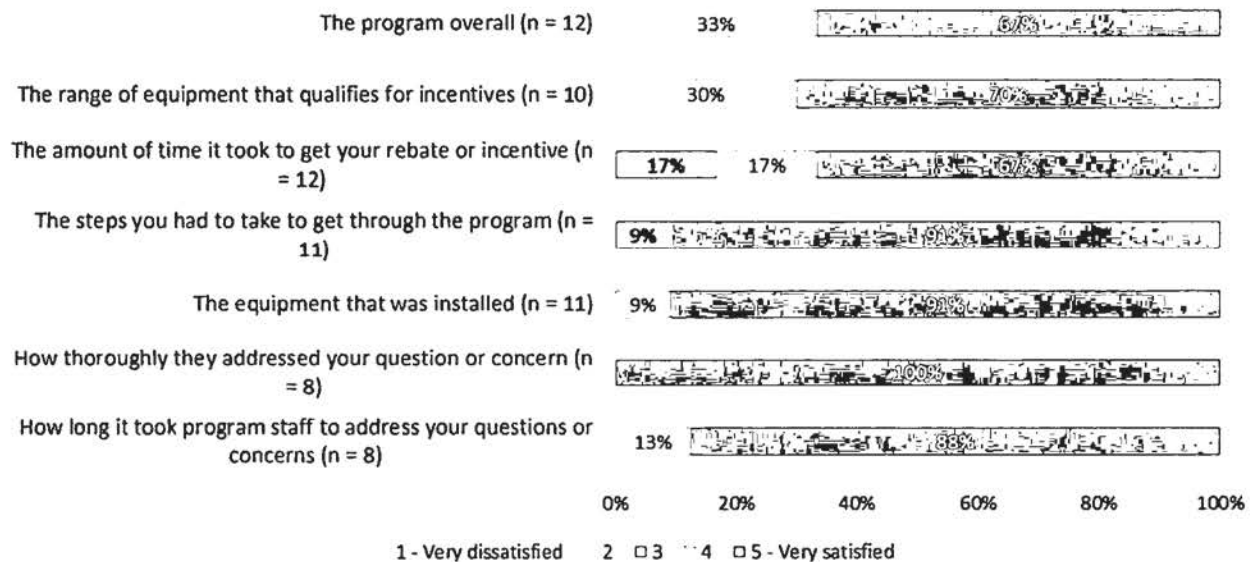
2.5.1. Data Tracking and Quality Control

Staff reported that the quality control process and workflow remained consistent with prior years. Staff continues to review each application, including submitted documentation, for completeness and to verify that the customer qualifies for the program and that the measures meet program requirements (e.g., DesignLights Consortium® listing). During the review, program staff determine if logging lighting hours is necessary. Verification visits are completed for all projects at or over 50,000 kWh and generally, pre-and post-visits are performed for any projects at or over 100,000 kWh.

The customer incentive is calculated based on the project energy savings. The implementation contractor then issues an invoice and supporting documentation to the Company. The Company reviews the invoice and supporting documentation and if complete issues payment to the implementation contractor. The implementation contractor then issues payment to the customer.

2.5.2. Participant Satisfaction

Survey respondents indicated high satisfaction with all aspects of the program and the program overall. All of the survey respondents reported that they were satisfied with the program overall. Program participants reported high levels of satisfaction with the equipment and the quality of the installation (see Figure 2-1).

Figure 2-1 Level of Satisfaction with Program

2.6. Findings and Recommendations

- **Participant survey feedback was positive.** All survey respondents that had questions of program staff were satisfied with the timeliness and thoroughness of their responses. Additionally, all participants reported satisfaction with the program overall.

3. C&I Standard Program

3.1. Program Description

The C&I Standard Program generates energy savings through the installation of non-lighting energy saving measures including compressed air, industrial motors, refrigerator equipment, kitchen equipment, and HVAC equipment. The program provided an incentive of \$0.12/kWh saved and capped incentives at 30% of the total project cost.

Expected kWh savings are shown in Table 3-1. There were 27 projects completed in the program during the 2021 program year which were expected to provide savings of 673,770 kWh.

Table 3-1 Ex Ante kWh Savings

<i>Number of Projects</i>	<i>Total Ex Ante kWh Savings</i>
27	673,770

3.1.1. Program Eligibility Requirements

The C&I Standard program is available to non-residential accounts served by the Company. Customers that meet one or more of the following conditions are not eligible for the program:

- ❑ Customers served under the Public Authority or Commonwealth of Virginia tariffs; and
- ❑ Customers who opted out of the Company's energy efficiency programs as of July 1, 2018.

Qualifying projects must be installed in a facility in the Company's service territory and must be fully installed. All projects must comply with state, federal, and local code requirements.

The following projects are not allowed:

- ❑ Projects that have received incentives from another Company program;
- ❑ Projects that involve fuel switching;
- ❑ On-site electricity generation;
- ❑ Gas-driven equipment; and
- ❑ Used or rebuilt equipment.

3.1.2. Summary of Savings by Eligible Rate Schedule

Table 3-2 compares average participant ex post net energy savings with the average energy usage of accounts for each applicable eligible rate schedules. The table also presents average participant account-level net ex post energy savings as a percentage of average participant baseline (2020 calendar year) energy usage.

Table 3-2 Summary of Savings by Eligible Rate Schedule³

Rate Schedule Class	Total Net Ex Post kWh Savings	Number of Participating Accounts	Average Participant Account-Level Net Ex Post kWh Savings	Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage
200	297,705	22	13,532	47,126	28.71%	0.64%
300	198,899	3	66,300	16,719,909	0.40%	0.58%

3.2. Data Collection

3.2.1. Verification of Measures

This section discusses the sampling plan and procedures used to verify the measures installed through the C&I Standard Program. The evaluation team used onsite visits and telephone communications to collect project.

3.2.1.1. Sampling Plan

Data used to estimate the gross savings achieved through the C&I Standard Program were collected for samples of projects completed during the period January 2021 through December 2021. Data provided by the implementation contractor and utility showed that during the 2021 program year, there were 27 projects completed under the program which were expected to provide savings of 673,770 kWh annually.

Inspection of data on kWh savings for individual projects provided by the implementation contractor indicated that the distribution of savings was generally positively skewed, with a relatively small number of projects accounting for a high percentage of the estimated savings. A sample design for selecting projects using a stratified random sampling method was used that took such skewness into account and allowed savings to be determined with ± 10 percent relative precision (or better) at the 90 percent confidence level. For the C&I Standard Program, the actual precision achieved for the sample was ± 9.9 percent.

Sampling for the collection of program M&V data accounted for the M&V effort occurring in real time during program implementation. Completed projects accumulate over time as the program is implemented, and sample selection was thus spread over the program year as projects are completed. The timing of sample selection was contingent upon the timing of the completion of projects during the program year.

³ The variable *Average Rate Schedule Account-Level kWh Usage* is calculated as the average annual kWh usage of all customer accounts for each schedule, excluding program-ineligible customers who opted out of paying for the costs of energy efficiency programs as of July 1, 2019. The variable *Average Participant Baseline Account-Level kWh Usage* is calculated as the average energy use of program participants for a given rate schedule during 2019, not accounting for any accounts for which a full year of 2019 data was unavailable.

3.2.1.2. Population Statistics and Expected Savings

Table 3-3 shows the number of projects, expected energy savings, and sampling statistics, by stratum, of the program sample.

Table 3-3 Population Statistics Used for Sample Design

<i>Variable</i>	<i>Stratum 1</i>	<i>Stratum 2</i>	<i>Stratum 3</i>	<i>Stratum 4</i>	<i>Stratum 5</i>	<i>Totals</i>
Strata boundaries (kWh)	> 80000	33000 - 80000	15000 - 33000	4000 - 15000	< 4000	
Number of projects	3	3	5	9	7	27
Total Ex Ante Annual kWh	292,527	174,038	117,464	76,901	12,840	673,770
Average kWh Savings	97,509	58,013	23,493	8,545	1,834	189,393
Std. dev. of kWh savings	19,244	20,271	6,554	3,216	884	50,168
Coefficient of variation	0.2	0.35	0.28	0.38	0.48	
Final design sample	2	2	3	2	4	13

As shown in Table 3-4, the sample projects for the C&I Standard Program account for approximately 59% of total expected kWh savings.

Table 3-4 Sampled Projects Expected Savings by Stratum

<i>Stratum</i>	<i>Sample Expected Savings</i>	<i>Total Expected Savings</i>
Stratum 1	205,265	292,527
Stratum 2	103,372	174,038
Stratum 3	60,799	117,464
Stratum 4	14,514	76,901
Stratum 5	5,547	12,840
Total	389,497	673,770

3.2.1.3. Verification Data Collection Procedures

Onsite visits and telephone interviews were used to collect data that were used in calculating savings impacts. The onsite visits and interviews with the contacts for the sampled projects were used to collect primary data on the facilities participating in the program.

When projects were selected for the M&V sample, the Evaluation Team notified the Company and the implementation contractor. This notification also served as a request to the implementation contractor for any documentation relating to the projects. This list included the company name, unique program number, expected savings estimate, and other information relative to the site visit and evaluation effort.

During an onsite visit or interview, staff accomplished three major tasks:

- First, they verified the implementation status of all measures for which customers received incentives. They verified that the energy efficiency measures were indeed installed, that they were installed correctly and that they still functioned properly.
- Second, they collected the physical data needed to analyze the energy savings that have been realized from the installed improvements and measures. Data were collected using a form that was prepared specifically for the project in question after an in-house review of the project file.
- Third, they interviewed the contact personnel at a facility to obtain additional information on the installed system to complement the data collected from other sources.

3.2.2. Participant Survey

The Evaluation Team surveyed program participants to collect data to estimate the net savings of the program.

The Evaluation Team contacted a census of unique customers to complete the survey in September 2021 and again in December 2021. Table 3-5 summarizes the data collection effort.

Table 3-5 Summary of C&I Lighting Survey Effort

<i>Survey Mode</i>	<i>Survey Time Frame</i>	<i>Number of Customers Contacted</i>
Online	September 2021	15
Online	December 2021	1
Total Survey Completes		4

3.3. Estimation of Ex Post Gross Savings

This section addresses the estimation of gross kWh savings and peak kW reductions resulting from measures installed in facilities of customers that obtained incentives under the C&I Standard Program during the period January 2021 through December 2021. Section 3.3.1 describes the methodology used for estimating gross savings. Section 3.3.2 presents the results from the effort to estimate savings for a sample of projects.

Volume II of commercial EM&V reporting contains specific methodologies for estimating gross savings and savings estimation results for each sampled project.

3.3.1. Methodology for Estimating Gross Savings

The methodology used for estimating gross savings is described in this section. The methodology used to estimate savings deviated from the preliminary EM&V plan set forth in the program filing. The preliminary EM&V plan stated that the Evaluation Team would perform on-site visits to verify measure installations and instead, the Evaluation Team verified the installed measures through both telephone interviews and onsite visits.

3.3.1.1. Review of Documentation and Measure Attributes Tracked

After the samples of projects were selected for the program, the program implementation contractor provided documentation pertaining to the projects. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort. The program records project specific details for the commercial programs in various project documents. The documents include measure spec sheets, invoices, and spreadsheets.

If there was uncertainty regarding a project, or apparently incomplete project documentation, the Evaluation Team contacted the implementation contractor to seek further information to ensure the development of an appropriate project-specific M&V plan.

Table 3-6 presents information on the equipment specification data tracked by the program. In addition to the information tracked in program data, the program tracks measure specific information, which includes the following:

- Guest room occupancy sensor: Equipment specification sheet.
- Packaged terminal heat pump: Capacity, model number.
- High Efficiency refrigeration/freezer cases: Model number, volume, door type.
- Auto closers for walk-in cooler/freezer doors: Equipment specification sheet.
- Air compressors: Equipment specification sheet.

Table 3-6 Gross Impact Attributes Tracked by Program – C&I Standard

<i>Measure</i>	<i>Attributes Tracked</i>
All measures	Project ID
	Measure Type
	Expected Savings
	Quantity

3.3.1.2. Procedures for Estimating Savings from Measures Sampled through the C&I Standard Program

Engineering equations were used to estimate savings for the verified measures. Project-specific information on savings calculations is contained in Volume II.

Gross impact evaluation results in two estimates of gross savings for each sample project: an expected gross savings estimate (as reported in the project documentation and program tracking system) and the verified gross savings estimates developed through the M&V procedures employed by the Evaluation Team. The Evaluation Team developed estimates of gross savings by applying a ratio estimation procedure in which achieved savings rates estimated for the sample projects were applied to the expected savings.

Energy savings realization rates⁴ were calculated for each project for which on-site data collection and engineering analysis were conducted. Sites with relatively high or low realization rates were further analyzed to determine the reasons for the discrepancy between expected and realized energy savings. This information for such sites is included in site-level M&V analyses presented in Volume II.

Table 3-7 summarizes the sources used to estimate the savings of the program measures. More specific information on the procedures to estimate measure savings is presented in Volume II.

Table 3-7 Sources for Ex Post Savings Analysis

<i>Measure</i>	<i>Saving Parameter Sources</i>
Guest room occupancy sensor	Project specific information and energy saving factors from The ESF factor was taken from the 2016 Pennsylvania TRM, June 2016, p. 302-305.
Packaged terminal heat pump	Project specific information and regional weather data.
High Efficiency refrigeration/freezer cases	Project specific information and the Mid-Atlantic TRM V10.0, May 2020, p. 334-341.
Auto closers for walk-in cooler/freezer doors	Fully deemed values from the 2016 Pennsylvania TRM, June 2016, p. 405 – 407.
VFD Air Compressor	Project specific information and the Illinois TRM V8.0, October 2019, p. 564-567
No-Loss Condensate Drain	Project specific information and the Illinois TRM V8.0, October 2019, p. 571-572
Engineered Air Nozzles	Project specific information and the Illinois TRM V8.0, October 2019, p. 573-575
Variable Frequency Drive Process Pump and Fans	Project specific information and the Illinois TRM V8.0, October 2019, p. 631-635
High Efficiency Evaporator Fan Motors	Project specific information and the Mid-Atlantic TRM V10.0, May 2020, p. 348-349

3.3.1.3. Procedures for Estimating Peak Demand Savings

The peak period for this program is defined as hours 3:00 pm to 6:00 pm, Monday through Friday. Peak demand savings for the program year are calculated using a ratio estimation procedure. Peak savings for sampled projects in each stratum were summed and divided by total kWh savings within the same stratum to produce a stratum-level realization rate (ratio). Each stratum-level realization rate was applied to all other (non-sampled) ex post savings values within each stratum. The sum of these values produced the estimated annual peak demand reduction for the program.

3.3.2. Results of Gross Savings Estimation

To estimate gross kWh savings and peak kW reductions for the program, data were collected and analyzed for a sample of 13 projects. The data were analyzed using the methods described in Section 3.3.1 to estimate project energy savings and peak kW reductions and to determine realization rates for the program. The results of the analysis are reported in this section.

⁴ The savings realization rate for a project is calculated as the ratio of the achieved savings for the project (as measured and verified through the M&V effort) to the expected savings (as determined through the project application procedure and recorded in the tracking system for the program).

3.3.2.1. Gross Ex Post kWh Savings

The realized gross kWh savings of the C&I Standard Program during the period January 2021 through December 2021 are summarized by sampling stratum in Table 3-8. Project-level realization rates are displayed in Table 3-9. Overall, the achieved gross savings of 546,502 kWh were equal to 81% of the expected savings.

Table 3-8 Sample Expected and Gross Realized kWh Savings by Sample Stratum

<i>Stratum</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>
Stratum 1	205,265	141,912	69%
Stratum 2	103,372	108,052	105%
Stratum 3	60,799	42,031	69%
Stratum 4	14,514	12,656	87%
Stratum 5	5,547	6,084	110%
Total	389,497	310,735	80%

Table 3-9 Expected and Gross Realized kWh Savings by Project

<i>Stratum</i>	<i>Program Number</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Project Gross Realization Rate</i>
1	EA-0000785164	119,708	118,607	99%
1	EA-0000857033	85,557	23,305	27%
2	EA-0000760493	68,740	73,420	107%
2	EA-0000759903	34,632	34,632	100%
3	EA-0000610618	26,320	28,871	110%
3	EA-0000783538	19,006	12,316	65%
3	EA-0000793747	15,472	844	5%
4	EA-0000775262	8,886	8,435	95%
4	EA-0000764396	5,628	4,221	75%
5	EA-0000749501	2,135	2,369	111%
5	EA-0000546874	1,137	1,238	109%
5	EA-0000546910	1,137	1,238	109%
5	EA-0000546915	1,137	1,238	109%
All Non-Sample Projects		284,274	235,768	83%
Total		673,770	546,502	81%

Realized gross impact savings are summarized in Table 3-10 below.

Table 3-10 C&I Standard Program Realized Gross Energy Savings

<i>Measure Name</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>
Auto Closers for Walk-In Cooler/Freezer Doors	1,886	2,068	110%
Engineered Air Nozzles	15,472	844	5%
Guest Room Occupancy Sensor	156,223	97,170	62%
High Efficiency Evaporator Fan Motors	5,628	4,221	75%
High Efficiency Refrigeration/Freezer Cases	3,412	3,714	109%
HVAC - Packaged Terminal Heat Pump	158,542	117,146	74%
No-Loss Condensate Drain	65,663	54,119	82%
Variable Frequency Drive Process Pump and Fans	11,793	9,631	82%
VFD Air Compressor	255,151	257,590	101%
Total	673,770	546,502	81%

3.3.3. Results of Peak Savings Estimation

As shown below in Table 3-11, the realized gross peak kW reductions of the Commercial & Industrial Standard Program during the period January 2021 through December 2021 totaled 85.00 kW.

Table 3-11 C&I Standard Program Realized Gross Peak kW Reductions

<i>Measure Name</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>
Auto Closers for Walk-In Cooler/Freezer Doors	0.27	0.37	136%
Engineered Air Nozzles	7.44	0.22	3%
Guest Room Occupancy Sensor	14.43	17.98	125%
High Efficiency Evaporator Fan Motors	0.64	0.05	8%
High Efficiency Refrigeration/Freezer Cases	0.45	0.49	109%
HVAC - Packaged Terminal Heat Pump	7.69	8.45	110%
No-Loss Condensate Drain	10.28	12.60	123%
Variable Frequency Drive Process Pump and Fans	2.48	2.08	84%
VFD Air Compressor	34.80	42.76	123%
Total	78.47	85.00	108%

3.4. Estimation of Ex Post Net Savings

The procedures used to estimate net savings of the C&I Lighting Program discussed in Section 2.4 were used to estimate the net savings of the C&I Standard Program.

3.4.1. Results of Net Savings Estimation

C&I Standard Program realized net energy savings totaled 496,604 kWh. The net to gross ratio for the program is 91%.

Table 3-12 C&I Standard Program Realized Net Energy Savings

<i>Measure Name</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kWh Savings</i>	<i>Net-to- Gross Ratio</i>	<i>Net Lifetime kWh Savings</i>
Auto Closers for Walk-In Cooler/Freezer Doors	1,886	2,068	110%	1,879	91%	15,036
Engineered Air Nozzles	15,472	844	5%	767	91%	11,504
Guest Room Occupancy Sensor	156,223	97,170	62%	88,298	91%	662,235
High Efficiency Evaporator Fan Motors	5,628	4,221	75%	3,836	91%	57,534
High Efficiency Refrigeration/Freezer Cases	3,412	3,714	109%	3,375	91%	40,501
HVAC - Packaged Terminal Heat Pump	158,542	117,146	74%	107,432	92%	1,611,477
No-Loss Condensate Drain	65,663	54,119	82%	49,538	92%	495,384
Variable Frequency Drive Process Pump and Fans	11,793	9,631	82%	8,751	91%	113,766
VFD Air Compressor	255,151	257,590	101%	232,727	90%	3,025,457
Total	673,770	546,502	81%	496,604	91%	6,032,895

The realized net peak demand reductions are summarized for the C&I Standard Program in Table 3-13.

Table 3-13 C&I Standard Program Realized Peak kW Reductions

<i>Measure Name</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Net Ex Post kW Savings</i>	<i>Net-to- Gross Ratio</i>
Auto Closers for Walk-In Cooler/Freezer Doors	0.27	0.37	136%	0.33	88%
Engineered Air Nozzles	7.44	0.22	3%	0.19	88%
Guest Room Occupancy Sensor	14.43	17.98	125%	15.78	88%
High Efficiency Evaporator Fan Motors	0.64	0.05	8%	0.04	88%
High Efficiency Refrigeration/Freezer Cases	0.45	0.49	109%	0.43	88%
HVAC - Packaged Terminal Heat Pump	7.69	8.45	110%	7.46	88%
No-Loss Condensate Drain	10.28	12.60	123%	11.35	90%
Variable Frequency Drive Process Pump and Fans	2.48	2.08	84%	1.83	88%
VFD Air Compressor	34.80	42.76	123%	37.19	87%
Total	78.47	85.00	108%	74.60	88%

3.5. Process Evaluation

A process evaluation was not performed for the C&I standard program. The following sections summarize the program data tracking and quality control procedures and customer satisfaction responses provided in the survey used to estimate the net program impacts.

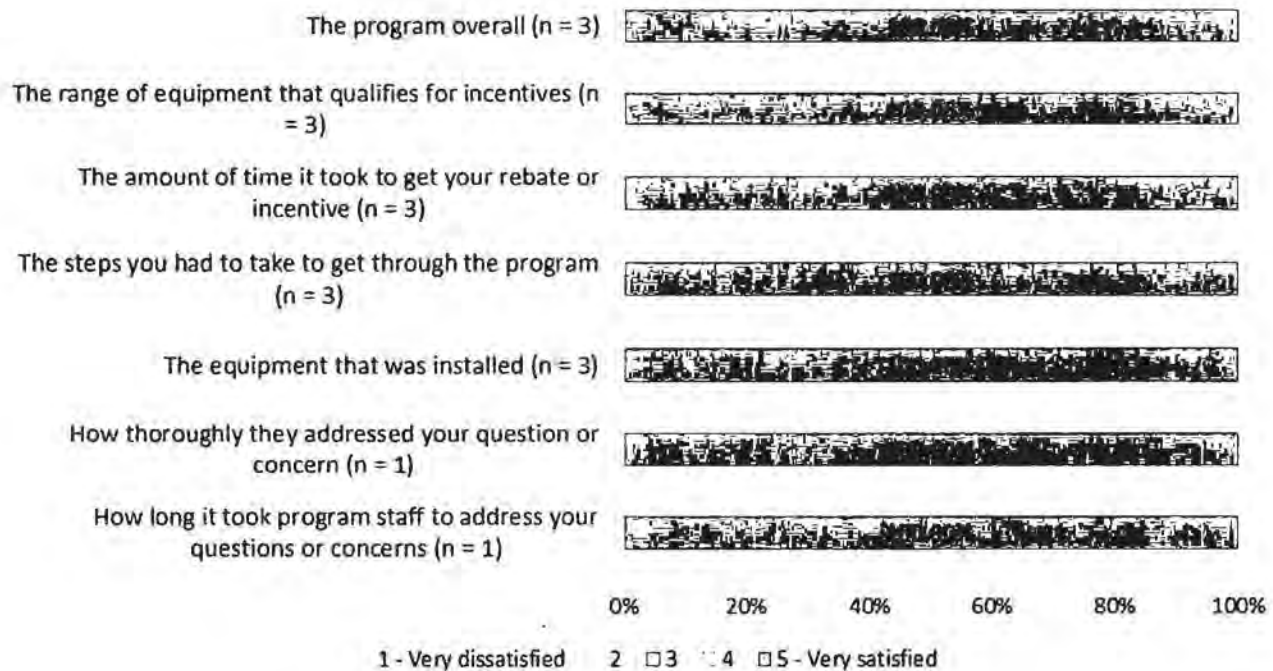
3.5.1. Quality Control

The quality control process and workflow for the C&I Standard Program is the same as for the C&I Lighting program. Staff reviews each application, including submitted documentation, for completeness and to verify that the customer qualifies for the program and that the measures meet program requirements. During the review, staff determine if monitoring pre- or post-installation is necessary. Verification visits are completed for all projects at or over 50,000 kWh and generally, pre-and post-visits are performed for any projects at or over 100,000 kWh.

The customer incentive is calculated based on the project energy savings. The implementation contractor then issues an invoice and supporting documentation to the Company. The Company reviews the invoice and supporting documentation and if complete, issues payment to the implementation contractor. The implementation contractor then issues payment.

3.5.2. Participant Satisfaction

All survey respondents were very satisfied with each rated aspect of the program and the program overall. See Figure 3-1 for details.

Figure 3-1 Level of Satisfaction with Program

3.5.3. Findings and Recommendations

- **Participant survey feedback was positive.** All survey respondents that asked program staff questions were very satisfied with the timeliness and thoroughness of their responses. Additionally, all participants reported satisfaction with the program overall.

4. Small Business Direct Install Program

4.1. Program Description

The Small Business Direct Install (SBDI) Program provides small businesses with a no-cost energy assessment and direct install measures including screw-in LED light bulbs and energy saving low-flow showerheads faucet aerators, and pre-rinse sprayers. Incentives are available for additional lighting and refrigeration measures.

4.1.1. Program Eligibility Requirements

The SBDI program is available to non-residential accounts served by the Company. To qualify, the facility must have a peak monthly demand of 200 kW or less. Customers served under the Public Authority or Commonwealth of Virginia tariffs (e.g., non-jurisdictional accounts) are not eligible for the program.

Qualifying projects must be installed in a facility in the Company's service territory and must be fully installed. All projects must comply with state, federal, and local code requirements.

The following projects are not allowed:

- Projects that have received incentives from another Company program;
- Projects that involve fuel switching;
- On-site electricity generation;
- Gas-driven equipment; and
- Used or rebuilt equipment.

4.1.2. Summary of Savings by Eligible Rate Schedule

Table 4-1 compares average participant ex post net energy savings with the average energy usage of accounts for each applicable eligible rate schedules. The table also presents average participant account-level net ex post energy savings as a percentage of average participant baseline (2020 calendar year) energy usage.

Table 4-1 Summary of Savings by Eligible Rate Schedule⁵

Rate Schedule Class	Total Net Ex Post kWh Savings	Number of Participating Accounts	Average Participant Account-Level Net Ex Post kWh Savings	Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage	Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage
200	40,973	470	87	47,126	0.18%	0.05%

4.2. Data Collection

4.2.1. Verification of Measures

This section discusses the sampling plan and procedures used to verify the measures installed through the SBDI Program. The evaluation team used onsite visits and telephone communications to collect project.

4.2.1.1. Sampling Plan

Data used to estimate the gross savings achieved through the SBDI Program were collected for samples of projects completed during the period January 2021 through December 2021. Data provided by the implementation contractor and utility showed that during the 2021 program year, there were 469 projects completed under the program which were expected to provide savings of 10,475,975 kWh annually.

Inspection of data on kWh savings for individual projects provided by the implementation contractor indicated that the distribution of savings was generally positively skewed, with a relatively small number of projects accounting for a high percentage of the estimated savings. A sample design for selecting projects using a stratified random sampling method was used that took such skewness into account and allowed savings to be determined with ± 10 percent relative precision (or better) at the 90 percent confidence level.

4.2.1.2. Population Statistics and Expected Savings

Table 4-2 shows the number of projects, expected energy savings, and sampling statistics, by stratum, of the program sample.

⁵ The variable *Average Rate Schedule Account-Level kWh Usage* is calculated as the average annual kWh usage of all customer accounts for each schedule, excluding program-ineligible customers who opted out of paying for the costs of energy efficiency programs as of July 1, 2019. The variable *Average Participant Baseline Account-Level kWh Usage* is calculated as the average energy use of program participants for a given rate schedule during 2019, not accounting for any accounts for which a full year of 2019 data was unavailable.

Table 4-2 Population Statistics Used for Sample Design

<i>Variable</i>	<i>Stratum 1</i>	<i>Stratum 2</i>	<i>Stratum 3</i>	<i>Stratum 4</i>	<i>Stratum 5</i>	<i>Totals</i>
Strata boundaries (kWh)	> 43000	28000 - 43000	25000 - 28000	20000 - 25000	< 20000	
Number of projects	2	54	33	207	173	469
Total Ex Ante Annual kWh	114,122	2,049,284	856,134	4,350,973	3,105,462	10,475,975
Average kWh Savings	57,061	37,950	25,943	21,019	17,951	159,924
Std. dev. of kWh savings	1,158	4,081	742	1,095	2,487	9,563
Coefficient of variation	0.02	0.11	0.03	0.05	0.14	
Final design sample	2	10	6	6	6	30

As shown in Table 4-3, the sample projects for the Small Business Direct Install Program account for approximately 9% of total expected kWh savings.

Table 4-3 Sampled Projects Expected Savings by Stratum

<i>Stratum</i>	<i>Sample Ex Ante kWh Savings</i>	<i>Total Ex Ante kWh Savings</i>
Stratum 1	114,122	114,122
Stratum 2	409,259	2,049,284
Stratum 3	154,228	856,134
Stratum 4	123,922	4,350,973
Stratum 5	106,274	3,105,462
Total	907,806	10,475,975

4.2.1.3. Verification Data Collection Procedures

Onsite visits and telephone interviews were used to collect data that were used in calculating savings impacts. The onsite visits and interviews with the contacts for the sampled projects were used to collect primary data on the facilities participating in the program.

When projects were selected for the M&V sample, the Evaluation Team notified the Company and the implementation contractor. This notification also served as a request to the implementation contractor for any documentation relating to the projects. This list included the company name, unique program number, expected savings estimate, and other information relative to the site visit and evaluation effort.

During an onsite visit or interview, staff sought to accomplish three major tasks:

- First, verify the implementation status of all measures for which customers received incentives. Specifically, that the energy efficiency measures were indeed installed, that they were installed correctly and that they still functioned properly.

- Second, collect the physical data needed to analyze the energy savings that have been realized from the installed improvements and measures. Data were collected using a form that was prepared specifically for the project in question after an in-house review of the project file.
- Third, interview the contact personnel at a facility to obtain additional information on the installed system to complement the data collected from other sources.

The Evaluation Team completed the verification activities for 29 sampled projects that tracking data indicated received direct install measures and concluded that there was not any evidence to indicate that the direct install measures were actually installed. Additional details on the site visit activities are provided in Volume II.

Two trade ally-installed projects were completed through the program. The Evaluation Team sampled the larger of these two projects and verified measure installation and determined ex post savings for that project. Since this project was in the sampling stratum of projects with greatest ex ante kWh savings and both projects in the stratum was sampled, the ex post savings for the project were not applicable to non-sampled projects.

4.2.2. Participant Survey

The Evaluation Team surveyed program participants to collect data to verify measures installed, estimate facility lighting hours, and estimate the net savings of the program.

4.2.2.1. Sampling Plan

The Evaluation Team contacted customers to complete the survey in September 2021. Participants were initially contacted through a letter mailed to them that included a link to allow them to take the participant survey online at their convenience. The Evaluation Team subsequently followed up with participants by telephone to complete the survey. In December 2021, the Evaluation Team attempted to contact an additional set of participants by telephone. All recruitment efforts offered the contacts a \$25 gift card as an incentive to complete the survey.

Table 4-4 summarizes the data collection effort. None of the contacts completed the survey. The majority of cases where the Evaluation Team reached the business by telephone, the person they spoke with reported not knowing of the business's participation, and / or were not familiar with the person listed as the contact. The Evaluation Team terminated the survey data collection effort after contacting 170 of the participating businesses in September and December without success.

Table 4-4 Summary of SBDI Survey Effort

<i>Survey Mode</i>	<i>Survey Time Frame</i>	<i>Number of Customers Contacted</i>
Letter mailed with web survey link	September 2021	290
Telephone follow up to letter	September 2021	153
Telephone	December 2021	17
Total Survey Completes		0

The poor response was a significant departure from prior years. To understand the reason for the poor response, the Evaluation Team contacted the implementation contractor and asked them to

confirm that the program data listed the correct contacts for the SBDI sites. The implementation contractor confirmed that the contacts listed in the completion reports matched what was shown in the data and that the telephone numbers matched the information listed for the service address.

4.3. Estimation of Ex Post Gross Savings

This section addresses the estimation of gross kWh savings and peak kW reductions resulting from measures installed in facilities of customers that obtained incentives under the SBDI Program during the period January 2021 through December 2021. Section 4.3.1 describes the methodology used for estimating gross savings. Section 4.3.2 presents the results from the effort to estimate savings for a sample of projects.

Volume II of commercial EM&V reporting contains specific methodologies for estimating gross savings and savings estimation results.

4.3.1. Methodology for Estimating Gross Savings

The methodology used for estimating gross savings is described in this section. The methodology used to estimate savings deviated from the preliminary EM&V plan set forth in the program filing. The preliminary EM&V plan stated that the Evaluation Team would perform on-site visits to verify measure installations and instead, the Evaluation Team verified the installed measures through both telephone interviews and onsite visits.

As noted in section 4.2.1.3, savings were estimated for the trade ally installed projects, both of which were lighting projects.

4.3.1.1. Review of Documentation and Measure Attributes Tracked

After the samples of projects were selected for the program, the program implementation contractor provided documentation pertaining to the projects. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort. The program records project specific details for the commercial programs in various project documents. The documents include measure spec sheets, invoices, and spreadsheets.

Table 4-5 presents information on the equipment specification data tracked by the program.

Table 4-5 Gross Impact Attributes Tracked by Program – SBDI

<i>Measure</i>	<i>Attributes Tracked</i>
All measures	Project ID
	Measure Type
	Expected Savings
	Quantity

4.3.1.2. Procedures for Estimating Savings from Measures Sampled through the SBDI Program

Engineering equations were used to estimate savings for the verified measures. Project-specific information on savings calculations is contained in Volume II of the commercial EM&V reporting.

Gross impact evaluation results in two estimates of gross savings for each sample project: an expected gross savings estimate (as reported in the project documentation and program tracking system) and the verified gross savings estimates developed through the M&V procedures employed by the Evaluation Team. The Evaluation Team developed estimates of gross savings by applying a ratio estimation procedure in which achieved savings rates estimated for the sample projects were applied to the expected savings.

Energy savings realization rates⁶ were calculated for the sampled project for which site specific data collection and engineering analysis were conducted.

Table 4-6 summarizes the sources used to estimate the savings of the program measures. More specific information on the procedures to estimate measure savings is presented in Volume II of the commercial EM&V reporting.

Table 4-6 Sources for Ex Post Savings Analysis

<i>Measure</i>	<i>Saving Parameter Sources</i>
LED lighting	Project specific information.

The sampled project realization rate was applied to the non-sampled project.

4.3.1.3. Procedures for Estimating Peak Demand Savings

The peak period for this program is defined as hours 3:00 pm to 6:00 pm, Monday through Friday. Peak demand savings for the program year are calculated using a ratio estimation procedure. Peak savings for sampled projects in each stratum were summed and divided by total kWh savings within the same stratum to produce a stratum-level realization rate (ratio). Each stratum-level realization rate was applied to all other (non-sampled) ex post savings values within each stratum. The sum of these values produced the estimated annual peak demand reduction for the program.

4.3.2. Results of Gross Savings Estimation

To estimate gross kWh savings and peak kW reductions for the program, data were collected and analyzed for a sample of one of two trade ally installed projects. The data were analyzed using the methods described in Section 4.3.1 to estimate project energy savings and peak kW reductions and to determine realization rates for the program. The savings for the direct install measures were determined to be zero based on the Evaluations Team failure to verify any of the installations. The results of the analysis are reported in this section.

4.3.2.1. Gross Ex Post kWh Savings

The realized gross kWh savings of the SBDI Program during the period January 2021 through December 2021 are summarized by sampling stratum in Table 4-7. Project-level realization rates are displayed in Table 4-8. Overall, the total program-level achieved gross savings of 47,096 kWh were equal to less than 1% of the expected savings.

⁶ The savings realization rate for a project is calculated as the ratio of the achieved savings for the project (as measured and verified through the M&V effort) to the expected savings (as determined through the project application procedure and recorded in the tracking system for the program).

Table 4-7 Sample Expected and Gross Realized kWh Savings by Sample Stratum

Stratum	Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate
Stratum 1	114,122	47,096	41%
Stratum 2	409,259	0	0%
Stratum 3	154,228	0	0%
Stratum 4	123,922	0	0%
Stratum 5	106,274	0	0%
Total	907,806	47,096	5%

Table 4-8 Expected and Gross Realized kWh Savings by Project

Stratum	Program Number	Ex Ante kWh Savings	Gross Ex Post kWh Savings	Project Gross Realization Rate
1	EA-0000780040	57,880	0	0%
1	EA-0000434761	56,242	47,096	84%
2	EA-0000777830	42,976	0	0%
2	EA-0000777832	42,976	0	0%
2	EA-0000777842	42,976	0	0%
2	EA-0000792208	42,976	0	0%
2	EA-0000796887	42,976	0	0%
2	EA-0000789234	42,976	0	0%
2	EA-0000789244	42,976	0	0%
2	EA-0000773130	40,365	0	0%
2	EA-0000768332	34,032	0	0%
2	EA-0000771498	34,032	0	0%
3	EA-0000794629	26,766	0	0%
3	EA-0000789233	25,960	0	0%
3	EA-0000794630	25,461	0	0%
3	EA-0000825906	25,461	0	0%
3	EA-0000863181	25,461	0	0%
3	EA-0000760446	25,119	0	0%
4	EA-0000785411	21,270	0	0%
4	EA-0000844597	21,268	0	0%
4	EA-0000792812	20,835	0	0%
4	EA-0000759631	20,183	0	0%
4	EA-0000759632	20,183	0	0%
4	EA-0000792809	20,183	0	0%
5	EA-0000771125	19,127	0	0%

<i>Stratum</i>	<i>Program Number</i>	<i>Ex Ante kWh Savings</i>	<i>Gross Ex Post kWh Savings</i>	<i>Project Gross Realization Rate</i>
5	EA-0000771135	19,127	0	0%
5	EA-0000759633	18,983	0	0%
5	EA-0000760441	17,066	0	0%
5	EA-0000760443	17,066	0	0%
5	EA-0000760442	14,904	0	0%
All Non-Sample Projects		9,568,170	0	0%
Total		10,475,975	47,096	0%

4.3.3. Results of Peak Savings Estimation

As shown in Table 4-9, the realized gross peak kW reductions of the SBDI Program during the period January 2021 through December 2021 totaled 10.68 kW.

Table 4-9 SBDI Program Realized Gross Energy Savings

<i>Ex Ante Gross kW Savings</i>	<i>Ex Post Gross kW Savings</i>	<i>Gross Realization Rate</i>
676.25	10.68	2%

4.4. Estimation of Ex Post Net Savings

The Evaluation Team applied the net-to-gross ratio developed for major, trade ally installed measures in PY2020 to the PY2021 projects.

4.4.1. Results of Net Savings Estimation

The procedures described in the preceding section were applied to responses from a sample of project decision makers to estimate free ridership rates and net-to-gross ratios for the SBDI Program for the period January 2021 through December 2021.

SBDI Program realized net energy savings totaled 40,973 kWh. The net to gross ratio for the program is 87%.

Table 4-10 SBDI Program Realized Net Energy Savings

<i>Ex Ante Annual kWh Savings</i>	<i>Ex Post Annual Gross kWh Savings</i>	<i>Gross Realization Rate</i>	<i>Ex Post Annual Net kWh Savings</i>	<i>Net-to-Gross Ratio</i>	<i>Lifetime Net Ex Post kWh Savings</i>
10,475,975	47,096	0%	40,973	87%	526,772

The realized net peak demand reductions are summarized for the SBDI Program in Table 4-11.

Table 4-11 SBDI Program Realized Peak kW Reductions

<i>Ex Ante Gross kW Savings</i>	<i>Ex Post Gross kW Savings</i>	<i>Gross Realization Rate</i>	<i>Ex Post Net kW Savings</i>	<i>Net-to- Gross Ratio</i>
676.25	10.68	2%	8.76	82%

4.4.2. Quality Control

The quality control process for program projects consists of the following elements:

- Trade allies must be approved to complete program projects and attend training on program procedures. Trade allies also receive a copy of the SBDI Trade Ally Network Manual.
- All project proposals are reviewed by program staff for approval. Pre-inspections may be scheduled to verify the facility type, the existing equipment, and the recommended measures and any customer satisfaction issues.
- The first 10 projects submitted by a trade ally are inspected, after which a minimum of 1 in 10 projects submitted by a trade ally is reviewed, but additional inspections may occur as warranted. During post inspections, staff verifies the installed equipment type and counts, the quality of the installation, the operating hours, and assesses customer satisfaction with the project.
- Trade allies must resolve any issues identified during inspections within 30 days and maintain an 80% pass rate.

Once the implementation contractor completes the project inspection, the project invoices and incentive request are provided to the Company for review. Upon review and approval of the projects, incentive payments are paid to the trade ally.

5. Opt Out Customers

Consistent with the Virginia State Corporation Commission's Rules (20VAC-350) for Large General Service Exemption from Energy Efficiency Rate Adjustment Clause(s), customers may obtain exemption from energy efficiency rate adjustment clauses (sometimes referred to as "riders") and are thereby no longer eligible to participate in the Company's energy efficiency programs. To facilitate exemption, customers have certified that they have implemented energy efficiency programs, at the customer's expense, that have produced measured and verified results within the prior five years. Customer-reported energy and demand savings associated with such customer-implemented programs are summarized in Table 5-1 below.

Table 5-1 Summary of Opt Out Customer Reported Savings

<i>Program Year</i>	<i>Number of Projects</i>	<i>Reported kWh Savings</i>	<i>Reported kW Savings</i>
PY2021	15	28,076,053	

6. Cost Effectiveness Evaluation

The following cost effectiveness tests were performed for the program: Total Resource Cost (TRC) test, Program Administrator Cost Test (PACT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The benefits and costs associated with each test are defined in Table 6-1.

Table 6-1 Summary of Benefits and Costs Included in each Cost Effectiveness Test

Variable	Definition	PCT		PACT		RIM		TRC	
		Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	Incentives paid to customers.	✓			✓		✓		
Program Installation Costs	Installation costs paid by program.				✓		✓		✓
Bill Savings / Lost Revenue	Reduction in electricity costs faced by customers as a result of implementation of program measures. Equal to revenue lost to the utility.	✓					✓		
Avoided Energy Costs	Energy-related costs avoided by utility.			✓		✓		✓	
Avoided Capacity Costs	Capacity-related costs avoided by utility, including T&D.			✓		✓		✓	
Incremental Costs	Incremental costs associated with measure implementation, as compared with what would have been done in absence of program.		✓						✓
Program Overhead Costs	Program costs other than incentive or installation costs.				✓		✓		✓

The results of the cost effectiveness analysis are presented in Table 6-2. For reference, for the Small Business Direct Install Program, supplemental test results are presented that are inclusive of PY2021 costs and benefits as well as costs of benefits of the program during PY2022 – PY2026, discounted to PY2021 net present value (NPV).

Table 6-2 Summary of Cost Effectiveness Test Scores

		<i>C&I Lighting</i>	<i>C&I Standard</i>	<i>Small Business Direct Install</i>	<i>Small Business Direct Install (PY2021 + NPV Projected PY2022 - PY2026)</i>
PCT	Benefit	\$14,439,273	\$572,429	\$223,148	\$10,351,113
	Cost	\$995,947	\$201,766	\$3,961	\$5,330,551
	Score	14.50	2.84	56.34	1.94
UCT	Benefit	\$7,072,016	\$242,962	\$22,377	\$10,150,341
	Cost	\$1,115,283	\$424,186	\$591,026	\$5,198,993
	Score	6.34	0.57	0.04	1.95
RIM	Benefit	\$7,072,016	\$242,962	\$22,377	\$27,760,848
	Cost	\$15,023,361	\$929,420	\$633,663	\$28,565,908
	Score	0.47	0.26	0.04	0.97
TRC	Benefit	\$7,072,016	\$242,962	\$22,377	\$10,150,341
	Cost	\$1,580,036	\$558,757	\$414,476	\$5,741,066
	Score	4.48	0.43	0.05	1.77

2021 Virginia Commercial & Industrial Program EM&V Report

Volume II of II

Prepared for:
Appalachian Power Company

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Prepared by:



ADM Associates, Inc.

3239 Ramos Circle
Sacramento, CA 95827
916.363.8383

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1. Introduction

Under contract with Appalachian Power Company (herein referred to as the "Company" or "APCo"), ADM Associates, Inc., (ADM) performed evaluation, measurement, and verification (EM&V) activities to confirm the energy savings (kWh) and demand reduction (kW) realized through the energy efficiency programs that the Company implemented in Virginia in 2021.

This report is divided into two volumes providing information on the impact, process, and cost effectiveness evaluation of the Commercial and Industrial Program (C&I Program) implemented in Virginia during the 2021 program year. Volume II contains chapters presenting detailed information regarding evaluation methodologies, data collection instruments, and evaluation results. Volume II is organized as follows:

- Chapter 2: Site-Level Estimation of Ex Post Gross Energy Impact
- Chapter 3: C&I Program Participant Survey Instrument
- Chapter 4: C&I Program Participant Survey Results
- Chapter 5: Confidential: EM&V Costs

See report Volume I for narrative and summary information pertaining to the evaluation methods and results.

2. Site-Level Estimation of Ex Post Gross Energy Impact

The table below provides a summary of the ex ante and ex post kWh savings of sampled PY2021 C&I program projects. The table is followed by individual site reports. Site reports appear in the order in which the applicable project IDs are listed in the table below.

<i>Project ID</i>	<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Gross Realization Rate</i>
<i>Lighting</i>			
EA-0000225998	8,612	1,861	22%
EA-0000564347 and EA-0000614804	134,873	89,084	66%
EA-0000566363	216,944	204,917	94%
EA-0000566528	891,748	786,530	88%
EA-0000610661	34,508	41,869	121%
EA-0000610682, EA-0000626450, and EA-0000626451	113,358	66,827	59%
EA-0000694572	2,338,482	2,068,710	88%
EA-0000694881	1,900,971	1,528,792	80%
EA-0000749024	918,227	925,780	101%
EA-0000749984	70,499	70,499	100%
EA-0000756887	378,287	378,287	100%
EA-0000757803	30,915	25,810	83%
EA-0000759565	78,208	92,245	118%
EA-0000763317	369,613	424,391	115%
EA-0000763421	21,764	11,402	52%
EA-0000764598	46,131	24,157	52%
EA-0000769170	11,509	11,509	100%
EA-0000769787	177,555	192,895	109%
EA-0000770672	72,461	41,216	57%
EA-0000773209	90,326	71,211	79%
EA-0000783992	16,779	16,792	100%
EA-0000784236	4,109	5,780	141%
EA-0000786014	527,243	514,800	98%
EA-0000787528	20,135	29,723	148%
<i>Standard</i>			
EA-0000546874, EA-0000546910, And EA-0000546915	3,412	3,714	109%
EA-0000610618 and EA-0000793747	41,792	29,715	71%
EA-0000749501	2,135	2,369	111%
EA-0000759903	34,632	34,632	100%
EA-0000760493 and EA-0000775262	77,626	81,855	105%
EA-0000764396	5,628	4,221	75%

<i>Project ID</i>	<i>Ex Ante kWh</i>	<i>Ex Post kWh</i>	<i>Gross Realization Rate</i>
EA-0000783538	19,006	12,316	65%
EA-0000785164	119,708	118,607	99%
EA-0000857033	85,557	23,305	27%
<i>SBDI</i>			
EA-0000434761	56,242	47,096	84%

2.1. Lighting

Project Number EA-0000225998

Executive Summary

Under project EA-0000225998, a program participant received incentives from Appalachian Power for replacing the existing outdoor lighting fixtures with LED lamps. The verified annual energy savings are 1,861 kWh and the realization rate is 22%.

Project Description

The customer received incentives for installing 10 exterior LED pole mounted fixtures, replacing existing metal halide fixtures. Four of the fixtures operated on sensors and six fixtures were controlled by a time clock.

Econometric Analysis

A review of energy consumption data and a billing analysis indicated that the energy savings estimate developed using engineering equations was not supported. Consequently, the estimate of realized energy savings was determined using an econometric weather and billing energy analysis with the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

<i>CDD</i>	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
<i>HDD</i>	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
<i>Post_Flag</i>	= Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
<i>Intercept</i>	= Y intercept

The results of the econometric analysis are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.00	0.45
HDD	0.00	5.15
Post_Flag	(5.10)	(4.00)
Intercept	25.70	14.71

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 1,861 kWh.

Ancillary Measurement and Verification Effort

The following section presents the analysis of energy savings based on engineering equations and project data.

ADM staff reviewed project documentation, the baseline and post-retrofit connected load. In addition, an interview and a site visit with the site contact was performed to determine lighting control methods. These data sources were referenced to develop an ancillary estimate of realized energy impacts.

Lighting energy savings are calculated as:

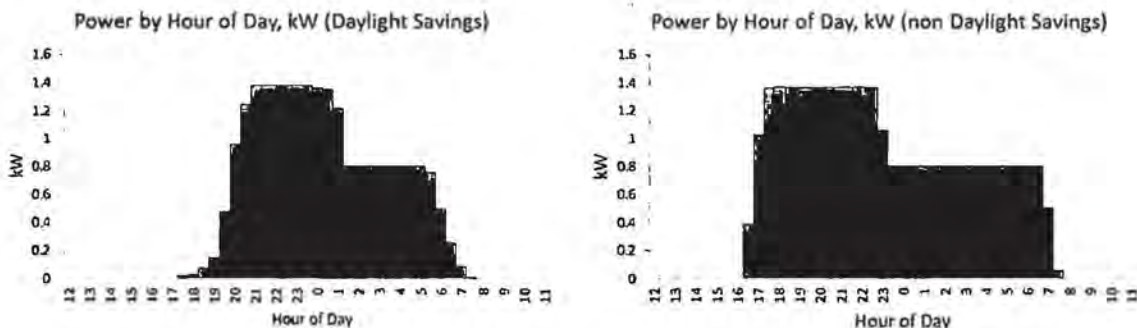
$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Annual lighting operating hours
$HCIF$	= HVAC interactive factor

The post period hours of use were verified by aggregating AMI billing data for daylight savings time months and standard time months. The binomial distribution of hours in the following two figures reflects the two control methods, one by sensor and the other by time clock.

Power Usage by Hour of Day



Ancillary Method - Lighting Energy Savings Calculations

<i>Measure</i>	<i>Quantity (Fixtures)</i>		<i>Wattage</i>		<i>Hours</i>	<i>Heating Cooling Interaction Factor</i>	<i>Expected kWh Savings</i>	<i>Ancillary Estimate kWh Savings</i>	<i>Gross Realization Rate</i>
	<i>Baseline</i>	<i>Efficient</i>	<i>Baseline</i>	<i>Efficient</i>					
MH400W to LED fixture	4	4	458	200	3,660	1.00	3,445	3,777	109%
MH400W to LED fixture	6	6	458	200	1,952	1.00	5,167	3,021	58%
Total	10	10					8,612	6,398	74%

Results*Measure-Level Realized Gross Savings*

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Lighting	8,612	1,861	22%	0.00	11,443
Total	8,612	1,861	22%	0.00	

The verified annual energy savings are 1,861 kWh resulting in a realization rate of 22%.

The realized energy savings estimate is equal to 16% of 2020 annual usage. The application stated the capacity of the existing metal halide fixtures, but it could not be determined if the existing lamps were 400W or if they were lower wattage. The econometric method results indicate that the lamps may have been less wattage, as the sum of ex ante base wattages exceeded the peak kW demand from 7:00 PM to 7:00 AM.

Project Number: EA-0000564347 and EA-0000614804

Executive Summary

Under projects EA-0000564347 and EA-0000614804, a program participant received incentives from Appalachian Power for installing LED lighting in the interior and exterior of their facility.

The verified annual energy savings are 89,084 kWh resulting in a gross energy savings realization rate of 66%.

Project Description

The participant received incentives for installing (73) LED Round 100W High Bay Fixtures, (68) LED 2' 9W lamps, (730) LED 4' 12.5W lamps, (13) LED 15W A-line lamps, (17) LED Exit Fixtures, and (4) LED 50W Mini Flood Fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline, and post-retrofit connected load. In addition, an on-site verification was performed, and 8 light loggers were installed to capture hour of use in different areas of the facility. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
564347									
4LT5 to LED high bay	73	73	234	100	2,595	1.09	51,057	27,674	54%
2' T8 to linear LED	2	2	20	9	2,224	1.09	115	53	46%
2' T8 to linear LED	1	1	20	9	2,224	1.09	57	27	46%
2' T8 to linear LED	7	14	33	9	2,224	1.09	548	255	46%
2' T8 to linear LED	17	51	47	9	2,224	1.09	1,775	824	46%
2L 4' T8 to linear LED	3	6	79	13	2,224	1.09	846	393	46%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
2L 4' T8 to linear LED	160	320	60	13	2,224	1.09	29,229	13,576	46%
2L 4' T8 to linear LED	100	300	93	13	5,672	1.09	28,968	34,315	118%
2L 4' T8 to linear LED	16	64	118	13	2,224	1.09	5,679	2,638	46%
2L 8' T8 to linear LED -	10	40	160	13	2,224	1.09	5,741	2,667	46%
CFL 72W to LED19	4	4	72	15	2,224	1.09	1,190	553	46%
2L 4' T8 to linear LED	9	9	39	15	2,224	1.09	1,127	524	46%
Incand Exit15W to LED	17	17	30	2	8,760	1.09	4,587	4,545	99%
614804									
MH100W to LED flood	4	4	128	50	3,338	1.00	1,041	1,041	100%
Total	423	905					134,873 ¹	89,084	66%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	134,873	89,084	66%	10.18	861,408
Total	134,873	89,084	66%	10.18	

The verified annual energy savings are 89,084 kWh resulting in a gross energy savings realization rate of 68%. The difference between the expected and realized savings estimates is explained by two factors.

- The ex post hours of use for eleven of the measures above (2,224) are fewer than the ex ante hours (4,745) resulting in a lower realization rate.
- The aggregated logged hours were less than the hours used in the ex ante estimate. The lesser logged hours are reasonable, and as a comparison, the Mid-Atlantic TRM v.10 states hours of use for education gym, classroom, computer rooms, and offices range from 1,505 to 2,088.

The realized energy savings estimate is equal to 10% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

¹ Total project ex ante kWh savings does not match sum of documented ex ante savings of all project measures.

<i>CDD</i>	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
<i>HDD</i>	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
<i>Post_Flag</i>	= Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
<i>Intercept</i>	= Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.11	1.43
HDD	0.00	0.22
Post_Flag	(50.75)	(0.33)
Intercept	1,932.18	8.99

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 18,525 kWh. Although the *Post_Flag* coefficient was statistically significant, visual inspection of the month-to-month usage indicates variable usage from month-to-month, and a lack of a cyclical pattern across months during the pre- and post- periods. As such, idiosyncratic factors at the site may have resulted in an erroneous regression estimate of the savings.

Project Number: EA-0000566363

Executive Summary

Under project EA-0000566363, a program participant received incentives from Appalachian Power for installing LED Lighting and Controls.

The verified annual energy savings are 204,917 kWh and the gross energy savings realization rate is 94%.

Project Description

The participant received incentives for installing (403) LED 65W retrofit kits and (17) occupancy sensors.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline, and post-retrofit connected load. In addition, ADM collected data on hours of operations and verified the installed measures through a phone interview. ADM referenced these site-specific data to develop estimates of realized energy impacts.

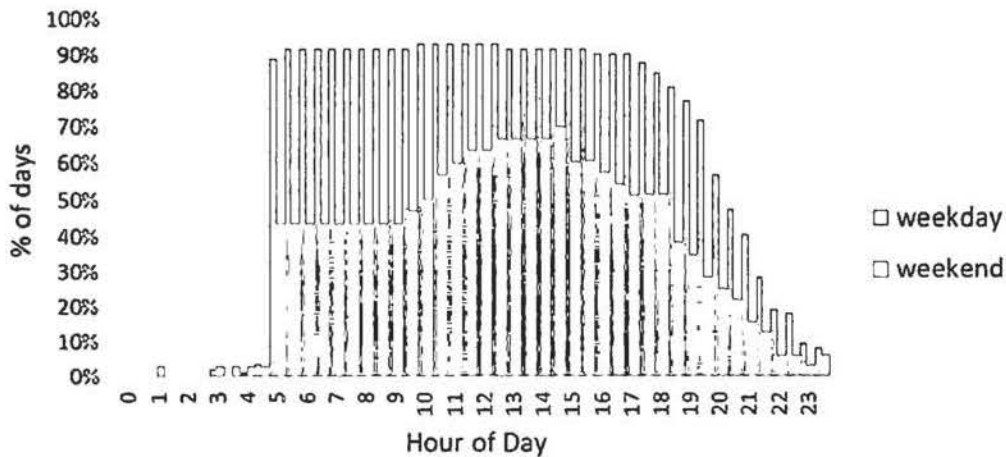
Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

ADM verified the hours of operation with an analysis of AMI billing data. In the analysis, the site total hourly power usage was used as an indicator of whether or the lights were on or off at the facility. The portion of days with the lights in the on state, compared to the hour of day and aggregated by weekday or weekend is presented in the following figure:

*Hourly Lighting Profile from AMI Data**Average Lighting usage by Hour of Day**Lighting Energy Savings Calculations*

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
8' 2-lamp T8 to LED Strip	37	37	160	65	8,760	1.10	33,871	33,880	100%
8' 2-lamp T8 to LED Strip	332	332	160	65	4,790	1.10	163,163	152,435	93%
8' 2-lamp T8 to LED Strip	34	34	160	65	4,790	1.10	16,711	15,611	93%
Total	403	403					213,744	201,926	94%

Lighting Controls Energy Savings Calculations

Measure	Quantity (Controls)	Controlled Wattage	Baseline Hours	Controls Factor	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
Occupancy Sensor	17	2,210	4,790	0.28	1.10	3,201	2,991	93%
Total	17					3,201	2,991	93%

Results*Measure-Level Realized Gross Savings*

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	213,743	201,926	94%	49.93	795,000
Lighting Controls	3,201	2,991	93%	0.40	
Total	216,944	204,917	94%	50.34	

The realized annual energy savings are 204,917 kWh with a gross energy savings realization rate of 94%. The difference between the realized and expected savings estimates is due to the following.

- The hours of use for 366 of the lamps (shown in the second and third line items in the table above) are less than the hours of use used in the expected estimate (4,392 vs. 4,790).
- Based on the interview with the site contact, ADM determined that the new controls were occupancy sensors and not daylight dimming sensors as identified in the project documentation.

The realized energy savings estimate is equal to 26% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

<i>CDD</i>	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
<i>HDD</i>	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
<i>Post_Flag</i>	= Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
<i>Intercept</i>	= Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.19	2.21
HDD	(0.03)	(1.93)
Post_Flag	(374.89)	(2.63)
Intercept	2,258.88	13.59

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 136,836 kWh, which is equal to 67% of the realized savings estimate. Although, the regression-based savings estimate is less than the engineering equation analysis, a comparison of monthly energy usage to the expected usage during the start of the cooling season indicates that other factors are impacting energy use, such as fluctuations in the production schedule of the facility or commissioning of HVAC equipment, and so the results of econometric analysis are not referenced as ex post savings.

Project Number: EA-0000566528

Executive Summary

Under project EA-0000566528, a program participant received incentives from Appalachian Power for upgrading their interior and exterior lighting.

The verified annual energy savings are 786,530 kWh resulting in a gross energy savings realization rate of 88%.

Project Description

The participant received incentives for installing (211) LED A-line lamps, (355) 2' LED Linear lamps, (1,382) 4' LED Linear lamps, (24) Bi-Pin LED lamps, (20) LED Canopy fixtures, (7) LED U-Tube lamps, (37) 4' LED Fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation and the baseline and post-retrofit connected load. In addition, ADM conducted an onsite survey of the facility and interviewed the site contact to verify the lighting hours of operation, installation locations, and measures installed. ADM referenced the data collected onsite, as well as deemed hours of use for hospital patient rooms from the Mid-Atlantic TRM V.10, to estimate the ex post energy savings.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
	Base	Efficient	Base	Efficient					
4' 1L 31W to 4'T8 11.5W	9	9	31	12	2,964	1.09	846	566	67%
4' 1L 31W to 4'T8 11.5W	17	17	31	12	8,760	1.09	3,194	3,162	99%
CFL43W to 6" Downlight	4	4	43	7	4,380	1.09	703	696	99%
CFL 43W to 9W A19	125	125	43	9	2,964	1.09	20,476	13,718	67%
CFL 43W to 9W A19	33	33	43	9	8,760	1.09	10,812	10,703	99%
CFL 43W to Bi-Pin 10W	24	24	43	10	8,760	1.09	7,632	7,555	99%
CFL 72W to LED A21	8	8	72	17	2,964	1.09	2,139	1,433	67%

Measure	Quantity		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
	Base	Efficient	Base	Efficient					
CFL 72w to LED A21	25	25	72	17	3,338	1.00	4,631	4,631	100%
CFL 72w to LED A21	2	2	72	17	8,760	1.09	1,070	1,059	99%
CFL43W to LED A19	14	14	43	9	2,964	1.09	2,293	1,536	67%
1L 2' T8 to 3' linear LED	1	1	20	12	4,380	1.09	39	38	99%
1L 2' T8 to 2' linear LED	3	3	20	15	4,380	1.09	72	72	99%
1L 24", T-8 1L, to 3' strip 15W	3	3	20	15	8,760	1.09	145	143	99%
1L 24", T-8 1L, to 8.5W 2'T8	1	1	20	9	8,760	1.09	111	110	99%
1L 24", T-8 1L, to 8.5W 2'T8 1L	22	22	20	9	2,964	1.09	1,219	817	67%
1L 24", T-8 1L, to 8.5W 2'T8 1L	1	1	20	9	4,380	1.09	55	55	99%
1L 48", 25W T-8 1L, to 12W 3'T8	1	1	22	12	4,380	1.09	48	48	99%
1L 48", Super T-8 1L, to 11.5W 4'T8 840	3	3	33	12	4,380	1.09	311	308	99%
1L 48", T-8 1L, to 11.5W 4'T8 840	3	3	31	12	2,964	1.09	282	189	67%
1L U-Tube, T-8 1L, to 17W U-T8 1L	3	3	31	17	4,380	1.09	202	200	99%
1L U-Tube, T-8 1L, to LL-RLB-2-11W-40K-F	2	2	31	11	4,380	1.09	193	191	99%
2L 24", STD HO T5 1L to 11.5W 4'T8 840	111	111	55	12	2,964	1.09	23,264	15,585	67%
2L 24", T-8 1L, to 8.5W 2'T8 1L	11	11	33	9	4,380	1.09	1,298	1,285	99%
2L 24", T-8 1L, to 8.5W 2'T8 1L	12	2	33	9	8,760	1.09	3,652	3,615	99%
2L 24", T-8 1L, to 8.5W 2'T8 2L	6	6	33	17	2,964	1.09	463	310	67%
2L 24", T-8 1L, to 8W 2'T8	3	3	33	8	4,380	1.09	361	358	99%
2L 24", T-8 1L, to 8W 2'T8 1L	2	2	33	8	4,380	1.09	241	238	99%
2L 48", T-8 1L, to 11.5W 4'T8 1L	7	7	59	12	2,964	1.09	1,602	1,073	67%
2L 48", T-8 1L, to 11.5W 4'T8 1L	9	9	59	12	3,338	1.00	1,427	1,427	100%
2L 48", T-8 1L, to 11.5W 4'T8 1L	167	167	59	12	4,380	1.09	38,219	37,836	99%
2L 48", T-8 1L, to 11.5W 4'T8 1L	239	239	59	12	8,760	1.09	109,393	108,296	99%
2L 48", T-8 1L, to 12W 3'T8	2	2	59	12	8,760	1.09	906	897	99%
2L 48", T-8 1L, to 17W U-T8 1L	1	1	59	17	4,380	1.09	202	200	99%
2L 48", T-8 1L, to CI_LED 1X4 2L, 4' T8	8	8	59	23	2,964	1.09	1,388	930	67%
2L 48", T-8 1L, to CI_LED 1X4 Retrofit Kit	17	17	59	23	8,760	1.09	5,897	5,838	99%
2L 48", T-8 1L, LED 2X4 2L, 4' T8	1	1	20	9	4,380	1.09	55	55	99%
2L 48", T-8 1L, LED 2X4	8	8	112	34	8,760	1.09	5,521	5,466	99%

Measure	Quantity		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
	Base	Efficient	Base	Efficient					
2L U-Tube, T-8 1L, to 17W U-T8 1L	1	1	59	17	8,760	1.09	405	401	99%
3L 48", T-8 1L, to 11.5W 4'T8 1L	69	69	89	12	2,964	1.09	25,764	17,260	67%
3L 48", T-8 1L, to 11.5W 4'T8 1L	326	326	89	12	8,760	1.09	243,454	241,014	99%
4L 24", T-8 1L, to 8.5W 2'T8 1L	111	111	61	9	2,964	1.09	28,077	18,810	67%
4L 24", T-8 1L, to 8.5W 2'T8 1L	78	78	61	9	8,760	1.09	39,459	39,064	99%
4L 48", T-8 1L, to 11.5W 4'T8 840	72	72	112	12	8,760	1.09	69,726	69,027	99%
4L 48", T-8 1L, to 11.5W 4'T8 1L	458	458	112	12	2,964	1.09	221,768	148,569	67%
MH to LED fixture	20	20	400	91	3,338	1.00	20,629	20,629	100%
Total							891,748 ²	786,530	88%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	891,748	786,530	88%	103.59	5,168,400
Total	891,748	786,530	88%	103.59	

The verified annual energy savings are 786,530 kWh and the realization rate is 88%.

The major difference between ex ante and ex post savings estimates primarily resulted from a difference in the hours of use for patient rooms. The expected savings estimate used a value of 4,380 hours, whereas the realized savings analysis used a value of 2,964 hours, which was the deemed value for measures installed in patient rooms as sourced from the Mid-Atlantic TRM V.10.

The realized energy savings estimate is equal to 15% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

² Total project ex ante kWh savings does not match sum of documented ex ante savings of all project measures.

- HDD* = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
- Post_Flag* = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
- Intercept* = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.49	2.24
HDD	(0.03)	(0.68)
Post_Flag	(1,209.46)	(2.82)
Intercept	13,924.98	24.27

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 441,454 kWh, which is less than the ex-post saving estimate. Review of the energy use data during the pre and post periods found that energy use is variable and that it is likely that there are factors not included in the model that are affecting the regression estimate.

Project Number: EA-0000610661

Executive Summary

Under project EA-0000610661, a program participant received incentives from Appalachian Power for replacing the existing lighting fixtures in their industrial facility with LED lamps.

The verified annual energy savings are 41,869 kWh and the realization rate is 121%.

Project Description

The participant received incentives for installing (16) LED High Bay Fixtures and (3) LED Wall Packs.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a site visit was performed to verify lighting installation and perform an interview with on-site staff relating to lighting operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

The table below presents expected and realized energy savings for the measures installed under the project

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 96", T-8 lamp, to high bays	105	13	109	200	2,165	1.00	31,460	19,150	120%
Fluorescent, (2) 96", T-8 lamp, to high bays	25	3	109	200	8,760	1.00		18,615	
Fluorescent, (2) 96", T-8 lamp, to wall packs	5	2	109	70	8,760	1.00	2,099	3,548	196%
Fluorescent, (2) 96", T-8 lamp, to wall packs	3	1	109	70	2,165	1.00		556	
Total	138	19					34,508 ³	41,869	125%

Results*Measure-Level Realized Gross Savings*

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	34,508	41,869	121%	11.63	118,800
Total	34,508	41,869	121%	11.63	

The verified annual energy savings are 41,869 kWh resulting in a gross energy savings realization rate of 125%. The difference between the ex ante and ex post savings estimates is due to the following factors:

- The ex ante savings is based on 2,868 hours of use, whereas the ex post used hours of use that varied by space type and ranged from 2,165 to 8,760 hours of use, with an average hours of use of 3,901.
- The ex post wall pack quantity (3) is greater than the ex ante quantity (2).
- During the site visit, it was also determined that the facility was unconditioned and not heated as noted in the provided documentation.

The realized energy savings estimate is equal to 35% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

³ Total project ex ante kWh savings does not match sum of documented ex ante savings of all project measures.

<i>CDD</i>	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
<i>HDD</i>	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
<i>Post_Flag</i>	= Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
<i>Intercept</i>	= Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.01	0.59
HDD	0.00	0.44
Post_Flag	(58.67)	(3.28)
Intercept	294.30	11.81

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 21,415 kWh, which is equal to 29% of the ex post kWh savings estimate. Although the *Post_Flag* coefficient is statistically significant, the ex post savings estimate was retained – review of the monthly consumption data found that pre-period electricity use was highly variable from month-to-month, which indicates that it is likely that there are factors not included in the model that are affecting the regression estimate.

Project Number: EA-0000610682, EA-0000626450, and EA-0000626451

Executive Summary

Under project EA-0000610682, EA-0000626450, and EA-0000626451, a program participant received incentives from Appalachian Power for installing LED Lighting in multiple parking lots.

The verified annual energy savings are 66,827 kWh and the realization rate is 59%.

Project Description

The participant installed (17) 300W LED Pole Lights, (7) 240W LED Pole Lights, and (1) 200W LED Pole Light.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a site visit was performed to verify the quantity of lights installed and verified dusk to dawn hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Project 610682									
Metal Halide, (1) 1000W lamp to 300W ATG AR-300	13	13	1,080	300	3,338	1.00	23,433	33,847	144%
Metal Halide, (1) 1000W lamp to 240W AR-240	2	2	1,080	240	3,338	1.00	19,627	5,608	44%
Metal Halide, (1) 1000W lamp to 200W AR -200	1	1	1,080	200	3,338	1.00		2,937	
Project 626450									
Metal Halide Pulse Start, (1) 1000W lamp to 240W AR-240	4	4	1,080	240	3,338	1.00	33,847	11,216	33%
Project 626451									
Metal Halide, (1) 1000W lamp to 300W ATG AR-300	4	4	1,080	300	3,338	1.00	36,451	10,415	36%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Metal Halide, (1) 1000W lamp to 240W AR-240	1	1	1,080	240	3,338	1.00		2,804	
Total	25	25					113,358	66,827	59%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	113,358	66,827	59%	0.00	875,247
Total	113,358	66,827	59%	0.00	

The verified annual energy savings are 66,827 kWh result and the realization rate is 59%. The expected savings estimate differed from the realized savings for the following reasons.

- The ex ante estimate was premised on the assumption that 43 pole lights were installed, whereas installation of 25 pole lights was verified during the site visit.
- For project EA-0000610682 the measure-level program tracking data listed a quantity of one and the measure name of Lighting-Retrofit. The actual quantity was 16 with a measure name of *LED Exterior-CI_Exterior LED replacing >400W HID*.

The ex post energy savings estimate is equal to 8% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	(0.00)	(0.01)
HDD	0.01	2.93
Post_Flag	(187.73)	(5.17)
Intercept	675.38	13.09

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 67,494 kWh, which is equal to 102% of the ex post savings estimate.

Project Number: EA-0000694572

Executive Summary

Under project EA-0000694572, a program participant received incentives from Appalachian Power for replacing the existing lighting fixtures in their manufacturing facility with LED lamps. The verified annual energy savings are 2,068,719 kWh resulting in a realization rate of 88%.

Project Description

The participant received incentives for installing (435) LED High Bay fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, and the baseline, and post-retrofit connected load. In addition, ADM conducted an on-site visit to verify the installation of measures, collect data on heating and cooling equipment for use in applying heating and cooling interactive factors, and to collect data on lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Site Visit Collected Data

<i>Variable</i>	<i>Verification</i>	<i>Source</i>
Base Wattage	400W/100W lamps	Remaining lamps in storage
Efficient Wattage	136W/270W fixtures	Model nameplate data
Hours of use – high bay lighting; M-Saturday	24 hours; 3 shifts-6 days	Site contact provided schedule
Hours of use – high bay lighting, Sunday	6 hours	Site contact provided schedule
Hours of use – task lighting	Varies by process	These lights were not retrofitted
Quantity	175/260	Tally count of fixtures

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

<i>Measure</i>	<i>Quantity (Fixtures)</i>		<i>Wattage</i>		<i>Hours</i>	<i>Heating Cooling Interaction Factor</i>	<i>Expected kWh Savings</i>	<i>Realized kWh Savings</i>	<i>Gross Realization Rate</i>
	<i>Baseline</i>	<i>Efficient</i>	<i>Baseline</i>	<i>Efficient</i>					
694572									
MH400W to LED high bay	175	175	458	136	7,749	1.00	493,626	436,680	88%
MH400W to LED high bay	260	260	1,080	270	7,749	1.00	1,844,856	1,632,030	88%
Total	435	435					2,338,482	2,068,710	88%

Results*Measure-Level Realized Gross Savings*

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Lighting	2,338,482	2,068,710	88%	266.95	9,217,260
Total	2,338,482	2,068,710	88%	266.95	

The realized annual energy savings are 2,068,710 kWh resulting in a realization rate of 88%. The realized savings differ from the expected savings for the following reasons.

- The hours of use verified during the site visit (7,749) are fewer than the hours used in the expected savings estimate (8,760). The site works 24/6 with an additional 6 hours on Sunday.

The realized energy savings estimate is equal to 22% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

- CDD* = Cooling Degree Days for a given month and assumes a base temperature of 75°F
- HDD* = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
- Post_Flag* = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
- Intercept* = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.48	1.50
HDD	(0.14)	(1.59)
Post_Flag	(2,443.77)	(3.80)
Intercept	25,693.22	28.62

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 891,976 kWh. The energy use during the pre and post periods and the difference between the regression estimate from the realized energy savings is likely due to variables not included in the model such as variation in the operational schedule.

Project Number: EA-0000694881

Executive Summary

Under project EA-0000694881, a program participant received incentives from Appalachian Power for replacing the existing lighting fixtures in their manufacturing facility with LED lamps. The verified annual energy savings are 1,528,792 kWh resulting in a realization rate of 80%.

Project Description

The participant received incentives for installing (225) LED High Bay fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, and the baseline, and post-retrofit connected load. In addition, ADM conducted an on-site visit to verify the installation of the measures, collect data on heating and cooling equipment for use in applying heating and cooling interactive factors, and to collect data on lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Site Visit Collected Data

<i>Variable</i>	<i>Verification</i>	<i>Source</i>
Base Wattage	400W/100W lamps	Remaining lamps in storage
Efficient Wattage	136W/270W fixtures	Model nameplate data
Hours of use – high bay lighting; M-Saturday	24 hours; 3 shifts-6 days	Site contact provided schedule
Hours of use – high bay lighting, Sunday	6 hours	Site contact provided schedule
Hours of use – task lighting	Varies by process	These lights were not retrofitted
Quantity	19/236	Tally count of fixtures

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

<i>Measure</i>	<i>Quantity (Fixtures)</i>		<i>Wattage</i>		<i>Hours</i>	<i>Heating Cooling Interaction Factor</i>	<i>Expected kWh Savings</i>	<i>Realized kWh Savings</i>	<i>Gross Realization Rate</i>
	<i>Baseline</i>	<i>Efficient</i>	<i>Baseline</i>	<i>Efficient</i>					
MH400W to LED highbay	19	19	458	136	7,749	1.00	58,953	47,411	80%
MH400W to LED highbay	236	236	1,080	270	7,749	1.00	1,842,018	1,481,381	80%
Total	255	255					1,900,971	1,528,792	80%

Results*Measure-Level Realized Gross Savings*

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Lighting	1,900,971	1,528,792	80%	197.28	16,934,100
Total	1,900,971	1,528,792	80%	197.28	

The realized annual energy savings are 1,528,792 kWh resulting in a realization rate of 80%. The difference between the expected and realized savings is due to the following factors.

- The hours of use (7,749) verified during the site visit are less than the ex ante hours (8,760).
- ADM confirmed during the site visit that the site was heated (non-electric) with no cooling while the expected savings used an HCIF for an air conditioned space.

The realized energy savings estimate is equal to 11% of 2020 annual usage.

Ancillary Econometric Analysis

The post period energy usage was greater than the pre period for the billing meter that measures the power at the lighting retrofitted building and also to an adjacent, larger, building. The production data was not released to ADM to include in a billing data-weather regression analysis. Additionally, the site contact reported that Covid-19 had impacted their operations and resulted in closures of the facility.

Project Number: EA-0000749024

Executive Summary

Under project EA-0000749024, a program participant received incentives from Appalachian Power for installing LED lighting in their facility.

The realized annual energy savings are 925,780 kWh resulting in a gross energy savings realization rate of 101%.

Project Description

The participant installed (1,064) LED 28W lamps, (2,048) LED 13W lamps, (34) LED 16W U-Tube lamps, and (3,468) LED 24W HO lamps.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, and the baseline, and post-retrofit connected load. In addition, ADM conducted an on-site visit to verify the installation of measures, collect data on heating and cooling equipment for use in applying heating and cooling interactive factors, and to collect data on lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
8L T5HO to linear LED	133	1,064	468	28	8,760	1	284,280	284,280	100%
4L T8 to linear LED	705	2,048	112	13	3,120	1.1	84,961	84,985	100%
2L UT8 to LED UT8	17	34	59	16	3,120	1.1	1,394	1,394	100%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
4L T5HO to linear LED HO	867	3468	234	25	6,065	1.00	547,283	555,120	101%
4LT8 to linear LED	259	518	59	13	3,120	1.10	21,120	21,126	100%
4LT8 to linear LED	55	110	59	13	3,120	1.10	6,229	6,231	100%
4LT8 to linear LED	33	99	89	13	3,120	1.10	5,663	5,664	100%
4LT8 to linear LED	28	112	112	13	3,120	1.10	5,766	5,767	100%
2L UT8 to linear LED	10	20	59	16	3,120	1.10	927	927	100%
4L T5HO to linear LED	473	1,892	234	25	6,065	1.00	272,898	276,783	101%
4L T5HO to linear LED	248	992	234	25	6,065	1.10	157,392	159,679	101%
4L T5HO to linear LED	146	584	234	25	6,065	1.00	116,993	118,658	101%
Total	1,722	6,614					918,227 ⁴	925,780	101%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	918,227	925,780	101%	162.91	5,983,250
Total	918,227	925,780	101%	162.91	

The realized annual energy savings are 925,780 kWh and the gross energy savings realization rate of 101%. The difference between the expected and realized energy was primarily due to a difference in the hours of use. Expected savings applied 5,980 for some of the project measures that were determined to operate for 6,065 hours during the site visit.

The realized energy savings estimate is equal to 15% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

⁴ Total project ex ante kWh savings does not match sum of documented ex ante savings of all project measures.

Intercept = *Y intercept*

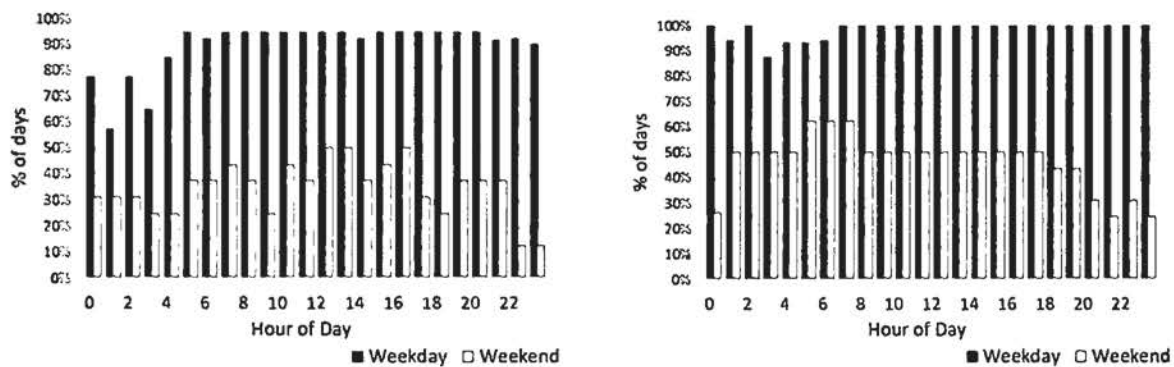
The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	(0.10)	(0.24)
HDD	(0.19)	(1.86)
Post_Flag	(1,885.07)	(2.83)
Intercept	19,346.59	23.32

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 688,049 kWh.

AMI billing data was disaggregated to the pre/post period, by hour of day and day of week. A threshold value for the hourly kWh value was determined to indicate when the facility was operating. The site contact noted that the weekend schedule was variable based on production demand. The following two figures illustrate this variability, with more weekend hours in the post regression period than the pre period.

Comparison of Lighting Usage in Pre to Post Period



Project Number: EA-0000749984

Executive Summary

Under project EA-0000749984, a program participant received incentives from Appalachian Power for installing LED lighting to the exterior of their facility.

The verified annual energy savings are 70,499 kWh resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (24) LED Area Lights.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline, and post-retrofit connected load. ADM conducted an on-site verification of the installed measures. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$ = Annual energy savings

N = Number of fixtures

W = Wattage of each fixture

t = Lighting operating hours

$HCIF$ = HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Metal Halide, (1) 1000W lamp to Area Light AR-200-50-T5	24	24	1,080	200	3,338	1.00	70,499	70,499	100%
Total	24	24					70,499	70,499	100%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	70,499	70,499	100%	0.00	88,223
Total	70,499	70,499	100%	0.00	

The verified annual energy savings are 70,499 kWh resulting in a gross energy savings realization rate of 100%.

The realized energy savings estimate is equal to 80% of 2020 annual usage. Energy use increased during the post period and the realized energy savings were 26% of the post-period energy use.

Ancillary Econometric Analysis

An Option C analysis is not viable for this site because energy use increased substantially during the post-period for reasons that are unlikely to be related to the installation of the project measures.

Project Number: EA-0000756887

Executive Summary

Under project EA-0000756887, a program participant received incentives from Appalachian Power for upgrading their exterior lighting.

The verified annual energy savings are 378,287 kWh resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (281) LED Canopy Fixtures and (34) LED Pole Light Heads.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, an on-site visit was conducted to verify installation and lighting hours of use. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Metal Halide, (1) 175W lamp to Canopy Lights	297	281	215	76	8,760	1.00	372,045	372,045	100%
Metal Halide, (1) 100W lamp to Pole Light heads	34	34	128	73	3,338	1.00	6,242	6,242	100%
Total	331	315					378,287	378,287	100%

Results

Measure-Level Realized Gross Savings

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Lighting	378,287	378,287	100%	42.47	31,067,572
Total	378,287	378,287	100%	42.47	

The verified annual energy savings are 378,287 kWh resulting in a gross energy savings realization rate of 100%.

The realized energy savings estimate is equal to 1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000757803

Executive Summary

Under project EA-0000757803, a program participant received incentives from Appalachian Power for upgrading to interior and exterior LED lighting at their facility.

The verified annual energy savings are 25,810 kWh resulting in a gross energy savings realization rate of 83%.

Project Description

The participant received incentives for installing (35) LED 200W High Bay fixtures, (5) LED Exit Signs, (40) LED 18W tubes, (47) LED 161W High Bay fixtures with Occupancy Sensors, (5) LED 13W PAR lamps, (2) LED Wall Packs, and (2) LED Canopy Lights.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, an on-site verification was performed to verify the installation and lighting hours of operation. Light loggers were installed to capture the hours of use in the facility. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (6) 48", HO T5 lamp to 200W LED high Bay	34	35	351	200	2,786	1.00	16,799	13,746	82%
EXIT Incandescent, (2) 25W lamp to 4.5W LED exit sign.	5	5	50	5	8,760	1.10	2,234	2,193	108%
Fluorescent, (3) 48", T-8 lamp, to 18W LED tube	13	40	93	18	2,786	1.00	1,665	1,362	82%
Fluorescent, (2) 96", T8 HO lamp to 161W LED high bay	48	47	160	161	2,691	1.00	385	304	79%
Incandescent, (1) 90W lamp to 13W LED Par 38	5	5	28	13	2,786	1.00	630	515	82%
Metal Halide, (1) 250W lamp to 78W Wall pack	2	2	295	78	3,338	1.00	1,449	1,449	100%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 48", STD HO T5 lamp to LED canopy light	2	2	117	36	3,338	1.00	541	539	100%
Total	109	136					23,502	20,109	86%

* The expected savings for this measure was corrected from 2,033 to 2,234.

Occupancy Sensor Savings Calculations

Measure	Quantity (Controls) Base	Quantity (Controls) Efficient	Controlled Wattage	Baseline Hours	Controls Factor	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
Occupancy Sensor	0	47	7,567	2,691	0.28	1.00	7,214	5,702	79%
Total	0	47					7,214	5,702	79%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	23,702	20,109	85%	5.04	69,921
Lighting Controls	7,214	5,702	79%	0.85	
Total	30,915	25,810	83%	5.89	

The verified annual energy savings are 25,810 kWh resulting in a gross energy savings realization rate of 83%. The differences between the expected and realized savings is due to the following factors.

- The logged interior hours of use for non-exit sign lighting (ranging from 2,691 to 2,786) are less than the ex ante hours (3,338). It appears that the ex ante savings estimate used dusk to dawn hours for both interior and exterior fixtures. In addition, the savings from the occupancy sensors was not as great as expected.
- The ex ante savings calculation for exit sign fixtures did not account for the efficient wattage of the new fixtures.
- The program tracking data did not separate the occupancy sensor data from the fixtures data but had combined the two under the fixture identifying measure name.

The realized energy savings estimate is equal to 37% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

<i>CDD</i>	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
<i>HDD</i>	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F
<i>Post_Flag</i>	= Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period
<i>Intercept</i>	= Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	(0.01)	(1.30)
HDD	(0.00)	(0.78)
Post_Flag	(22.69)	(1.61)
Intercept	186.52	9.66

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 8,282 kWh. Although this estimate is lower than the estimate realized savings, there may be factors impacting energy use that are not included in the model. Related to this, the site contact reported that operations have increased as compared with the months immediately after emergence of Covid-19.

Project Number: EA-0000759565

Executive Summary

Under project EA-0000759565, a program participant received incentives from Appalachian Power for installing LED lamps inside and to the exterior of their facility.

The verified annual energy savings are 92,245 kWh resulting in a gross energy savings realization rate of 118%.

Project Description

The participant received incentives for installing (429) LED 10.5W lamps, (14) LED 20.5W lamps, (5) LED 6" Downlights, (1) 14W A-line lamp, (5) LED Area Lights, and (2) LED Canopy Lights.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, ADM conducted an on-site verification to verify the lighting hours of operation and measure installation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 48", T-8 lamp, to 10.5T8/4F/840/BYP	203	406	60	11	8,760	1.14	60,564	79,159	131%
Fluorescent, (1) 48", T-8 lamp, to 20.5T8/4F/840/BYP	2	2	36	21	8,760	1.14	237	310	131%
Fluorescent, (1) 48", T-8 lamp, to 20.5T8/4F/840/BYP	6	12	65	21	8,760	1.14	1,102	1,440	131%
Fluorescent, (2) 48", T-8 lamp, to 10.5T8/4F/840/BYP	15	15	32	11	8,760	1.14	2,467	3,225	131%
baseline 65W incandescent to 6/835/DIM10UNV	5	5	65	9	8,760	1.14	2,142	2,800	131%
baseline 43W incandescent to 14A21DIM/830	1	1	43	14	8,760	1.14	222	290	131%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 48", T-8 lamp, to 10.5T8/4F/840/BYP	2	8	112	11	8,760	1.14	1,071	1,400	131%
Metal Halide, (1) 175W lamp to AR-60-50-T3 Area light	5	5	215	60	3,338	1.00	2,587	2,587	100%
Metal Halide, (1) 175W lamp to SCP-60-50	2	2	215	60	3,338	1.00	1,035	1,035	100%
Ex Ante Correction							6,782		
Total	241	456					78,208	92,245	118%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	78,208	92,245	118%	7.15	776,700
Total	78,208	92,245	118%	7.15	

The realized annual energy savings are 92,245 kWh resulting in a gross energy savings realization rate of 118%. The ex post interior hours of use (8,760) are greater than the ex ante hours (7,650), the installed measures are in common areas that always remain lit. In addition, the ex post analysis used the facility type of nursing home producing a kW reduction of 7.15 whereas the ex ante savings estimate was greater (12.76).

The ex ante savings of 78,208 kWh is greater than what could be reproduced during the ex post for the savings estimate (71,426).

The realized energy savings estimate is equal to 12% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.09	1.18
HDD	0.03	1.57
Post_Flag	(20.90)	(0.12)
Intercept	1,791.79	7.67

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 7,627 kWh. The *Post_Flag* coefficient is not statistically significant and the pre and post-period energy use is highly variable, suggesting that the regression estimate of savings is not reliable and highly sensitive to the energy use during the specific months included in the model. Additionally, the realized savings estimate is 12% of facility energy usage, which is at the lower end of the range where Option C analysis is viable.

Project Number: EA-0000763317

Executive Summary

Under project EA-0000763317, a program participant received incentives from Appalachian Power for upgrading their lighting in their facility.

The verified annual energy savings are 424,391 kWh resulting in a gross energy savings realization rate of 115%.

Project Description

The participant received incentives for (179) LED High Bay fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, ADM conducted an on-site visit to verify installation, hours of use, and interactive factors. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 48", T-8 lamp, to LED High Bay	843	144	59	100	5,296	1.13	210,480	211,476	100%
Fluorescent, (2) 96", T-8 lamp, to LED High Bay	294	35	109	100	6,600	1.13	159,133	212,915	134%
Total	1,137	179					369,613	424,391	115%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	369,613	424,391	115%	71.80	1,202,000
Total	369,613	424,391	115%	71.80	

The realized annual energy savings are 424,391 kWh, resulting in a gross energy savings realization rate of 115%. Realized savings differed from expected saving for the following reasons.

- ADM verified 179 fixtures onsite instead of the expected quantity of 185. The site purchased 185 fixtures but only 179 were installed.
- The verified hours of use ranged from 5,296 to 6,600 and the expected savings assumed 6,084 hours of use.
- The site was air conditioned and not unconditioned as assumed in the expected savings calculation.

The realized energy savings estimate is equal to 35% of 2020 annual usage.

Ancillary Econometric Analysis

An Option C analysis is not viable for this site because energy use increased substantially during the post-period for reasons that are unlikely to be related to the installation of the project measures.

Project Number: EA-0000763421

Executive Summary

Under project EA-0000763421, a program participant received incentives from Appalachian Power for installing LED lighting in the exterior of the facility.

The verified annual energy savings are 11,402 kWh resulting in a gross energy savings realization rate of 52%.

Project Description

The participant received incentives for installing (6) LED 300W Area Lights, (1) LED 100W Area Light, and (4) LED 80W Wall Packs.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. ADM conducted an on-site verification of the installed measures. The variables and source used for the energy savings are listed in the following table:

Variables for Lighting Savings Algorithm

<i>Variable</i>	<i>Description</i>	<i>Ex Ante</i>	<i>Ex Post</i>	<i>Source</i>
N	Number of fixtures	Pole: 6 Flood: 1 Wall: 4	Pole: 6 Flood: 1 Wall: 4	Site Visit Invoice
$W_{as-built}$	Efficient Wattage	Pole: 300W Flood: 100W Wall: 80W	Pole: 300W Flood: 100W Wall: 80W	Mfg nameplate Specification Sheets
Hours	Daily hours x 8760	3,338	3,338	Site Visit AMI Data
W_{base}	Existing Wattage	Pole: 1,000 W	Pole: 750 W	Mfg spec sheet equivalent replacement
		Flood: 1000W Wall: 295 W	Flood: 288 W Wall: 171 W	MidAtlantic TRM V10 Outdoor Pole/Wall Mounted Area Lights

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$$kWh_{savings} = \text{Annual energy savings}$$

$$N = \text{Number of fixtures}$$

W = Wattage of each fixture

Hours = Lighting operating hours

HCIF = HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
MH1000 to LED pole fixture	2	2	750	300	3,338	1.00	5,207	3,004	58%
MH1000 to LED pole fixture	4	4	750	300	3,338	1.00	10,415	6,008	58%
MH1000 to LED flood	1	1	288	100	3,338	1.00	3,271	1,175	36%
MH250 to LED wall pack	4	4	171	80	3,338	1.00	2,871	1,215	42%
Total	11	11					21,764	11,402	52%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	21,764	11,402	52%	0.00	25,894
Total	21,764	11,402	52%	0.00	

The verified annual energy savings are 11,403 kWh resulting in a gross energy savings realization rate of 52%. The expected savings used the existing fixtures for the baseline, which were higher wattage than the lumen equivalence baseline used in the realized savings analysis. The references from the installation contractor for the pole fixtures referenced the “shoe box” rated wattage, which may not have represented the actual wattage of the existing lamps. The manufacturer specification sheets for the pole mounted LED fixtures listed the equivalent replacement as 750 W MH, compared to the value of 1,000 W used in the expected savings analysis. The wall packs did not have a specified equivalent replacement, so the MidAtlantic TRM V10 was referenced for the measure category “LED Outdoor Area Fixture replacing up to 175 HID” with an efficient equivalent wattage of 99 W.

The realized energy savings estimate is equal to 44% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	(0.00)	(1.89)
HDD	0.00	3.06
Post_Flag	(19.60)	(9.70)
Intercept	63.03	22.75

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 7,155 kWh, which is less than the realized savings estimate. There is uncertainty if all the existing pole mounted MH lamps and wall pack lamps were operating, or if any had burned out. The engineering analysis savings method referenced a normal replacement baseline, which determined the baseline wattage based on the lumen equivalence instead of the existing equipment.

Project Number: EA-0000764598

Executive Summary

Under project EA-0000764598, a program participant received incentives from Appalachian Power for installing LED lighting in the exterior of their facility.

The verified annual energy savings are 24,157 kWh resulting in a gross energy savings realization rate of 52%.

Project Description

The participant received incentives for installing (11) LED Area Lights, (1) LED Flood Light, (20) LED Soffit Lights, and (4) LED Wall Packs.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. ADM conducted an on-site verification of the installed measures. Baseline lamps were no longer available to note lamp wattages, and the burnout rate was unknown. The variables and source used for the energy savings are listed in the following table:

Variables for Lighting Savings Algorithm

<i>Variable</i>	<i>Description</i>	<i>Ex Ante</i>	<i>Ex Post</i>	<i>Source</i>
N	Number of fixtures	Pole: 11 Flood: 1 Soffit: 20 Wall: 4	Pole: 11 Flood: 1 Soffit: 20 Wall: 4	Site Visit Invoice
$W_{as-built}$	Efficient Wattage	Pole: 300W Flood: 100W Soffit: 20 Wall: 80W	Pole: 300W Flood: 100W Soffit: 20 Wall: 80W	Mfg nameplate Specification Sheets
Hours	Daily hours x 8760	3,338	3,500	Site Contact scheduled hours, average DST & Non-DST hours
W_{base}	Existing Wattage	Pole: 1,000 W	Pole: 750 W	Mfg spec sheet equivalent replacement
		Flood: 1000W Wall: 295 W	Flood: 288 W Wall: 171 W	MidAtlantic TRM V10 Outdoor Pole/Wall Mounted Area Lights
		Soffit: 190	Soffit: 90	Mid Atlantic TRM V10 Recessed Downlight

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
MH to LED pole fixture	4	4	750	300	3,500	1.00	10,415	6,300	60%
MH to LED pole fixture	7	7	750	300	3,500	1.00	18,225	11,025	60%
MH to LED flood fixture	1	1	288	100	3,500	1.00	3,271	658	20%
MH soffit to LED recessed	20	20	90	20	3,500	1.00	11,349	4,900	43%
MH to LED wall pack	4	4	171	80	3,500	1.00	2,871	1,275	44%
Total	36	36					46,131	24,157	52%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	46,131	24,157	52%	0.00	35,942
Total	46,131	24,157	52%	0.00	

The verified annual energy savings are 24,157 kWh resulting in a gross energy savings realization rate of 52%.

The realized energy savings estimate is equal to 67% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD	= Cooling Degree Days for a given month and assumes a base temperature of 75°F
HDD	= Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.00	0.30
HDD	0.00	3.00
Post_Flag	(38.49)	(15.26)
Intercept	82.17	23.88

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 14,048 kWh, which is less than the realized savings estimate. There is uncertainty if all the existing pole mounted MH lamps and wall pack lamps were operating, or if any had burned out. The engineering analysis savings method references a normal replacement baseline, as the baseline wattage was determined by lumen equivalence.

Project Number: EA-0000769170

Executive Summary

Under project EA-0000769170, a program participant received incentives from Appalachian Power for installing LED lighting in the exterior of their facility.

The verified annual energy savings are 11,509 kWh resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (7) LED 150W Area Lights and (4) LED 135W Flood Lights.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. ADM conducted an on-site verification of the installed measures. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$ = Annual energy savings

N = Number of fixtures

W = Wattage of each fixture

t = Lighting operating hours

$HCIF$ = HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
MH400W to LED fixture	5	5	458	150	3,338	1.00	5,141	5,141	100%
MH400W to LED flood	4	4	458	135	3,338	1.00	4,313	4,313	100%
MH400W to wall pack	2	2	458	150	3,338	1.00	2,056	2,056	100%
Total	11	11					11,509	11,509	100%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	11,509	11,509	100%	0.00	263,440
Total	11,509	11,509	100%	0.00	

The verified annual energy savings are 11,509 kWh resulting in a gross energy savings realization rate of 100%.

The realized energy savings estimate is equal to 4% of 2020 annual usage.

Ancillary Econometric Analysis

billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000769787

Executive Summary

Under project EA-0000769787, a program participant received incentives from Appalachian Power for upgrading to LED lighting in their facility.

The verified annual energy savings are 192,895 kWh resulting in a gross energy savings realization rate of 109%.

Project Description

The participant received incentives for installing (289) 8' LED Linear Fixtures, (12) 4' LED Linear Fixtures, (26) 2x4 LED fixtures, (3) 1x4 LED Fixtures, and (7) 2x2 LED Fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, ADM conducted an on-site visit to verify installation, hours of use, and interactive factors. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (2) 96", T-8 lamp, to 8 FT Grid - Direct Linear	304	259	109	48	6,445	1.12	137,144	148,996	109%
Fluorescent, (2) 48", T-8 lamp, to 4 FT Grid - Direct Linear	33	4	59	27	6,445	1.12	12,183	13,234	109%
Fluorescent, (4) 48", T-8 lamp, to 2x4	26	26	112	50	6,445	1.12	10,679	11,601	109%
Fluorescent, (3) 48", T-8 lamp, to 1x4	3	3	89	40	6,445	1.12	974	1,058	109%
Fluorescent, (2) 24", T-8 lamp, to 2x2	7	7	31	40	6,445	1.12	-417	-453	109%
Fluorescent, (2) 96", T-8 lamp, to 8FT CPG Linear Kit	30	30	109	49	6,445	1.12	11,925	12,954	109%
Fluorescent, (4) 48", T-8 lamp, to 4 FT Grid - Direct Linear	9	9	112	27	6,445	1.12	5,068	5,505	109%
Total	412	338					177,555	192,895	109%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	177,555	192,895	109%	29.95	1,443,040
Total	177,555	192,895	109%	29.95	

The verified annual energy savings are 192,895 kWh resulting in a gross energy savings realization rate of 109%. The ex post analysis hours of use (6,445) were greater than the ex ante hours (6,022). The ADM site visit confirmed the lighting is on 17 hours per day plus a percentage constantly lit 24/7. In addition, the site is comfort cooled while the ex ante savings estimate did not use these interactive factors.

The realized energy savings estimate is equal to 13% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = *Y intercept*

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.15	2.85
HDD	0.01	0.38
Post_Flag	(186.18)	(1.68)
Intercept	3,842.12	25.40

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 67,957 kWh. This estimate is lower than the realized savings estimate. The regression estimate may not be reliable because the project energy savings proportion to total usage is at the lower end of the range for which Option C analysis may be viable. Because the energy savings are based on hours of use obtained during the site visit and are plausible for the building type (grocery store), ADM did not modify realized savings estimate.

Project Number: EA-0000770672

Executive Summary

Under project EA-0000770672, a program participant received incentives from Appalachian Power for installing LED lighting in their facility.

The verified annual energy savings are 41,216 kWh resulting in a gross energy savings realization rate of 57%.

Project Description

The participant received incentives for installing (100) LED High Bay Fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a phone interview with the site contact was performed to verify installation of the measures, heating and cooling, and the lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
4' 6-lamp T5 to LED High Bay	100	100	351	150	2,592	0.79	72,461	41,216	57%
Total	100	100					72,461	41,216	57%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	72,461	41,216	57%	12.56	220,000
Total	72,461	41,216	57%	12.56	

The verified annual energy savings are 41,216 kWh resulting in a gross energy savings realization rate of 57%. The difference between expected and realized savings is due to the following factors.

- The facility hours verified during a telephone interview were 2,592, fewer than the 3,338 hours used in the expected savings analysis.
- The expected savings did not account for heating and cooling interaction factors. The site is heated and cooled with a ducted heat pump.

The realized energy savings estimate is equal to 19% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.00	0.06
HDD	(0.00)	(1.46)
Post_Flag	(93.38)	(5.10)
Intercept	573.36	23.33

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 34,082 kWh. At 83% of the realized savings, the Option C regression estimate reasonably approximates the realized savings estimate given that other factors not included in the model may impact energy usage.

Project Number: EA-0000773209

Executive Summary

Under project EA-0000773209, a program participant received incentives from Appalachian Power for installing LED lighting in the exterior of their facility.

The verified annual energy savings are 71,211 kWh resulting in a gross energy savings realization rate of 79%.

Project Description

The participant received incentives for installing (25) LED Area Lights.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. ADM conducted an on-site verification of the installed measures, verifying the installed quantity and photocell lighting control. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
MH1000W to LED pole 300W	16	16	1,080	300	4,308	1.00	41,658	53,764	129%
MH1000W to LED pole 300W	9	9	750	300	4,308	1.00	48,668	17,447	36%
Total	25	25					90,327	71,211	79%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	90,326	71,211	79%	0.00	121,093
Total	90,326	71,211	79%	0.00	

The verified annual energy savings are 71,211 kWh, resulting in a gross energy savings realization rate of 79%. ADM was not able to confirm the baseline of (16) for the second line item in the above table to ensure that this was not a one-to-one upgrade (9) instead of a reduction in quantity. The normal replacement baseline of the lumen equivalent of the fixture was sourced from the manufacturer specification sheet.

The realized energy savings estimate is equal to 59% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysis are presented in the table below:

Coefficients	Value	T-Statistic
CDD	(0.01)	(0.98)
HDD	0.00	0.63
Post_Flag	(206.92)	(10.96)
Intercept	275.59	10.71

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 75,524 kWh, which is somewhat similar to the verified savings estimate of 71,211 kWh.

Project Number: EA-0000783992

Executive Summary

Under project EA-0000783992, a program participant received incentives from Appalachian Power for upgrading interior lighting.

The verified annual energy savings are 16,792 kWh resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (68) LED 25W T5 lamps and (6) LED 18W T8 lamps.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. Multiple attempts were made to verify the measure installation and hours of operation without success. These data sources were referenced to develop estimates of realized energy impacts.

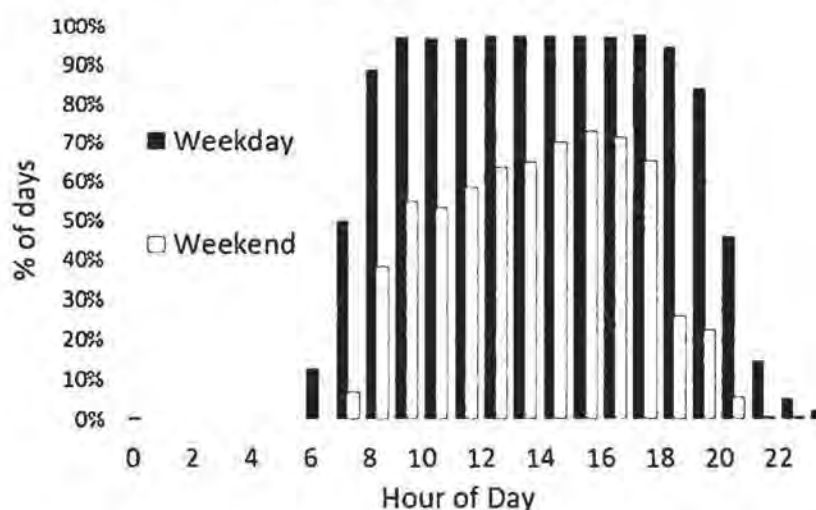
Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times Hours \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built})/1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
$Hours$	= Lighting operating hours
$HCIF$	= HVAC interactive factor

ADM verified the hours of operation with an analysis of AMI billing data. In the analysis, the site total hourly power usage was used as an indicator of lighting turned on or off at the facility. The portion of days with the lights in the on state, compared to the hour of day and aggregated by weekday or weekend is presented in the following figure:

Hourly Lighting Profile from AMI Data*Lighting Energy Savings Calculations*

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
6L T5HO to linear LED	13	52	351	25	3,380	1.10	12,131	12,141	100%
4L T8 to linear LED	3	6	118	18	3,380	1.10	915	915	100%
6L T5HO to linear LED	4	16	351	25	3,380	1.10	3,733	3,736	100%
Total	20	74					16,779	16,792	100%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	16,779	16,792	100%	3.54	72,968
Total	16,779	16,792	100%	3.54	

The verified annual energy savings are 16,792 kWh resulting in a gross energy savings realization rate of 100%. The ex post analysis was based on the ex ante installed measures and hours of use. ADM's multiple attempts to speak with the site contact was unsuccessful.

The realized energy savings estimate is equal to 23% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysts are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.00	0.87
HDD	(0.00)	(2.96)
Post_Flag	(21.13)	(1.74)
Intercept	238.18	14.59

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 7,712 kWh. The difference in the Option C analysis savings from the realized savings may be due to factors impacting month-to-month energy usage not included in the regression model.

Project Number: EA-0000784236

Executive Summary

Under project EA-0000784236, a program participant received incentives from Appalachian Power for upgrading their interior lighting.

The verified annual energy savings are 5,780 kWh resulting in a gross energy savings realization rate of 141%.

Project Description

The participant received incentives for installing (8) LED 8' lamps and (48) LED 4' lamps.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a phone interview with the site contact was performed to verify the lighting hours of operation and installed measures. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
8' 2-lamp T8 to LED 8' tube	4	8	160	43	2,043	1.12	537	675	126%
4' 4-lamp T8 to LED 4' tube	24	48	118	18	2,323	1.12	3,573	5,104	143%
Total	28	56					4,109	5,780	141%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	4,109	5,780	141%	2.96	44,080
Total	4,109	5,780	141%	2.96	

The verified annual energy savings are 5,780 kWh resulting in a gross energy savings realization rate of 141%. The verified hours of use (2,043 and 2,323), confirmed with the site contact, are greater than the hours used in the expected savings estimate (1,650).

The realized energy savings estimate is equal to 13% of 2020 annual usage.

Ancillary Econometric Analysis

An Option C analysis is not viable for this site because energy use increased substantially during the post-period for reasons that are unlikely to be related to the installation of the project measures.

Project Number: EA-0000786014

Executive Summary

Under project EA-0000786014, a program participant received incentives from Appalachian Power for upgrading to LED lighting.

The verified annual energy savings are 514,800 kWh resulting in a gross energy savings realization rate of 98%.

Project Description

The participant received incentives for installing (167) LED 4' 10W T8 lamps, (1) LED A-19 lamp, (12) LED 104W High Bay, (1) LED 4' Strip fixture, (4) LED 8' Strip fixtures, (30) LED Emergency lights, (63) LED 136W High Bay fixtures, (273) LED 92.4W High Bay fixtures, (14) LED Exit Signs, (4) LED Bug Eye Exit Signs, and (23) Occupancy Sensors.

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
4' T8 to LED CSS48	1	1	59	55	2,920	1.05	11	12	109%
2L 8' T* to 8' LED fixture	4	4	109	72	2,920	1.05	415	454	109%
CFL26W to LED A19	1	1	26	8	1,456	1.05	49	28	57%
Incand Exit to LED Exit	4	4	15	4	8,760	1.05	416	398	96%
Incand Exit 15W to LED Exit	14	14	15	2	8,760	1.05	1784	1702	95%
Incand Exit 5W to LED Exit	30	30	5	1	8,760	1.05	1285	1226	95%
2L T8 to T8 LED	4	4	59	10	4,368	1.05	693	899	130%
2L T8 to T8 LED	2	2	59	10	8,736	1.05	942	899	95%
3L T8 to T8 LED	142	142	89	10	4,368	1.05	40052	49338	123%
3L T8HO to T8 LED	1	1	89	10	1,456	1.05	110	121	110%
4L T5HO to T5LED	18	18	112	10	4,368	1.05	6665	8293	124%
6L T5HO to LED	12	12	351	104	5,110	1.05	16661	15909	95%
HPS 250W to LED fixture	22	22	295	136	4,368	1.05	12376	16049	130%
HPS 250W to LED fixture	8	8	295	92	5,840	1.05	10412	9942	95%
HPS 250W to LED fixture	264	264	295	92	5,840	1.05	343597	328100	95%
MH175W to LED fixture	1	1	215	92	3,276	1.05	442	422	95%

MH400W to LED fixture	3	3	458	136	5,840	1.05	6206	5926	95%
MH400W to LED fixture	38	38	458	136	5,840	1.05	78605	75060	95%
Unknown fixture	0	0					119	0	NA
Total	574	574					520,838	514,787	98%

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a phone interview was attempted with the site contact was performed to verify the lighting hours of operation but was unsuccessful. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Occupancy Sensor Savings Calculations

Measure	Quantity (Controls) Base	Quantity (Controls) Efficient	Controlled Wattage	Baseline Hours	Controls Factor	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
Occupancy Sensor	18	18	180	4,368	0	1.05	4,919	0	0%
	1	1	10	4,368	0	1.05	273	0	0%
	3	3	30	4,368	0	1.05	820	0	0%
	0	1	10	4,368	0.28	1.05	393	13	3%
Total	22	23					6,406	13	0%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	520,838	514,787	99%	92.48	2,582,640
Lighting Controls	6,406	13	0%	0.00	
Total	527,243	514,800	98%	92.48	

The verified annual energy savings are 514,800 kWh resulting in a gross energy savings realization rate of 98%. The ex ante savings calculator has an error within the calculation for screw-in lamps when the client uses the lumens for the efficient lamp instead of the actual wattage. The error uses the baseline wattage as the savings. In addition, the majority of the installed occupancy sensors were replacing existing occupancy sensors so there was no additional savings produced.

The realized energy savings estimate is equal to 20% of 2020 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 75°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 60°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysis are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	0.22	1.73
HDD	(0.05)	(2.06)
Post_Flag	(1,688.46)	(8.30)
Intercept	7,496.54	28.19

The *Post_Flag* coefficient is associated with an estimate of annual energy savings of 616,289 kWh.

Project Number: EA-0000787528

Executive Summary

Under project EA-0000787528, a program participant received incentives from Appalachian Power for upgrading their exterior lighting.

The verified annual energy savings are 29,723 kWh resulting in a gross energy savings realization rate of 148%.

Project Description

The participant received incentives for installing (6) LED Area Lights and (4) LED Wall Packs.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, a phone interview with the site contact was performed to verify the lighting hours of operation and installed measures. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Metal Halide to LED Area Light	6	6	1,080	300	4,927	1.00	15,622	23,061	148%
Metal Halide to LED Wall Pack	4	4	458	120	4,927	1.00	4,513	6,662	148%
Total	10	10					20,135	29,723	148%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	20,135	29,723	148%	0.75	2,180,000
Total	20,135	29,723	148%	0.75	

The verified annual energy savings are 29,723 kWh resulting in a gross energy savings realization rate of 148%. The difference between the realized and expected savings is due to greater hours of operation verified by the site contact than was used in the calculation of realized savings. The site contact confirmed that the exterior lighting is on a timer and is not adjusted throughout the year.

The realized energy savings estimate is equal to 1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

2.2. Standard

Project Number: EA-0000546874, EA-0000546910, and EA-0000546915

Executive Summary

Under project EA-0000546874, EA-0000546910, and EA-0000546915 a program participant received incentives from Appalachian Power for installing commercial refrigerators at their facilities.

The verified annual energy savings are 3,714 kWh resulting in a gross energy savings realization rate of 109%.

Project Description

The participant received incentives for installing (2) Commercial Refrigerators in each of the three stores.

Measurement and Verification Effort

ADM conducted two on-site visits and one remote visit to verify equipment installation, baseline, and efficient measure information. These findings were used to calculate energy savings.

Energy savings for Commercial Refrigerators at Time of Sale are calculated as follows:

$$\Delta kWh = (kWh_{BASEdaily\max} - kWh_{EEdaily\max}) * 365$$

Where:

$$kWh_{BASEdaily\max} = 0.29V + 2.95 \text{ (Vertical Closed Transparent)}$$

$$kWh_{EEdaily\max} = 0.232V + 2.36 \text{ (Vertical Closed Transparent)}$$

$$V = \text{unit volume in cubic feet}$$

$$\text{Hours} = 5858 \text{ full load hours}$$

$$CF = 0.77$$

For Commercial Refrigerators, the values above are from the Mid-Atlantic TRM v.10.0, May 2020, p.338 – 341.

The tables shown below present expected and realized energy savings for the measures installed under the project.

Commercial Refrigerator Savings Calculations

Measure	Quantity	kWh _{base}	KW _{ee}	Volume	Full Load Hours	CF	Expected kWh Savings	Realized kWh Savings	Realization Rate
Refrigerator - 546874	2	5.76	4.064	49	5858	0.77	1,137	1,238	109 %
Refrigerator - 546910	2	5.76	4.064	49	5858	0.77	1,137	1,238	109%
Refrigerator - 546915	2	5.76	4.064	49	5858	0.77	1,137	1,238	109%
Total	6						3,412	3,714	109%

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Commercial Refrigerator	3,412	3,714	109%	0.488	4,653,568
Total	3,412	3,714	109%	0.488	

The verified annual energy savings are 3,714 kWh resulting in a realization rate of 109%. The difference between the realized and expected savings was the result of differing volumes for the refrigerator. The realized savings analysis used the volume (49 cu. ft.) stated in the product specification sheet, which is greater than the volume (43.25cu. ft.) used in the calculation of expected savings.

The realized energy savings estimate is equal to <1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000610618 and EA-0000793747

Executive Summary

Under project EA-0000610618, a program participant received incentives from Appalachian Power for replacing fixed-speed air compressors with new efficient rotary screw air compressors and a variable speed air compressor. At the same time, under project EA-0000793747, they replaced handheld blow off air nozzles with entrained air nozzles.

The combined realized annual energy savings are 29,715 kWh resulting in a realization rate of 71%. The new air compressor realized savings of 28,871 were 110% of the expected savings, and the air nozzles realized savings of 844 kWh were 5% of the expected savings.

Project Description

The customer received incentives for installing the following measures:

- (30) Air entraining compressed air blow off nozzles
- (1) Variable speed rotary screw air compressor, 75 hp
- (3) Fixed speed rotary screw air compressors, 60 hp

Which replaced:

- (30) Straight pipe air blow off nozzles
- (1) Fixed speed air compressor, 75 hp
- (3) Fixed speed air compressors, 60 hp

Measurement and Verification Effort

During the site visit, ADM staff verified equipment installation, collected model nameplate data, and captured the operating profile of the equipment from the equipment interface. These findings were used to calculate energy savings.

Efficient compressed air nozzles energy savings are calculated as:

$$kWh_{savings} = (CFM_{base} - CFM_{eff}) \times \frac{kW}{CFM} \times Annual\ Hours \times \%Use \times Qty$$

Where:

$kWh_{savings}$	= Annual energy savings
CFM_{base}	= Air flow through 5/64" pipe; 30 cfm
CFM_{eff}	= Air flow through entrainment nozzle; 10 cfm
kW/CFM	= Measured system power/measured system air flow; 0.185 kW/CFM
Annual Hours	= Annualized metered hours from February 2021 to December 2021
%Use	= 0.20%; (30 seconds x 3 times/day/36000 sec/hr) / Daily Hours
Quantity	= 30 nozzles

Efficient Compressed Air Nozzles EA-0000793747

<i>Measure</i>	<i>Quantity</i>	<i>CFMbase</i>	<i>CFMeff</i>	<i>kW/CFM</i>	<i>%USE</i>	<i>Annual Hours</i>	<i>Expected kWh Savings</i>	<i>Realized kWh Savings</i>	<i>Realization Rate</i>
Air entraining air nozzle	30	30	10	0.185	0.2%	3,696	15,472	844	5%
Total	30						15,472	844	5%

ADM obtained usage data from the variable and fixed speed air compressor equipment interfaces during the period beginning with the installation in February 2021 and ending when ADM completed its site visit in December 2021.

The usage data is summarized in the following table.

Air Compressor Plant Operating Data

Measure	HP	Air Compressor Operation, % of capacity					Air Compressor Load/Unload	
		0-20%	20-40%	40-60%	60-80%	80-100%	Loaded	Unloaded
VSD compressor	75	1.7 hr	1.4 hr	3.9 hr	3.7 hr	1.6 hr		
Fixed speed compressor 1	60	Lead/lag					5.2 hr	1.0 hr
Fixed speed compressor 2	60	Lead/lag						
Fixed speed compressor 3	60	Lead/lag						

The CAGI (Compressed Air and Gas Institute) performance verification data sheets were collected for the new and existing air compressors. A one-minute engineering bin profile was built with this data for a typical 12-hour shift, 6 days per week schedule with 12 holidays. The profile included the air compressor plant air flow for the new compressors, which ADM retrospectively applied to the operating characteristics of the existing air compressors. The power usage of the existing compressors was determined by their specifications and compressor performance curves.

Air Compressor Energy Savings EA-0000610618

<i>Measure</i>	<i>Weekly Air Flow (CFM)</i>	<i>Weekly kWh</i>	<i>kWh/CFM</i>	<i>Annual Hours</i>	<i>Annual kWh</i>	<i>Realized kWh Savings</i>	<i>Expected kWh Savings</i>	<i>Realization Rate</i>
Existing air plant	23,935	5,009	0.21	3,696	250,430	28,871	26,320	114%
Installed air plant		4,431	0.19		221,559			

Results*Realized Gross Savings/Realization Rates by Measure*

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Entrained air compressor nozzle	15,472	844	5%	0.22	4,382,400
Efficient Air Compressors	26,320	28,871	110%	7.42	
Total	41,792	29,715	71%	7.64	

The verified annual energy savings for the air compressors from EA-0000610618 is 28,871 kWh resulted in a realization rate of 110%. The Ex Post analysis utilized site specific collected operating data that represented nearly the entire year's air compressor usage. The usage indicated 12.3 hours per day at 6 days per week. The verified annual energy savings for air nozzles from EA-0000793747 are 844 kWh resulting in a realization rate of 5%. The Ex Post analysis utilized site specific data for the air compressor usage along with interview data regarding the daily usage of the handheld entrained air nozzles. The usage of 30 seconds blow off time, approximately three times per day for each of the 30 nozzles, produces a usage rate of 0.2% of the air compressor run time. The PA TRM measure for air entraining air nozzles considers both continuous blow off machine mounted nozzles and handheld nozzles. The handheld nozzle usage is footnoted at a 2% usage factor, compared to the machine mounted of 8%. The site visit data suggested the usage was even lower, at 0.2% for the intermittent usage of the handheld air nozzle.

Recommend for the program implementer to include the specific application type of the air entraining nozzle to discern if handheld or machine mounted.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, ADM also conducted an econometric energy usage analysis using the following equation:

$$kWh_{monthly} = CDD + HDD + Post_Flag + Intercept$$

Where:

CDD = Cooling Degree Days for a given month and assumes a base temperature of 60°F

HDD = Heating Degree Days for a given month in the post period and assumes a base temperature of 75°F

Post_Flag = Binary flag for post-project completion month. 1 = Post Period, 0 = Pre Period

Intercept = Y intercept

The results of the ancillary econometric analysis are presented in the table below:

<i>Coefficients</i>	<i>Value</i>	<i>T-Statistic</i>
CDD	255	2.3
HDD	(102)	-1.2
Post_Flag	(49,789)	-4.8
Intercept	327,129	21.9

Comparing the pre period to the post period after the installation in June 2021 produced a *Post_Flag* coefficient associated with 597,463 annual energy savings.

Project Number: EA-0000749501

Executive Summary

Under project EA-0000749501, a program participant received incentives from Appalachian Power for upgrading heating and cooling units.

The verified annual energy savings are 2,369 kWh resulting in a gross energy savings realization rate of 111%.

Project Description

The participant received incentives for installing (2) Package Terminal Air Conditioner/ Heat Pump units.

Measurement and Verification Effort

During the remote site visit, ADM staff verified equipment installation, baseline and efficient measure information. These findings were used to calculate energy savings.

Energy savings for PTHPs are calculated as follows:

$$kWh = \Delta kWh_{COOL} + \Delta kWh_{HEAT}$$

$$kWh_{savings} = \text{Annual energy savings}$$

$$kWh_{cool} = (BTU/h_{COOL}/1000) * ((1/EER_{BASE}) - (1/EER_{EE})) * EFLH_{COOL}$$

$$kWh_{heat} = (BTU/h_{HEAT}/1000) * ((1/HSPF_{BASE}) - (1/HSPF_{EE})) * EFLH_{HEAT}$$

where:

BTU/h = Capacity of Unit

$Eflh$ = Full Load Cooling/Heating Hours for Facility Type in Zip Code

EER = Cooling Efficiency

$HSPF$ = Heating Efficiency

For the new PTHP units, the base and post-project capacity were based on data collected from the site visit, along with equipment efficiency. The EFLH values were derived from weather data following the method in the MidAtlantic TRM for Virginia zip codes. The tables shown below present expected and realized energy savings for the measures installed under the project.

HVAC Savings Calculations

Measure	Quantity	EER		HSPF		Cooling Hours	Heating Hours	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
		Baseline	Efficient	Baseline	Efficient					
PTHP	1	8.20	11.30	3.41	11.60	644	913	1068	2252	211%
PTHP	1	10.70	11.30	10.58	11.60	644	913	1068	118	11%
Total	2							2,135	2,369	111%

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
HVAC	2,136	2,369	111%	0.26	497,400
Total	2,136	2,369	111%	0.26	

The verified annual energy savings are 2,369 kWh resulting in a realization rate of 111%. ADM found that one baseline unit was electric resistance resulting in a greater realization rate. The second baseline unit was a heat pump resulting in minimal savings.

The realized energy savings estimate is equal to less than 1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000759903

Executive Summary

Under project EA-0000759903, a program participant received incentives from Appalachian Power for replacing a fixed-speed air compressor with a variable speed rotary screw air compressor.

The verified annual energy savings are 34,632 kWh resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing:

- (1) 25 hp fixed-speed air compressor

And replacing:

- (1) 25 hp fixed-speed air compressor

Measurement and Verification Effort

During the desk review of the project, ADM staff verified equipment installation by review of invoices, and determined the appropriate baseline and efficient measure information. These findings were used to calculate energy savings.

Energy savings for Variable Speed Compressor are calculated as follows:

$$kWh_{savings} = 0.9 * HP * HOURS * (COMPF_{base} - COMPF_{ee})$$

Where:

$kWh_{savings}$	= Annual energy savings
HP	= Compressor motor nominal HP, 25hp
HOURS	= Hours of operation, 8320
$COMPF_{base}$	= Baseline compressor factor, 0.89
$COMPF_{ee}$	= Efficient compressor factor, 0.705

The baseline and efficient compressor factors are from the Mid-Atlantic TRM v.10.0.

The table shown below present expected and realized energy savings for the measure installed under the project.

Air Compressor Calculations

Measure	Quantity	HP	$COMPF_{base}$	$COMPF_{ee}$	Hours	Expected kWh Savings	Realized kWh Savings	Realization Rate
Air Compressor	1	25	0.89	0.705	8320	34,632	34,632	100%
Total	1					34,632	34,632	100%

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Air Compressor	34,632	34,632	100%	3.95	15,766,900
Total	34,632	34,632	100%	3.95	

The verified annual energy savings are 34,632 kWh resulting in a realization rate of 100%.

The realized energy savings estimate is equal to <1% of 2020 annual energy usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000760493 and EA-0000775262

Executive Summary

Under project EA-0000760493 and EA-0000775262, a program participant received incentives from Appalachian Power for upgrading with an air compressor and no-loss condensate drains.

The verified annual energy savings are 81,855 kWh resulting in a gross energy savings realization rate of 105%.

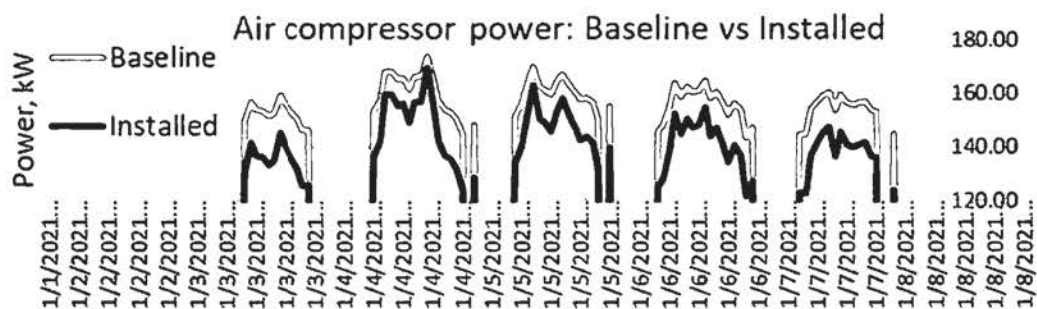
Project Description

The participant received incentives for installing (1) VFD Air Compressor and (5) No-Loss Condensate Drains.

Measurement and Verification Effort

During the desk review of the project, ADM staff verified equipment installation by review of invoices, determined the appropriate baseline and efficient measure information. Data was received via email from the participant for the air compressor usage for one week. This data was used to perform an hourly bin analysis of air compressor air flow and power used for the efficient and baseline air compressor, using their respective CAGI verification air flow to power relationship. The air compressor power for the baseline and installed for the modeled air flow are presented in the following figure.

Air Compressor Modeled Power



The tables shown below present expected and realized energy savings for the measure installed under the project.

Air Compressor Calculations

Measure	Quantity	HP	Expected kWh Savings	Realized kWh Savings	Realization Rate
Air Compressor	1	200	55,411	60,767	110%
Total	1		55,411	60,767	110%

Energy savings for No-loss Condensate Drains are calculated as follows:

$$kWh_{savings} = ALR * COMP * OPEN * AF * PNC$$

Where:

$kWh_{savings}$	= Annual energy savings
ALR	= Air Loss Rate, 109.4
COMP	= Compressor kW/CFM, 0.23
OPEN	= Hours per year drain is open, 146
AF	= Adjustment Factor, 0.97
PNC	= Percent Not Condensate, 0.75

The method and values used to calculate savings for no-loss condensate drains were based on the values in the Pennsylvania 2021 TRM v. 3, p. 263 – 267. The tables shown below present expected and realized energy savings for the measures installed under the project.

Measure	Quantity	ALR	COMP	OPEN	AF	PNC	Expected kWh Savings	Realized kWh Savings	Realization Rate
No-Loss Condensate Drains	3	7.66	0.189022	4004	0.97	0.75	13,329	12,653	95%
No-Loss Condensate Drains	2	7.66	0.189022	4004	0.97	0.75	8,886	8435	95%
Total	5						22,215	21,088	95%

Results

Realized Gross Savings/Realization Rates by Measure

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Air Compressor	55,411	60,767	110%	9.86	10,162,800
No-Loss Condensate Drain	22,215	21,088	147%	5.00	
Total	77,626	81,855	105%	14.87	

The verified annual energy savings are 81,855 kWh resulting in a realization rate of 105%. The expected savings analysis was based on the hours of use from the bin analysis, which showed greater hours of use than what the ex ante savings estimate was based on.

The realized energy savings estimate is equal to 1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000764396

Executive Summary

Under project EA-0000764396, a program participant received incentives from Appalachian Power for installing evaporator fan motors.

The verified annual energy savings are 4,221 kWh resulting in a gross energy savings realization rate of 75%.

Project Description

The participant received incentives for installing (6) ECM motor fans at their facility.

Measurement and Verification Effort

During an on-site visit, ADM staff verified equipment installation and collected information on the baseline and efficient measure. These findings were used to calculate energy savings.

Energy savings for ECM motors for walk-in coolers are calculated as follows:

$$kWh_{savings} = kW_{hp} * HP * \% \Delta P * \% ON_{UC} * HOURS * WHF_e$$

Where:

$kWh_{savings}$	= Annual energy savings
kW_{hp}	= connected load kW per horsepower of motor
HP	= Horsepower of ECM or SP motor
$\% \Delta P$	= Percent change in power relative to ECM kW
$\% ON_{UC}$	= Effective run time of motor with controls
HOURS	= Hours of operation
	= 8,760
WHF_e	= Waste heat factor for energy

For ECM Motors for coolers, the assumed values for $\% \Delta P$ (157%), $\% ON_{UC}$ (97.8%), and WHF_e (1.38) were based on the values in the Mid-Atlantic TRM v.10.0, May 2020, p.348 – 349. The tables shown below present expected and realized energy savings for the measures installed under the project.

ECM Motors for Walk-In Coolers Savings Calculations

Measure	Quantity	kWh _{hp}	HP	$\% \Delta P$	$\% ON_{UC}$	HOURS	WHF_e	Expected kWh Savings	Realized kWh Savings	Realization Rate
1/20 hp Cooler ECM Fan Motor	6	0.76	0.05	157%	97.8%	8,760	1.38	5,628	4,221	75%
Total	6							5,628	4,221	75%

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
ECM for Coolers	5,628	4,221	75%	0.48	267,080
Total	5,628	4,221	75%	0.48	

The verified annual energy savings are 4,221 kWh resulting in a realization rate of 75%. The realized savings were less than the expected savings because ADM found that all the installed ECM motors, verified with nameplate data, were 1/20th horsepower and not 1/15th as stated in the project documentation.

The realized energy savings estimate is equal to 2% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000783538

Executive Summary

Under project EA-0000783538, a program participant received incentives from Appalachian Power for installing a variable-speed drive refrigerated air dryer and condensate drain.

The verified annual energy savings are 12,316 kWh resulting in a gross energy savings realization rate of 65%.

Project Description

The participant received incentives for installing a (1) variable speed refrigeration dryer and (3) no-loss condensate drains.

Measurement and Verification Effort

During the desk review of the project, ADM staff verified equipment installation by review of invoices, determined the appropriate baseline and efficient measure information. These findings were used to calculate energy savings.

Energy savings for the variable speed refrigerated dryer are calculated as follows:

$$kWh_{savings} = 0.9 * HP * HOURS * (COMPF_{base} - COMPF_{ee})$$

Where:

$kWh_{savings}$	= Annual energy savings
HP	= Compressor motor nominal HP
HOURS	= Hours of operation
$COMPF_{base}$	= Baseline compressor factor, 0.89
$COMPF_{ee}$	= Efficient compressor factor, 0.75

The air dryer is a refrigerant compressor, with a similar load profile to an air compressor, so the algorithm was based on the values in the Mid-Atlantic TRM v.10.0, May 2020, p.407 – 409. The tables shown below present expected and realized energy savings for the measures installed under the project.

Variable Speed Air Dryer Savings Calculations

Measure	Quantity	HP	$COMPF_{base}$	$COMPF_{ee}$	HOURS	Expected kWh Savings	Realized kWh Savings	Realization Rate
Variable Speed Refrigeration Dryer	1	4.1	0.89	0.75	8,320	5,678	4,298	76%
Total	10					5,678	4,298	76%

Energy savings for no-loss condensate drains are calculated as follows:

$$kWh_{savings} = ALR * COMP * OPEN * AF * PNC$$

Where:

$kWh_{savings}$	= Annual energy savings
-----------------	-------------------------

<i>ALR</i>	= Air Loss Rate, 109.4
<i>COMP</i>	= Compressor kW/CFM, 0.23
<i>OPEN</i>	= Hours per year drain is open, 146
<i>AF</i>	= Adjustment Factor, 0.97
<i>PNC</i>	= Percent Not Condensate, 0.75

The method and values used to calculate savings for no-loss condensate drains were based on the values in the Pennsylvania 2021 TRM v. 3, p. 263 – 267. The tables shown below present expected and realized energy savings for the measures installed under the project.

<i>Measure</i>	<i>Quantity</i>	<i>ALR</i>	<i>COMP</i>	<i>OPEN</i>	<i>AF</i>	<i>PNC</i>	<i>Expected kWh Savings</i>	<i>Realized kWh Savings</i>	<i>Realization Rate</i>
No-Loss Condensate Drains	3	109.4	0.23	146	0.97	0.75	13,329	8,018	60%
Total	3						13,329	8,018	60%

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Variable Speed Refrigeration Dryer	5,678	4,298	76%	0.49	7,833,600
No-Loss Condensate Drains	13,329	8,018	60%	0.92	
Total	19,006	12,316	65%	1.41	

The verified annual energy savings are 12,316 kWh resulting in a realization rate of 66%. The expected savings were based on an energy calculator which used hours of operation, motor horsepower, and a savings factor to estimate the savings. The realized savings estimate utilized the same inputs for hours and horsepower and operating pressure, along with the TRM values for the other parameters in the equation.

The realized energy savings estimate is equal to <1% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000785164

Executive Summary

Under project EA-0000785164, a program participant received incentives from Appalachian Power for replacing two existing fixed speed air compressors in their manufacturing facility with two variable speed air compressors. The realized annual energy savings are 118,607 kWh resulting in a realization rate of 99%.

Project Description

The customer received incentives for installing the following measures:

- (2) 180 hp variable speed rotary screw air compressors
- (2) Low loss condensate drains

Which replaced:

- (2) 180 hp fixed speed air compressors
- (2) Condensate drains

Measurement and Verification Effort

During a remote site visit, ADM staff verified equipment installation and collected data on the baseline and efficient equipment. These findings were used to calculate energy savings.

Air compressor energy savings are calculated as:

$$kWh_{savings} = hp_{comp} \times HOURS \times \left(\frac{kW}{hp} CF_b - \frac{kW}{hp} CF_e \right)$$

Where:

$kWh_{savings}$	= Annual energy savings
hp_{comp}	= Compressor motor nominal hp
$HOURS$	= Compressor total hours of operation
CF_b	= Baseline compressor factor
kW/hp_b	= Baseline kW/hp
CF_e	= Baseline compressor factor
kW/hp_e	= Efficient kW/hp

The compressor factors from the Illinois TRM v.10.0, September 2021, p. 681 – 684 are based on the control method, with the efficient variable speed control and base period inlet modulation control. The kW/hp were referenced from CAGI verification sheets for each air compressor and operating pressure. The tables shown below present expected and realized energy savings for the measures installed under the project.

Air Compressor Savings Calculations

Measure	Qty	hp _{comp}	Duty Cycle	HOURS	CF _b	kW/hp _{base}	CF _e	kW/hp _{eff}	Expected kWh Savings	Realized kWh Savings	Realization Rate
VSD Air Compressor	2	180	0.5	6,500	0.89	0.85	0.66	0.79	110,822	111,609	101%

The quantity of the no-loss condensate drains was also verified, and the savings determined by:

$$kWh_{savings} = CFM_{reduced} \times kW_{CFM} \times Hours$$

Where:

$kWh_{savings}$ = Annual energy savings

$CFM_{reduced}$ = Reduced air consumption (CFM) per drain

kW_{CFM} = System power reduction per reduced air demand (kW/CFM)

Hours = Compressed air system pressurized hours

The $CFM_{reduced}$ is a deemed value from the Illinois TRM v.10.0, September 2021, p. 688 – 690 and factored by the known kW/CFM and hours the air compressor plant is pressurized. The tables shown below present expected and realized energy savings for the measures installed under the project.

No Loss Condensate Drain Savings Calculations

Measure	Quantity	CFM _{reduced}	kW _{CFM}	Hours	Expected kWh Savings	Realized kWh Savings	Realization Rate
No Loss Condensate Drain	2	3	0.18	6,500	8,886	6,998	79%
Total	4				8,886	6,998	79%

Results*Realized Gross Savings/Realization Rates by Measure*

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Air Compressor	110,822	111,609	101%	16.31	2,235,500
No Loss Condensate Drain	8,886	6,998	79%	1.02	
Total	119,708	118,607	99%	17.33	

The realized annual energy savings are 118,607 kWh resulting in a realization rate of 99%. The expected kWh energy savings calculation listed a 40hp value for the new air compressor in the savings calculation. The invoice and the site contact for the facility indicated the compressor was 75hp. The Ex Post analysis included the duty cycle of the air compressors that operate as lead/lag control.

The realized energy savings estimate is equal to 5% of 2020 annual usage.

Ancillary Econometric Analysis

A billing regression to substantiate the engineering analysis was not feasible for this project because the project savings are too small relative to the facility's total usage. IPMVP Option C requires that "savings are predicted to be greater than 10% to 20% of the overall consumption measured by the utility or submeter on a monthly basis."

Project Number: EA-0000857033

Executive Summary

Under project EA-0000857033, a program participant received incentives from Appalachian Power for upgrading to smart thermostats in their facility.

The verified annual energy savings are 23,305 kWh resulting in a gross energy savings realization rate of 27%.

Project Description

The participant received incentives for installing (79) Smart Thermostats.

Measurement and Verification Effort

During the desk review, ADM staff verified equipment installation, baseline, and efficient measure information. These findings were used to calculate energy savings.

Energy savings for Smart Thermostats are calculated as follows:

$$kWh_{savings} = kWh/Ton_{baseline} \cdot \text{Unit Size}$$

Where:

$kWh_{savings}$ = Annual energy savings

$kWh/Ton_{baseline}$ = Guest Room Energy Management Heating Source Electric Savings based on Region and Setback⁵

Unit Size = Tons

For Smart Thermostats were installed in a hotel with an energy management control system, the savings were estimated by the guest room energy management (GREM) measure from the Illinois TRM v.10, September 2021, p. 243 – 249. The Illinois GREM savings estimates were developed using prototypical EnergyPlus simulations. The tables shown below present expected and realized energy savings for the measures installed under the project.

Smart Thermostat Savings Calculations

Measure	Quantity Baseline	Quantity Efficient	kWh/Ton _{baseline}	Unit Size (Tons)	Expected kWh Savings	Realized kWh Savings	Realization Rate
Smart Thermostat	0	79	295	1	85,557	23,305	27%
Total	0	79			85,557	23,305	27%

⁵ Illinois TRM V.10 Guest Room Energy Management (PTAC & PTHP) pages 243-249

Results

Realized Gross Savings/Realization Rates by Measure

<i>Measure Category</i>	<i>kWh Savings</i>			<i>Realized Peak kW Reduction</i>	<i>2020 Total Energy Usage</i>
	<i>Expected</i>	<i>Realized</i>	<i>Realization Rate</i>		
Smart Thermostat	85,557	23,305	27%	8.69	335,680
Total	85,557	23,305	27%	8.69	

The verified annual energy savings are 23,305 kWh resulting in a realization rate of 27%. The project was installed at the end of December 2021, so there is insufficient billing data to compare usage during the pre and post-periods.

The realized energy savings estimate is equal to 25% of 2020 annual usage.

Ancillary Econometric Analysis

The post-period usage was greater than the pre-period usage and the post-period was limited because the measure was implemented toward the end of the program year. Consequently, an Option C analysis was not feasible.

2.3. SBDI

Project Number: EA-0000434761

Executive Summary

Under project EA-0000434761 a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The verified annual energy savings are 47,096 kWh resulting in a gross energy savings realization rate of 84%.

Project Description

The participant received incentives for installing (25) LED Reflector lamps, (89) LED A-Line lamps, (39) LED 4' LED fixtures, (21) 2x4 LED panels, (130) LED 2x4 Retrofit Kits, and (6) LED 2x4 Strip Fixtures.

Measurement and Verification Effort

To verify the project savings, ADM staff reviewed project documentation, baseline and post-retrofit connected load. In addition, an on-site verification was performed during which the contact verified the lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} [HCIF \times t \times (N_{base} \times W_{base} - N_{as-built} \times W_{as-built}) / 1000]$$

Where:

$kWh_{savings}$	= Annual energy savings
N	= Number of fixtures
W	= Wattage of each fixture
t	= Lighting operating hours
$HCIF$	= HVAC interactive factor

Lighting Energy Savings Calculations

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Fluorescent, (4) 48", T-8 lamp, to James - VLED-PAN2X4	76	76	112	40	3,146	1.10	18,112	18,954	105%
Incandescent, (1) 40W lamp to Duracell - LED11809	25	25	30	8	3,146	1.10	2,648	1,905	72%
Fluorescent, (3) 48", T-8 lamp, to Honya - HY4FTLW10240W	39	39	89	40	3,146	1.10	8,602	6,619	77%
Fluorescent, (2) 48", T-8 lamp, to James - VLED-PAN2X4	54	54	59	40	3,146	1.10	4,618	3,554	77%
Incandescent, (1) 60W lamp to Duracell - LED11823	26	26	43	10	3,146	1.10	4,346	3,017	69%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Incandescent, (1) 45W lamp to Duracell - LED11823	8	8	29	10	3,146	1.10	940	540	57%
Incandescent, (1) 40W lamp to Duracell - LED11823	55	55	29	10	3,146	1.10	5,552	3,715	67%
Fluorescent, (4) 48", T-8 lamp, to Hony HYPB2X4P3W3CCT	21	21	144	40	3,146	1.10	9,831	7,565	77%
Fluorescent, (3) 48", T-8 lamp, to Wisdom WL-RTST230-40K	6	6	89	30	3,146	1.10	1,593	1,226	77%
Total	310	310					56,242	47,096	84%

Results

Measure-Level Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2020 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	56,242	47,096	84%	10.68	294,240
Total	56,242	47,096	84%	10.68	

The verified annual energy savings are 47,096 kWh resulting in a gross energy savings realization rate of 84%. The realized energy savings were less than the expected savings because fewer hours of use were reported by the site contact than were used in the expected savings analysis.

In addition, the realized energy savings analysis used the adjusted baseline wattage for the incandescent lamps from the Mid-Atlantic V.10 TRM. The adjusted baseline wattage was less than the wattage used in the expected savings analysis.

Ancillary Econometric Analysis

An Option C analysis is not viable for this site because energy use increased substantially during the post-period for reasons that are unlikely to be related to the installation of the project measures.

Direct Install Verifications

Executive Summary

The Evaluation Team completed the verification activities at the 29 sampled sites listed in the table below that received direct install measures and concluded that there was not evidence to indicate that the direct install measures were installed. This conclusion was based on the following:

- During site visits, staff spoke with a contact at the site, such as a manager, and none of the individuals spoken to confirmed that a program representative installed the equipment.
- While we found LED lighting installed, the quantities of installed lamps did not correspond to the reported quantities in the data.
- The LEDs installed at site were a mix of models and manufacturers. Typically, in direct install programs, implementers purchase large quantities of lamps and what is installed is limited to a small number of models and manufacturers.
- The pre-rinse sprayers we observed installed at sites were not low flow sprayers.
- For verifications performed by telephone, the Evaluation Team spoke with multiple individuals at each site and in no case verified that someone had installed the efficient measures listed in the project tracking data.

<i>Mode of Verification</i>	<i>Project Number</i>
Onsite	EA-0000759631
	EA-0000759632
	EA-0000759633
	EA-0000760442
	EA-0000771125
	EA-0000771135
	EA-0000777832
	EA-0000789233
	EA-0000789234
	EA-0000794629
Telephone	EA-0000760441
	EA-0000760443
	EA-0000760446
	EA-0000768332
	EA-0000771498
	EA-0000773130
	EA-0000777830
	EA-0000777842
	EA-0000780040
	EA-0000785411
	EA-0000789244
	EA-0000792208
	EA-0000792809

<i>Mode of Verification</i>	<i>Project Number</i>
	EA-0000792812
	EA-0000794630
	EA-0000796887
	EA-0000825906
	EA-0000844597
	EA-0000863181

220450002

3. C&I Program Participant Survey Instrument

1. What is your job title or role?
1. Facilities Manager
2. Energy Manager
3. Other facilities management/maintenance position
4. Chief Financial Officer
5. Other financial/administrative position
6. Proprietor/Owner
7. President/CEO
8. Manager
9. Other (Please specify) [OPEN ENDED]
99. Prefer not to state

VERIFICATION BLOCK [DO NOT DISPLAY]

2. To begin with we would like to ask you about some of the equipment that our records indicate were installed at your business located at [LOCATION].

[DISPLAY Q3 IF PAR_QUANT > 0]

3. According to our records, [PAR_QUANT] PAR LED lamps (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q4 IF Q3 = 2]

4. How many PAR LED lamps were installed?

[DISPLAY Q5 IF PAR_QUANT > 0]

5. Were the PAR LED lamps installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q6 IF PAR_QUANT > 0]

6. Have any of the PAR LED lamps been removed?

1. No
2. Yes (How many?)

[DISPLAY Q6 IF LINEARLAMP_QUANT > 0]

7. According to our records, [LINEARLAMP_QUANT] LINEAR LAMPS (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q7 IF Q6 = 2]

8. How many LINEAR LAMPS were installed?

[DISPLAY Q8 IF LINEARLAMP_QUANT > 0]

9. Were the LINEAR LAMPS installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q9 IF LINEARLAMP_QUANT > 0]

10. Have any of the LINEAR LAMPS been removed?

1. No
2. Yes (How many?)

[DISPLAY Q10 IF TROFFER_QUANT > 0]

11. According to our records, [TROFFER_QUANT] TROFFER LAMPS (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q11 IF Q10 = 2]

12. How many TROFFER LAMPS were installed?

[DISPLAY Q12 IF TROFFER_QUANT > 0]

13. Were the TROFFER LAMPS installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q13 IF TROFFER_QUANT > 0]

14. Have any of the TROFFER LAMPS been removed?

1. No
2. Yes (How many?)

[DISPLAY Q14 IF LINEARAMBIENT_QUANT > 0]

15. According to our records, [LINEARAMBIENT_QUANT] LINEAR AMBIENT lamps (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q15 IF Q14 = 2]

16. How many LINEAR AMBIENT lamps were installed?

[DISPLAY Q16 IF LINEARAMBIENT_QUANT > 0]

17. Were the LINEAR AMBIENT lamps installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q17 IF LINEARAMBIENT_QUANT > 0]

18. Have any of the LINEAR AMBIENT lamps been removed?

1. No
2. Yes (How many?)

[DISPLAY Q3 IF LED_QUANT > 0]

19. According to our records, [LED_QUANT] A shape LED lamps (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q20 IF Q19 = 2]

20. How many A shape LED lamps were installed?

[DISPLAY Q21 IF LED_QUANT > 0]

21. Were the A shape LED lamps installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q22 IF LED_QUANT > 0]

22. Have any of the A shape LED lamps been removed?

1. No
2. Yes (How many?)

[DISPLAY Q3 IF DOWNLIGHT_QUANT > 0]

23. According to our records, [DOWNLIGHT_QUANT] LED downlights (shown below) were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q24 IF Q23 = 2]

24. How many LED downlights were installed?

[DISPLAY Q25 IF DOWNLIGHT_QUANT > 0]

25. Were the LED downlights installed inside, outside or both inside and outside locations?

1. Inside
2. Outside
3. Inside and outside

[DISPLAY Q26 IF DOWNLIGHT_QUANT > 0]

26. Have any of the LED downlights been removed?

1. No
2. Yes (How many?)

[DISPLAY Q27 IF PAR_QUANT > 0 OR LED_QUANT > 0 OR DOWNLIGHT > 0 OR
LINEARLAMP_QUANT > 0 OR TROFFER_QUANT > 0 OR LINEARAMBIENT_QUANT >
0]

27. Please enter how many hours for each of the following days the building is open, and the lights are in use. When entering the hours, please consider normal business operations NOT any impacts resulting from COVID- 19. [TEXT BOX GRID]

1. Monday
2. Tuesday
3. Wednesday
4. Thursday
5. Friday
6. Saturday
7. Sunday

[DISPLAY Q28 IF PAR_QUANT > 0 OR LED_QUANT > 0 OR DOWNLIGHT > 0 OR LINEARLAMP_QUANT > 0 OR TROFFER_QUANT > 0 OR LINEARAMBIENT_QUANT > 0]

28. Was your business closed for any full days or did it operate on reduced hours because of COVID-19?

1. Yes, closed for the full day on some days
2. Yes, open but operated on reduced hours on some days
3. Yes, closed both entirely some days and operated on reduced hours on other days
4. No, business hours have not been impacted by COVID-19

[DISPLAY Q29 IF Q28 = 1 OR 3]

29. How many days was your business closed entirely? Your best guess is fine.

[DISPLAY Q30 IF Q28 = 2 OR 3]

30. About how many months in the past year have you operated on reduced hours because of COVID-19? Your best guess is fine.

[TEXT BOX]

[DISPLAY Q31 IF Q28 = 2 OR 3]

31. Thinking about the time that you operated on reduced hours because of COVID-19, about what percent were your hours reduced? For example, if your hours were reduced by about 10 percent, please enter 10%. Your best guess is fine.

[TEXT BOX]

[DISPLAY Q32 IF PAR_QUANT > 0 OR LED_QUANT > 0 OR DOWNLIGHT > 0 OR LINEARLAMP_QUANT > 0 OR TROFFER_QUANT > 0 OR LINEARAMBIENT_QUANT > 0]

32. Select all of the 2021 holidays the site is closed, and the lighting turned off.
[MULTISELECT]

1. New Year's Day (Tuesday 1/1/2021)
2. Martin Luther King Day (Monday 1/18/2021)
3. President's Day (Monday 2/15/2021)
4. Memorial Day (Monday 5/31/2021)
5. Independence Day (Thursday 7/4/2021)
6. Labor Day (Monday 9/6/2021)
7. Columbus Day (Monday 10/11/2021)
8. Veterans Day (Monday 11/11/2021)
9. Thanksgiving Day (Thursday 11/25/2021)
10. Christmas Eve (Tuesday 12/24/2021)
11. Christmas Day (Wednesday 12/25/2021)

[DISPLAY Q33 IF PAR_QUANT > 0 OR LED_QUANT > 0 OR DOWNLIGHT > 0 OR
LINEARLAMP_QUANT > 0 OR TROFFER_QUANT > 0 OR LINEARAMBIENT_QUANT >
0]

33. Please enter the total number of additional days, if any, that the site is closed, and the
lighting turned off not included in the list of holidays above or closed due to COVID-19.

1. [TEXT BOX] additional days closed
2. The site is not closed any additional days

[DISPLAY Q34 IF SHOWER_QUANT > 0]

34. According to our records, [SHOWER_QUANT] low-flow showerheads were installed in
your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q35 IF Q34 = 2]

35. How many low-flow showerheads were installed?

[DISPLAY Q36 IF SHOWER_QUANT > 0]

36. Have any of the low-flow showerheads been removed?

1. No
2. Yes (How many?)

[DISPLAY Q37 IFAERATOR_QUANT > 0]

37. According to our records, [AERATOR_QUANT] low-flow faucet aerator heads were installed in your business. Does that number seem about right?

1. Yes
2. No

[DISPLAY Q38 IF Q37 = 2]

38. How many low-flow faucet aerator heads were installed?

[DISPLAY Q38 IF AERATOR_QUANT > 0]

39. Have any of the low-flow faucet aerators been removed?

1. No
2. Yes (How many?)

[DISPLAY Q40 IF SPRAYVALVE_QUANT > 0]

40. According to our records, [SPRAYVALVE_QUANT] pre-rinse spray valves were installed in your business. Does that number seem about right?

1. Yes
2. No

41. How many pre-rinse spray valves were installed?

[DISPLAY Q42 IF SPRAYVALVE_QUANT > 0]

42. Have any of the pre-rinse spray valves been removed?

1. No
2. Yes (How many?)

[DISPLAY Q43 IF AUTO_CLOSERS = 1]

43. According to our records, you received a discount for auto closers for walk-in refrigerator and/or freezer doors. Is that correct?

1. Yes
2. No

[DISPLAY Q44 IF STRIP_CURTAINS = 1]

44. According to our records, you received a discount for strip curtains for walk-in freezers and/or coolers. Is that correct?

1. Yes
2. No

[DISPLAY Q45 IF STRIP_CURTAINS = 1]

45. Our records say that the strip curtains were installed on about [STRIP_SQUARE_FEET] square feet of freezer and/or cooler space. Does that sound about like the total amount of square feet of freezer and/or cooler space that the strip curtains were installed on?

1. Yes
2. No

[DISPLAY Q46 IF CASE_LIGHTING = 1]

46. According to our records, you received a discount for LED refrigerated case lighting. Is that correct?

1. Yes
2. No

AWARENESS [DO NOT DISPLAY]

47. How did you FIRST learn about Appalachian Power's incentives for efficient equipment or upgrades? [RANDOMIZE ORDER OF 1 - 10]

1. From a Trade Ally, contractor, equipment vendor, or energy consultant
2. [DISPLAY IF SBDI = 1] A Small Business Direct Install Energy Advisor
3. From an Appalachian Power Account Representative
4. From a program representative
5. Through an internet search
6. At an event or trade show
7. Received an email blast or electronic newsletter from Appalachian Power
8. From social media post (Facebook, Twitter, LinkedIn)
9. From the Appalachian Power program website
10. From friends or colleagues
11. Other (Please specify) [OPEN ENDED]
98. Don't know

PROGRAM DELIVERY EFFICIENCY [DO NOT DISPLAY]

SBDI [Do Not Display] [Display Block if SBDI = 1]

48. Did you have any concerns about participating in the program when you were first learned about it or was it an easy decision?

1. I had some concerns
2. It was an easy decision

[DISPLAY Q49 IF Q48= 1]

49. What were your concerns? (Select all that apply) [MULTISELECT]

1. Upfront costs of the efficient equipment
2. Time for return on investment

3. Performance of new equipment
4. If the offer of the program incentive was legitimate
5. Other concerns (Please specify) [OPEN]

[DISPLAY Q50 IF Q48= 1]

50. Why did you decide to participate despite your concerns?

Application Process [Do Not Display] [Display Block if SBDI = 0]

[DISPLAY Q51 IF SBDI = 0]

51. Regarding your organization's decision to participate in the incentive program, who initiated the discussion about the incentive opportunity?

1. Your organization initiated it
2. Your vendor or contractor initiated it
3. The idea arose in discussion between your organization and your vendor or contractor
00. Other (Please specify) [OPEN ENDED]

[DISPLAY Q52 IF STATE = VA AND SBDI = 0]

52. Which of the following people worked on completing your application for program incentives, including gathering required documentation? [MULTISELCT]

1. Yourself
2. Another member of your company
3. A contractor
4. An equipment vendor
5. A designer or architect
6. Program Representative
98. Don't know who completed application

[DISPLAY IF Q52 = 1 "YOURSELF"]

53. Thinking back to the application process, please rate the clarity of information on how to complete the application using a scale where 1 means not at all clear and 5 means completely clear.

1. 1 – Not at all clear
2. 2
3. 3
4. 4
5. 5 – Completely clear
98. Not Applicable or Don't Know

[DISPLAY Q54 ONLY IF Q53 < 4]

54. What information, including instructions on forms, needs to be further clarified?

[DISPLAY Q55 AND CI_STANDARD = 0 AND CI_LIGHTING = 1]

55. Did you know that Appalachian Power provides standard incentives for non-lighting equipment such as compressed air efficiency improvements, efficient refrigeration equipment, and efficient heating and cooling equipment?

1. Yes
2. No

[DISPLAY Q56 CI_STANDARD = 0 AND CI_LIGHTING = 1]

56. Would you like the C&I Standard Program team member to contact you about these other energy efficiency opportunities?

1. Yes
2. No

Equipment Selection [DO NOT DISPLAY]

57. Not including the project completed through the [PROGRAM NAME] program, has your organization purchased any significant energy efficient equipment in the last three years?

1. Yes
 2. No
98. Don't know

[DISPLAY Q58 IF Q57= 1]

58. Did you install any of that equipment WITHOUT applying for a financial incentive through an energy efficiency program?

1. Yes
 2. No
98. Don't know

[DISPLAY Q59 IF SBDI = 0]

59. Did a program representative provide on-site assistance in planning and specifying equipment for your project completed at [LOCATION]?

1. Yes
 2. No
98. Don't know

[DISPLAY Q60 IF Q59= 1]

60. How did the site visit affect your decision to install the energy saving equipment that you received an incentive for?

1. Critical effect – could not have made decision without it
2. Moderate to large effect on decision
3. Small effect on decision
4. Input did not affect decision
98. Don't know

[DISPLAY Q61 IF SBDI = 0]

61. Who installed your program-qualified equipment or efficiency upgrades? Was it...

1. Your own staff
2. A contractor you've worked with before
3. A contractor recommended by your Appalachian Power incentives program
4. A new contractor that someone else recommended
5. Someone else [OPEN ENDED]
98. Don't know

FREE RIDERSHIP DIRECT INSTALL MEASURE 1 [DO NOT DISPLAY] [DISPLAY PAGE IF DIMEASURE_COUNT > 0]

62. The next few questions are about the energy efficient items you received for free through the program.

Did you have any [DIMEASURE1] installed at the [LOCATION] location before you received some for free through the program?

1. Yes
2. No
98. Don't know

63. Did you have plans to install the [DIMEASURE1] at the [LOCATION] location before receiving them for free through the program?

1. Yes
2. No
98. Don't know

[DISPLAY Q64 IF Q62= 1]

64. Would you have gone ahead with this installation even if you had not received them for free through the program?

1. Yes
2. No
98. Don't know

65. Would your organization have been financially able to install the [DIMEASURE1] at the [LOCATION] location if they were not provided for free through the program?

- 1. Yes
- 2. No
- 98. Don't know

66. How likely is it that you would have installed the [DIMEASURE1] at this location if you did not get them for free?

- 1. Definitely would have installed
- 2. Probably would have installed
- 3. Probably would not have installed
- 4. Definitely would not have installed
- 98. Don't know

[DISPLAY Q67 IF DIMEASURE1_QUANTITY > 1]

67. Did you install more [DIMEASURE1] than you would have if they had not been provided for free through the program?

- 1. Yes, would not have installed any [DIMEASURE1]
- 2. Yes, would have installed some of the [DIMEASURE1]
- 3. No, program did not affect quantity
- 98. Don't know

[DISPLAY Q68 IF Q67 = 2]

68. How many of the [DIMEASURE1_QUANTITY] [DIMEASURE1] would you have installed if they had not been provided for free through the program?

69. Did you install the [DIMEASURE1] earlier than you otherwise would have without the program?

- 1. Yes
- 2. No, program did not affect did not affect timing of project.
- 98. Don't know

[DISPLAY Q70 IF Q69 = 1]

70. When would you otherwise have installed the [DIMEASURE1]?

- 1. Less than 6 months later
- 2. 6-12 months later
- 3. 1-2 years later
- 4. 3-5 years later
- 5. More than 5 years later

98. Don't know

FREE RIDERSHIP DIRECT INSTALL MEASURE 2 [DO NOT DISPLAY] [DISPLAY PAGE IF DIMEASURE_COUNT > 1]

71. Did you have any [DIMEASURE2] installed at the [LOCATION] location before you received some for free through the program?

1. Yes

2. No

98. Don't know

72. Did you have plans to install the [DIMEASURE2] at the [LOCATION] location before receiving them for free through the program?

1. Yes

2. No

98. Don't know

[DISPLAY Q73 IF Q71= 1]

73. Would you have gone ahead with this installation even if you had not received them for free through the program?

1. Yes

2. No

98. Don't know

74. Would your organization have been financially able to install the [DIMEASURE2] at the [LOCATION] location if they were not provided for free through the program?

1. Yes

2. No

98. Don't know

75. How likely is it that you would have installed the [DIMEASURE2] at this location if you did not get them for free?

1. Definitely would have installed

2. Probably would have installed

3. Probably would not have installed

4. Definitely would not have installed

98. Don't know

[DISPLAY Q76 IF DIMEASURE2_QUANTITY> 1]

76. Did you install more [DIMEASURE2] than you would have if they had not been provided for free through the program?

1. Yes, would not have installed any [DIMEASURE2]
 2. Yes, would have installed some of the [DIMEASURE2]
 3. No, program did not affect quantity
98. Don't know

[DISPLAY Q77 IF Q76 = 2]

77. How many of the [DIMEASURE2_QUANTITY] [DIMEASURE2] would you have installed if they had not been provided for free through the program?

78. Did you install the [DIMEASURE2] earlier than you otherwise would have without the program?

1. Yes
 2. No, program did not affect did not affect timing of project.
98. Don't know

[DISPLAY Q79 IF Q78 = 1]

79. When would you otherwise have installed the [DIMEASURE2]?

1. Less than 6 months later
 2. 6-12 months later
 3. 1-2 years later
 4. 3-5 years later
 5. More than 5 years later
98. Don't know

FREE RIDERSHIP MAJOR MEASURE 1 [DO NOT DISPLAY] [DISPLAY PAGE IF MAJ_MEASURE_COUNT > 0]

80. The next questions are about your decision to [INSTALL1] the [MAJ_EFFICIENT1] at the facility located at [LOCATION].

Before PARTICIPATING in the program, had you completed a project similar to the [MAJ_EFFICIENT1] [INSTALLED1] at the [LOCATION] location?

1. Yes
 2. No
98. Don't know

81. In deciding to do a project of this type, there are usually a number of reasons why it may be undertaken.

Why did you decide to [INSTALL1] the [MAJ_EFFICIENT1]?

Please select all that apply. [RANDOMIZE ORDER, BUT FIX OTHER AND DON'T KNOW]
[MULTISELCT]

1. To replace old or outdated equipment
2. As part of a planned remodeling, build-out, or expansion
3. To gain more control over how the equipment was used
4. The maintenance downtime and associated expenses for the old equipment were too high
5. Had process problems and were seeking a solution
6. To improve equipment performance
7. To improve the product quality
8. To comply with codes set by regulatory agencies
9. To comply with organizational policies regarding regular/normal maintenance/replacement policy
10. To get an incentive from the program
11. To protect the environment
12. To reduce energy costs
13. To reduce energy use
00. Other (Please specify) [OPEN ENDED]
98. Don't know

82. When did you first learn about Appalachian Power's energy efficiency incentives? Was it BEFORE or AFTER you finalized the specifications of your project, including the efficiency level and the scope of the project?

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

83. Did you have plans to [INSTALL1] the [MAJ_EFFICIENT1] at the [LOCATION] location before participating in the program?

1. Yes
2. No
98. Don't know

[DISPLAY Q84 IF Q83= 1]

84. Would you have gone ahead with this planned project even if you had not participated in the program?

1. Yes
2. No
98. Don't know

85. Prior to completing this project, did you have previous experience with the program?

1. Yes

- 2. No
- 98. Don't know

[DISPLAY Q86 IF Q85 = 1]

86. How important was previous experience with the Appalachian Power-offered program in making your decision to [INSTALL1] the [MAJ_EFFICIENT1] at the [LOCATION] location? Would you say that it was...

- 1. Very important
- 2. Somewhat important
- 3. Only slightly important
- 4. Not at all important
- 98. Don't know

[DISPLAY IF SBDI = 0]

87. Did a program representative or other Appalachian Power representative recommend that you [INSTALL1] the [MAJ_EFFICIENT1] at the [LOCATION] location?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q88 IF Q87 = 1]

88. If the program representative had not recommended [INSTALLING1] the [MAJ_EFFICIENT1], how likely is it that you would have [INSTALLED1] it anyway?

- 1. Definitely would have [INSTALLED1]
- 2. Probably would have [INSTALLED1]
- 3. Probably would not have [INSTALLED1]
- 4. Definitely would not have [INSTALLED1]
- 98. Don't know

[DISPLAY IF SBDI = 1]

89. If the program energy advisor or trade ally that installed your equipment had not recommended [INSTALLING1] the [MAJ_EFFICIENT1], how likely is it that you would have [INSTALLED1] it anyway?

- 1. Definitely would have
- 2. Probably would have
- 3. Probably would not have
- 4. Definitely would not have
- 98. Don't know

90. Would your organization have been financially able to [INSTALL1] the [MAJ_EFFICIENT1] at the [LOCATION] location without the financial incentive from the program?

1. Yes

2. No

98. Don't know

[DISPLAY Q91 IF Q90 = 2]

91. To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

1. Yes

2. No

98. Don't know

92. If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [INSTALLED1] the [MAJ_EFFICIENT1] at the [LOCATION] location anyway?

1. Definitely would have [INSTALLED1]

2. Probably would have [INSTALLED1]

3. Probably would not have [INSTALLED1]

4. Definitely would not have [INSTALLED1]

98. Don't know

[DISPLAY Q93 IF Q83= 1 AND Q84 =1 AND Q90 = 2 AND Q91 = 1]

93. Previously you said that your organization had plans to complete the project and would have completed it if you had not participated in the program. You also said that your organization would not have been financially able to install the equipment without the program incentive. In your own words, can you explain the role that the financial incentive played in your decision to complete this project?

[DISPLAY Q94 IF MEASURE_QUANT1 > 1]

94. We would like to know whether the availability of information and financial incentives through the program affected the quantity of [MAJ_EFFICIENT1] that you purchased and [INSTALLED1] at the [LOCATION] location.

Did you purchase and install more [MAJ_EFFICIENT1] than you otherwise would have without the program?

1. Yes

2. No, program did not affect quantity purchased and installed.

98. Don't know

[DISPLAY Q95 = IF ENERGY_EQUIP1 = 1]

95. We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [MAJ_EFFICIENT1] at the [LOCATION] location.

Did you choose equipment that was more energy efficient than you would have chosen because of the program?

1. Yes
2. No, program did not affect level of efficiency chosen for equipment.
98. Don't know

[DISPLAY Q96 IF Q95 = 1]

96. What kind of equipment, if any, would you have installed if the information and incentives were not available from the program?

[OPEN ENDED]

97. We would like to know whether the availability of information and financial incentives through the program affected the timing of the [MAJ_EFFICIENT1] project at the [LOCATION].

Did you [INSTALL1] the [MAJ_EFFICIENT1] earlier than you otherwise would have without the program?

1. Yes
2. No, program did not affect did not affect timing of project.
98. Don't know

[DISPLAY Q98 IF Q97 = 1]

98. When would you otherwise have completed the project?

1. Less than 6 months later
2. 6-12 months later
3. 1-2 years later
4. 3-5 years later
5. More than 5 years later
98. Don't know

[DISPLAY Q99 IF MAJ_MEASURE_COUNT > 1]

99. Our records indicate you [INSTALLED2] [MAJ_MEASURE2] at the [LOCATION] location in addition to [MAJ_EFFICIENT1]. Did both of these projects go through the same decision-making process or was a separate decision made for each?

1. The same decision-making process applies to both projects.
2. A different decision-making process applies to each project.

3. We did not [INSTALL2] [MAJ_MEASURE2] at the [LOCATION] location.
 98. Don't know

FREE RIDERSHIP MAJOR MEASURE 2 [DO NOT DISPLAY] [DISPLAY PAGE IF
 Q99 = 2 AND Q99 = 2]

100. Before PARTICIPATING in the program, had you completed a project similar to the
 [MAJ_MEASURE2] [INSTALLED2] at the [LOCATION] location?

1. Yes
 2. No
 98. Don't know

101. Why did you decide to [INSTALL2] the [MAJ_MEASURE2]?

Please select all that apply. [RANDOMIZE ORDER, BUT FIX OTHER AND DON'T KNOW]
 [MULTISELCT]

1. To replace old or outdated equipment
2. As part of a planned remodeling, build-out, or expansion
3. To gain more control over how the equipment was used
4. The maintenance downtime and associated expenses for the old equipment were too high
5. Had process problems and were seeking a solution
6. To improve equipment performance
7. To improve the product quality
8. To comply with codes set by regulatory agencies
9. To comply with organizational policies regarding regular/normal
 maintenance/replacement policy
10. To get an incentive from the program
11. To protect the environment
12. To reduce energy costs
13. To reduce energy use
00. Other (Please specify) [OPEN ENDED]
98. Don't know

102. When did you first learn about Appalachian Power's energy efficiency incentives? Was it
 BEFORE or AFTER you finalized the specifications of your project, including the efficiency level
 and the scope of the project?

- 1 Before
 2 After
 98 Don't know

103. Did you have plans to [INSTALL2] the [MAJ_MEASURE2] at the [LOCATION] location
 before participating in the program?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q104 IF Q103= 1]

104. Would you have gone ahead with this planned project even if you had not participated in the program?

- 1. Yes
- 2. No
- 98. Don't know

105. Prior to completing this project, did you have previous experience with the program?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q106 IF Q105 = 1]

106. How important was previous experience with the Appalachian Power-offered program in making your decision to [INSTALL2] the [MAJ_MEASURE2] at the [LOCATION] location? Would you say that it was...

- 1. Very important
- 2. Somewhat important
- 3. Only slightly important
- 4. Not at all important
- 98. Don't know

[DISPLAY IF SBDI = 0]

107. Did a program representative or other Appalachian Power representative recommend that you [INSTALL2] the [MAJ_MEASURE2] at the [LOCATION] location?

- 1. Yes
- 2. No
- 98. Don't know

[DISPLAY Q108 IF Q107 = 1]

108. If the program representative had not recommended [INSTALLING2] the [MAJ_MEASURE2], how likely is it that you would have [INSTALLED2] it anyway?

- 1. Definitely would have [INSTALLED2]
- 2. Probably would have [INSTALLED2]
- 3. Probably would not have [INSTALLED2]
- 4. Definitely would not have [INSTALLED2]

98. Don't know

[DISPLAY IF SBDI = 1]

109. If the program energy advisor or trade ally that installed your equipment had not recommended [INSTALLING2] the [MAJ_MEASURE2], how likely is it that you would have [INSTALLED2] it anyway?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have
98. Don't know

110. Would your organization have been financially able to [INSTALL2] the [MAJ_MEASURE2] at the [LOCATION] location without the financial incentive from the program?

1. Yes
2. No
98. Don't know

[DISPLAY Q111 IF Q110 = 2]

111. To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

1. Yes
2. No
98. Don't know

112. If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [INSTALLED2] the [MAJ_MEASURE2] at the [LOCATION] location anyway?

1. Definitely would have [INSTALLED2]
2. Probably would have [INSTALLED2]
3. Probably would not have [INSTALLED2]
4. Definitely would not have [INSTALLED2]
98. Don't know

[DISPLAY Q113 IF Q103= 1 AND Q104=1 AND Q110 = 2 AND Q111 = 1]

113. Previously you said that your organization had plans to complete the project and would have completed it if you had not participated in the program. You also said that your organization would not have been financially able to install the equipment without the program incentive. In your own words, can you explain the role that the financial incentive played in your decision to complete this project?

[DISPLAY Q114 IF MEASURE_QUANT2 > 1]

114. We would like to know whether the availability of information and financial incentives through the program affected the quantity of [MAJ_MEASURE2] that you purchased and [INSTALLED2] at the [LOCATION] location.

Did you purchase and install more [MAJ_MEASURE2] than you otherwise would have without the program?

1. Yes
2. No, program did not affect quantity purchased and installed.
98. Don't know

[DISPLAY Q115= IF ENERGY_EQUIP2 = 1]

115. We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [MAJ_MEASURE2] at the [LOCATION] location.

Did you choose equipment that was more energy efficient than you would have chosen because of the program?

1. Yes
2. No, program did not affect level of efficiency chosen for equipment.
98. Don't know

[DISPLAY Q116 IF Q115 = 1]

116. What kind of equipment, if any, would you have installed if the information and incentives were not available from the program?

[OPEN ENDED]

117. We would like to know whether the availability of information and financial incentives through the program affected the timing of the [MAJ_MEASURE2] project at the [LOCATION].

Did you [INSTALL2] the [MAJ_MEASURE2] earlier than you otherwise would have without the program?

1. Yes
2. No, program did not affect did not affect timing of project..
98. Don't know

[DISPLAY Q118 IF Q117 = 1]

118. When would you otherwise have completed the project?

1. Less than 6 months later
2. 6-12 months later
3. 1-2 years later
4. 3-5 years later
5. More than 5 years later
98. Don't know

SPILLOVER [DO NOT DISPLAY]

[DISPLAY IF STATE = VA]

[NOTE: THESE QUESTIONS SERVE TO COLLECT DATA TO QUANTIFY SPILLOVER EFFECTS FROM the INCENTIVE PROGRAMS AND DIRECT IMPACTS OF THE ENERGY ASSESSMENT TOOL]

119. Since you completed the incentive project, have you installed any energy efficient equipment at a facility that receives electrical service from Appalachian Power and that you DID NOT get a rebate or discount for from Appalachian Power?

1. Yes
2. No
98. Don't know

[DISPLAY Q120 if Q119 = 1]

120. What additional energy efficient equipment have you installed? [MULTI SELECT]

1. Lighting
2. Lighting controls or occupancy sensors
3. Unitary or split air conditioning system or chiller
4. ENERGY STAR Room air conditioners
5. Efficient motors
6. Refrigeration equipment (including LED case lighting)
7. Kitchen equipment
8. Something else [OPEN ENDED]
96. Didn't implement any measures [SKIP TO FIRMOGRAPHICS]
98. Don't know

[DISPLAY Q121 IF Q119= 1]

121. Why didn't you receive incentives for those items? [MULTI SELECT RANDOMIZE ORDER, BUT FIX OTHER AND DON'T KNOW]

1. Didn't know whether equipment qualified for financial incentives

2. Equipment did not qualify for financial incentives
3. Too much paperwork for the financial incentive application
4. Financial incentive was insufficient
5. Didn't have time to complete paperwork for financial incentive application
6. Didn't know about financial incentives until after equipment was purchased
7. We did receive an incentive [SKIP TO FIRMOGRAPHICS]
8. Other (Please specify) [OPEN ENDED]
98. Don't know

[DISPLAY Q122 IF Q119= 1]

122. Did you work with a contractor to install that efficient equipment or did your company's staff install the equipment?

1. Worked with a contractor
2. Company self-installed the equipment
3. Both
98. Don't know

LIGHTING [DO NOT DISPLAY]

[DISPLAY Q123 IF Q119 = 1]

123. What type of lighting did you install? [MULTI-SELECT]

1. T8 Fluorescent linear lamps – Single (1) lamps
2. T8 Fluorescent linear lamps – 2 lamp fixtures
3. T8 Fluorescent linear lamps – 4 lamp fixtures
4. T8 Fluorescent linear lamps – 6 lamp fixtures
5. T5 Fluorescent linear lamps – Single (1) lamps
6. T5 Fluorescent linear lamps – 2 lamp fixtures
7. T5 Fluorescent linear lamps – 4 lamp fixtures
8. T5 Fluorescent linear lamps – 6 lamp fixtures
9. LED Screw-in BAR/R/ER bulbs
10. LED Screw-in Interior PAR/MR bulbs
11. LED Screw-in omnidirectional A-line bulbs
12. LED 2-foot linear replacement lamps
13. LED 4-foot linear replacement lamps
14. LED exterior flood or spot luminaires
15. LED 1x4 panel or troffer
16. LED 2x2 panel or troffer
17. LED 2x4 panel or troffer
18. LED high-bay lighting
19. LED exit signs
19. Another type
98. Don't know

[DISPLAY Q124 IF Q123 = 20]

124. What other type of lighting equipment did you install?

[TEXT BOX]

[REPEAT Q125 - Q128 FOR EACH TYPE SELECTED IN Q123]

125. How many [Q123 RESPONSE] did you install?

[TEXT BOX] Watts

126. What was the average wattage of the [Q123 RESPONSE]?

[TEXT BOX]

127. Were the [Q123 RESPONSE] installed inside, outside, or in a parking garage?

- 1. Inside
- 2. Outside
- 3. Parking garage
- 98. Don't know

[DISPLAY Q128 IF Q127 = 1]

128. What type of building did you install the [Q123 RESPONSE] in?

- 1. Food Sales
- 2. Food Service
- 3. Health Care
- 4. Hotel/Motel
- 5. Office
- 6. Public Assembly
- 7. Public Services (non-food)
- 8. Retail
- 9. Warehouse
- 10. School
- 11. College
- 12. Industrial – 1 Shift
- 13. Industrial – 2 Shift
- 14. Industrial – 3 Shift
- 15. Other (Please describe)
- 98. Don't know

[DISPLAY Q129 IF Q127 = 1]

129. Is the inside space heated, cooled, or both?

- 1. Heated
- 2. Cooled
- 3. Both
- 98. Don't know

130. What type of lighting did the [Q123 RESPONSE] replace?

1. T12s (linear fluorescents)
2. T8s (linear fluorescents)
3. Metal-halide / High-intensity discharge
4. Incandescent
5. [DISPLAY IF Q123 = 9, 11, OR 12] Compact fluorescent (CFL)
6. Something else [OPEN]

98. Don't know

131. What was the average wattage of the old lamps or bulbs?

132. How many of the old lamps or bulbs did you remove?

[DISPLAY Q133 IF Q123 = 20]

133. Did you install single-sided, double-sided, or both single and double-sided LED exit signs?

1. Single-sided exit signs
2. Double-sided exit signs
3. Both single and double-sided exit signs

98. Don't know

[DISPLAY Q134 IF Q133 = 1 OR Q133 = 3]

134. How many single-sided LED exit signs did you install?

[DISPLAY Q135 IF Q133 = 1 OR Q133 = 3]

135. How many double-sided LED exit signs did you install?

[DISPLAY Q136 IF Q133 = 98]

136. How many LED exit signs did you install?

[DISPLAY Q137 IF Q120 = 1]

137. How important was your experience with the program in your decision to install this lighting equipment?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q138 IF Q120 = 1]

138. If you had NOT participated in the program, how likely is it that your organization would still have installed this lighting equipment?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q139 IF [Q137=0,1,2,3 AND Q138=0,1,2,3]

OR IF [Q137=8,9,10 AND Q138=8,9,10]

139. You scored the importance of your program experience to your decision to implement additional lighting measures with [Q137 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing additional lighting measures if your organization had not participated in the program with [Q138 RESPONSE] out of 10 possible points.

Can you please explain the role the program made in your decision to implement this measure?

LIGHTING CONTROLS [DO NOT DISPLAY]

[DISPLAY Q140 IF Q120 = 2]

140. How many fixtures are being controlled by the lighting controls?

[TEXT BOX]

[DISPLAY Q141 IF Q120 = 2]

141. On average, how many lamps or bulbs does each fixture contain?

[TEXT BOX]

[DISPLAY Q142 IF Q120 = 2]

142. What is the average wattage of these lamps?

[TEXT BOX]

[DISPLAY Q143 IF Q120 = 2]

143. Are any of the lighting controls that you installed central time clock controls?

1. Yes

2. No

98. Don't know

[DISPLAY Q144 IF Q143 = 1]

144. How many of the fixtures are controlled by the central time clock?

[TEXT BOX]

[DISPLAY Q145 IF Q120 = 2]

145. What type of building did you install the lighting controls in?

1. Food Sales

2. Food Service

3. Health Care

4. Hotel/Motel

5. Office

6. Public Assembly

7. Public Services (non-food)

8. Retail

9. Warehouse

- 10. School
- 11. College
- 12. Industrial – 1 Shift
- 13. Industrial – 2 Shift
- 14. Industrial – 3 Shift
- 16. Other (Please specify)
- 98. Don't know

[DISPLAY Q146 IF Q120 = 2]

146. How important was your experience with the program in your decision to install lighting controls?

[SCALE 0 "Not at all important" - 10 "Very important"]

- 98. Don't know

[DISPLAY Q147 IF Q120 = 2]

147. If you had NOT participated in the program, how likely is it that your organization would still have installed lighting controls?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

- 98. Don't know

[DISPLAY Q148 IF [Q146=0,1,2,3 AND Q147=0,1,2,3]

OR [Q146=8,9,10 AND Q147=8,9,10]]

148. You scored the importance of your program experience to your decision to implement lighting controls with [Q146 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing lighting controls if your organization had not participated in the program with [Q147 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

HVAC MEASURES [DO NOT DISPLAY]

[DISPLAY Q149 IF Q120 = 3]

149. What types of energy efficient equipment did you install as part of the HVAC project?
[MULTI SELECT]

- 1. Split air conditioning system (An A/C system that has an evaporator indoors and the compressor and condenser outdoors.)
- 2. Packaged air conditioning system (A type of central air conditioning that contains both the air handler fan, compressor and condenser in a single unit. These are typically mounted on the roof.)
- 3. Heat pump (An electric heating and cooling system)
- 4. Air cooled chiller (A system that produces cold liquid sent around to individual spaces used for cooling air usually found in larger facilities)

- 5. Water cooled chiller (A system that produces cold liquid sent around to individual spaces used for cooling air usually found in larger facilities)
- 6. Another type
- 98. Don't know

[DISPLAY Q150 IF Q149 = 6]

150. What other type of HVAC equipment did you install?

[TEXT BOX]

[REPEAT Q151 – Q153 FOR EACH SELECTED IN Q149]

151. We would like to know more about the rated efficiency and number of units of the [Q149 RESPONSE](s) that you installed.

For each level of efficiency of the equipment you installed, please provide the rated efficiency and the number of units.

152. What type of building did you install the heating/cooling equipment in?

- 1. Grocery
- 2. High School
- 3. Hospital
- 4. Light Industrial
- 5. Office - Large
- 6. Office - Small
- 7. Primary School
- 8. Religious Worship
- 9. Restaurant - Fast Food
- 10. Restaurant - Full Service
- 11. Retail - Big Box
- 12. Retail - Large
- 13. Retail - Small
- 14. University
- 15. Warehouse
- 16. Other (Please specify)
- 98. Don't know

153. What city is the building where you installed the heating/cooling equipment located in?

[TEXT BOX]

[DISPLAY Q154 IF Q149 = 1-7]

154. How important was your experience with the program in your decision to install the energy efficient HVAC equipment?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q155 IF Q149 = 1-7]

155. If you had NOT participated in the program, how likely is it that your organization would still have installed the energy efficient HVAC equipment?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q156 IF [Q154=0,1,2,3 AND Q155=0,1,2,3] OR [Q154=8,9,10 AND Q155=8,9,10]]

156. You scored the importance of your program experience to your decision to implement energy efficient HVAC equipment with [Q154 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing the energy efficient HVAC equipment if your organization had not participated in the program with [Q155 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

[DISPLAY Q157 IF Q120 = 4]

157. How many ENERGY STAR room air conditioners did you install?

[TEXT BOX]

[DISPLAY Q158 IF Q120 = 4]

158. What type of building did you install the heating/cooling equipment in?

1. Grocery
2. High School
3. Hospital
4. Light Industrial
5. Office - Large
6. Office - Small
7. Primary School
8. Religious Worship
9. Restaurant - Fast Food
10. Restaurant - Full Service
11. Retail - Big Box
12. Retail - Large
13. Retail - Small
14. University
15. Warehouse
16. Other
98. Don't know

[DISPLAY Q159 IF Q120 = 4]

159. What city is the building where you installed the room air conditioners located in?

[TEXT BOX]

[DISPLAY Q160 IF Q120 = 4]

160. How important was your experience with the program in your decision to install the heating/cooling equipment?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q161 IF Q120 = 4]

161. If you had NOT participated in the program, how likely is it that your organization would still have installed the heating/cooling equipment?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q162 IF [Q160=0,1,2,3 AND Q161=0,1,2,3] OR [Q160=8,9,10 AND Q161=8,9,10]]

162. You scored the importance of your program experience to your decision to install the energy efficient air conditioners with [Q160 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of installing the energy efficient air conditioners if your organization had not participated in the program with [Q161 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

EFFICIENT MOTORS [DO NOT DISPLAY]

[DISPLAY Q163 IF Q120 = 5]

163. How many efficient motors did you install?

[TEXT BOX]

[DISPLAY Q164 IF Q120 = 5]

164. What is the approximate average horsepower of the new motors? That is, what is the average across all of the motors you installed without an incentive?

[TEXT BOX]

[DISPLAY Q165 IF Q120 = 5]

165. What is the approximate average efficiency of the new motors? That is, what is the average efficiency across all of the new motors?

[TEXT BOX] Rated efficiency (%)

[DISPLAY Q166 IF Q120 = 5]

166. On average, how many hours per day do the motors operate? That is, what the average number of hours the motors you installed operate?

[TEXT BOX] hours per day

[DISPLAY Q167 IF Q120 = 5]

167. How important was your experience with the program in your decision to install efficient motors?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q168 IF Q120 = 5]

168. If you had NOT participated in the program, how likely is it that your organization would still have installed the efficient motors?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q169 IF [Q167=0,1,2,3 AND Q168=0,1,2,3] OR [Q167=8,9,10 AND Q168=8,9,10]]

169. You scored the importance of your program experience to your decision to implement efficient motors with [Q167 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing the efficient motors if your organization had not participated in the program with [Q168 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

COMMERCIAL REFRIGERATION EQUIPMENT [DO NOT DISPLAY]

[DISPLAY Q170 IF Q120 = 6]

170. What types of energy efficient refrigeration equipment did you install?

1. ENERGY STAR Commercial freezer
2. ENERGY STAR Commercial refrigerator
3. Anti-sweat heater controls
4. LED refrigerated case lighting
5. Refrigerated case covers
6. Some other type of refrigeration equipment

98. Don't know

[DISPLAY Q171 IF Q170 = 6]

171. What other type of energy efficient refrigeration equipment did you install?

[TEXT BOX]

[DISPLAY Q172 IF Q170 = 1]

172. How many ENERGY STAR commercial freezers did you install?

[TEXT BOX]

[DISPLAY Q173 IF Q172 = 1, REPEAT FOR EACH UP TO THREE TIMES]

173. What is the volume in cubic feet of the first freezer?

[TEXT BOX]

[DISPLAY Q174 IF Q172 = 1, REPEAT FOR EACH UP TO THREE TIMES]

174. Does this freezer have a solid door or a glass door?

- 1. Solid door
- 2. Glass door
- 98. Don't know

[DISPLAY Q175 IF Q172 = 1, REPEAT FOR EACH UP TO THREE TIMES]

175. Is this a vertical freezer or a chest type freezer?

- 1. Vertical
- 2. Chest
- 98. Don't know

[DISPLAY Q176 IF Q170 = 2]

176. How many ENERGY STAR commercial refrigerators did you install?

[TEXT BOX] refrigerators

[DISPLAY Q177 IF Q176 = 2, REPEAT FOR EACH UP TO THREE TIMES]

177. What is the volume in cubic feet of the first refrigerator?

[TEXT BOX] cubic feet

[DISPLAY Q178 IF Q176 = 2, REPEAT FOR EACH UP TO THREE TIMES]

178. Does this refrigerator have a solid door or a glass door?

- 1. Solid door
- 2. Glass door
- 98. Don't know

[DISPLAY Q179 IF Q176 = 2, REPEAT FOR EACH UP TO THREE TIMES]

179. Is this a vertical refrigerator or a chest type refrigerator?

- 1. Vertical
- 2. Chest
- 98. Don't know

[DISPLAY Q180 IF Q170 = 3]

180. Did you install humidity-based controls or conductivity-based controls, or both types?

- 1. Humidity-based controls
- 2. Conductivity-based controls
- 3. Both types
- 98. Don't know

[DISPLAY Q181 IF Q180= 1 OR 3]

181. How many humidity-based controls did you install?

[TEXT BOX]

[DISPLAY Q182 IF Q180= 1 OR 3]

182. What is the total number of freezer or refrigerator doors controlled by the humidity-based controls?

[TEXT BOX]

[DISPLAY Q183 IF Q180= 2 OR 3]

183. How many conductivity-based controls did you install?

[TEXT BOX]

[DISPLAY Q184 IF Q180= 2 OR 3]

184. What is the total number of freezer or refrigerator doors controlled by the conductivity-based controls?

[TEXT BOX]

[DISPLAY Q185 IF Q180 = 98]

185. How many anti-sweat heater controls did you install?

[TEXT BOX]

[DISPLAY Q186 IF Q180 = 98]

186. What is the total number of freezer or refrigerator doors controlled by the anti-sweat heater controls?

[TEXT BOX]

[DISPLAY Q187 IF Q170 = 4]

187. How many linear feet in total of LED case lighting did you install?

[TEXT BOX]

[DISPLAY Q188 IF Q170 = 5]

188. How many linear feet of refrigerated case covers did you install?

[TEXT BOX]

[DISPLAY Q189 IF Q120=6]

189. How important was your experience with the program in your decision to install the energy efficient refrigeration equipment?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q190 IF Q120=6]

190. If you had NOT participated in the program, how likely is it that your organization would still have installed this energy efficient refrigeration equipment?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q191 IF [Q189=0,1,2,3 AND Q190=0,1,2,3] AND [Q189=8,9,10 AND Q190=8,9,10]]

191. You scored the importance of your program experience to your decision to implement energy efficient refrigeration equipment with [Q189 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing energy efficient refrigeration equipment if your organization had not participated in the program with [Q190 RESPONSE] out of 10 possible points. Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

COMMERCIAL KITCHEN EQUIPMENT [DO NOT DISPLAY]

[DISPLAY Q192 IF Q120 = 7]

192. What type of kitchen equipment did you install?

1. Low flow pre-rinse spray valves
2. ENERGY STAR Commercial fryers
3. ENERGY STAR Commercial steam cookers
4. ENERGY STAR hot food holding cabinets
5. ENERGY STAR commercial griddles
6. ENERGY STAR commercial convection ovens
7. ENERGY STAR commercial combination ovens
8. Some other type of kitchen equipment

98. Don't know

[DISPLAY Q193 IF Q192 = 8]

193. What other type of kitchen equipment did you install?

[TEXT BOX]

[DISPLAY Q194 IF Q192 = 1]

194. Is the flow rate for any of the spray valves you installed equal to or less than 1.6 gallons per minute?

1. Yes
 2. No
98. Don't know

[DISPLAY Q195 IF Q192 = 1]

195. How many pre-rinse spray valves with a flow rate equal to or less than 1.6 gallons per minute did you install?

[TEXT BOX]

[DISPLAY Q196 IF Q192 = 1]

196. Did you install the pre-rinse spray valves that the [LOCATION] location?

1. Yes

2. No

98. Don't know

[DISPLAY Q197 IF Q196= 2]

197. In what city is the building where you installed the pre-rinse spray valves located in?

[TEXT BOX]

[DISPLAY Q198 IF Q192 = 2]

198. How many ENERGY STAR commercial fryers did you install?

[TEXT BOX]

[DISPLAY Q199 IF Q192 = 3]

199. How many ENERGY STAR commercial steam cookers did you install?

1. Number of 3 pan steam cookers [NUMERIC]

2. Number of 4 pan steam cookers [NUMERIC]

3. Number of 5 pan steam cookers [NUMERIC]

4. Number of 6 pan steam cookers [NUMERIC]

98. Don't know

[DISPLAY Q200 IF Q192 = 4]

200. How many ENERGY STAR hot food holding cabinets did you install?

[TEXT BOX]

[DISPLAY Q201 IF Q192 = 5]

201. How many ENERGY STAR commercial griddles did you install?

[TEXT BOX]

[DISPLAY Q202 IF Q192 = 6]

202. How many ENERGY STAR commercial convection ovens did you install?

[TEXT BOX]

[DISPLAY Q203 IF Q192 = 7]

203. How many ENERGY STAR commercial combination ovens did you install?

[TEXT BOX]

[DISPLAY Q204 IF Q120= 1 AND Q192=1-8]

204. How important was your experience with the program in your decision to install this kitchen equipment?

[SCALE 0 "Not at all important" - 10 "Very important"]

98. Don't know

[DISPLAY Q205 IF Q120= 1 AND Q192=1-8]

205. If you had NOT participated in the program, how likely is it that your organization would still have installed this kitchen equipment?

[SCALE 0 "Definitely would not have installed" - 10 "Definitely would have installed"]

98. Don't know

[DISPLAY Q191 IF [Q204=0,1,2,3 AND Q205=0,1,2,3] OR [Q204=8,9,10 AND Q205=8,9,10]]

206. You scored the importance of your program experience to your decision to implement energy efficient kitchen equipment with [Q204 RESPONSE] out of 10 possible points. You ALSO scored the likelihood of implementing energy efficient kitchen equipment if your organization had not participated in the program with [Q205 RESPONSE] out of 10 possible points.

Can you please explain the role the program made in your decision to implement this measure?

[TEXT BOX]

MEASUREMENT AND VERIFICATION [DO NOT DISPLAY]

207. After your project was completed, did a program representative inspect the work done through the program?

1. Yes

2. No

98. Don't know

[DISPLAY Q208 If Q207=1]

208. Using the scale where 1 means you completely disagree and 5 means you completely agree, please rate your agreement with the following statements:

[FOR EACH, 1 = 1 – Completely disagree, 2 = 2, 3 = 3, 4 = 4, 5 = 5 – Completely agree, 98 = Not Applicable or Don't know]

a. The inspector was courteous

b. The inspector was efficient

CUSTOMER SATISFACTION [DO NOT DISPLAY HEADING; DISPLAY INTRO]

The following few questions pertain to your communications with the program staff. Program staff are anyone that reviewed your application, conducted site inspections, determined your incentive amount, or processed your incentive check. Program staff are not anyone hired by you to conduct an audit, design your system, or install your hardware.

209. In the course of doing this project did you have any interactions with program staff?

1. Yes
2. No
98. Not Applicable or Don't Know

210. Using a scale where 1 means completely dissatisfied and 5 means very satisfied, how satisfied are you with:

[FOR EACH, 1 = 1 – Completely dissatisfied, 2 = 2, 3 = 3, 4 = 4, 5 = 5 – Completely satisfied, 98 = Not Applicable or Don't know]

- a. [DISPLAY IF Q209 = 1] how long it took program staff to address your questions or concerns
- b. [DISPLAY IF Q209 = 1] how thoroughly they addressed your question or concern
- c. the equipment that was installed
- d. [DISPLAY IF Q61 = 2,3,4] the quality of the installation
- e. the steps you had to take to get through the program
- f. the amount of time it took to get your rebate or incentive
- g. the range of equipment that qualifies for incentives
- h. the program, overall

[DISPLAY IF ANY IN Q210 <3]

211. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above?

212. Not including lighting equipment, is there any other energy efficient technology or equipment that the program DOES NOT offer an incentive for that you would like to install in your facility?

1. Yes
2. No

[DISPLAY IF Q212 = 1]

213. What energy efficient technology or equipment are you interested in installing that the program does not offer an incentive for? (Select all that apply)

1. Heating, cooling, and ventilation equipment
2. Motors or drives
3. Refrigeration equipment
4. Kitchen equipment
5. Agricultural equipment

6. Compressed air equipment
7. Some other type of equipment

[DISPLAY IF Q213 = 1 - 7]

214. What is the specific type(s) of equipment that you are interested in?

215. Do you have any suggestions for improving the program or on energy efficiency in commercial and industrial facilities?

FIRMOGRAPHICS [DO NOT DISPLAY]

[DISPLAY Q216 IF FIRM = 0]

216. What is the type of work that your firm or organization does at [LOCATION]?

1. Industrial
2. Restaurant - not fast food
3. Fast food restaurant
4. Retail
5. Office
6. Grocery and convenience
7. School
8. Lodging
9. Warehouse
00. Other (Please specify) [OPEN ENDED]
98. Don't know

217. Including all the properties, how many separate work locations does your organization own or lease space in, in Appalachian Power territory? (A work location may consist of multiple buildings in close proximity to each other, such as a university campus – please indicate the number of locations)

[OPEN ENDED]

218. How many square feet (indoor space) is the part of the property at [LOCATION] that your firm or organization occupies? (If your firm or organization occupies the entire property, indicate the total size of that property.)

1. Less than 5,000
2. 5,001 to 10,000
3. 10,001 to 20,000
4. 20,001 to 50,000
5. 50,001 to 75,000
6. 75,001 to 100,000
7. 100,001 to 250,000

8. 250,001 to 500,000
9. 500,001 to 1,000,000
10. More than 1,000,000
98. Don't know

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4. C&I Program Participant Survey Results

4.1. C&I Lighting

Q1 - What is your job title or role?

#	Answer	%	Count
1	Facilities Manager	0.0%	0
2	Energy Manager	0.0%	0
3	Other facilities management/maintenance position	7.7%	1
4	Chief Financial Officer	7.7%	1
5	Other financial/administrative position	7.7%	1
6	Proprietor/Owner	7.7%	1
7	President/CEO	30.8%	4
8	Manager	23.1%	3
9	Other	15.4%	2
	Total	100%	13

Q49 - How did you FIRST learn about Appalachian Power's incentives for efficient equipment or upgrades?

#	Answer	%	Count
1	From a Trade Ally, contractor, equipment vendor, or energy consultant	50.0%	7
2	A Small Business Direct Install Energy Advisor	0.0%	0
3	From an Appalachian Power Account Representative	21.4%	3
4	From a program representative	7.1%	1
5	Through an internet search	7.1%	1
6	At an event or trade show	0.0%	0
7	Received an email blast or electronic newsletter from Appalachian Power	0.0%	0
8	From social media post (Facebook, Twitter, LinkedIn)	0.0%	0
9	From the Appalachian Power program website	7.1%	1
10	From friends or colleagues	7.1%	1
11	Other	0.0%	0
	Total	100%	14

Q55 - Regarding your organization's decision to participate in the incentive program, who initiated the discussion about the incentive opportunity?

#	Answer	%	Count
1	Your organization initiated it	38.5%	5
2	Your vendor or contractor initiated it	38.5%	5
3	The idea arose in discussion between your organization and your vendor or contractor	15.4%	2
4	Other (Please specify)	7.7%	1
	Total	100%	13

Q56 - Which of the following people worked on completing your application for program incentives, including gathering required documentation? Select all that apply.

#	Answer	%	Count
1	Yourself	69.2%	9
2	Another member of your company	30.8%	4
3	A contractor	38.5%	5
4	An equipment vendor	23.1%	3
5	A designer or architect	0.0%	0
6	Program Representative	15.4%	2
	Total	100%	13

Q57 - Thinking back to the application process, please rate the clarity of information on how to complete the application using a scale where 1 means not at all clear and 5 means completely clear.

#	Answer	%	Count
1	1 – Not at all clear	0.0%	0
2	2	0.0%	0
3	3	12.5%	1
4	4	62.5%	5
5	5 – Completely clear	25.0%	2
	Total	100%	8

Q59 - Did you know that Appalachian Power provides standard incentives for non-lighting equipment such as compressed air efficiency improvements, efficient refrigeration equipment, and efficient heating and cooling equipment?

#	Answer	%	Count
1	Yes	38.5%	5
2	No	61.5%	8
	Total	100%	13

Q60 - Would you like the C&I Standard Program team member to contact you about these other energy efficiency opportunities?

#	Answer	%	Count
1	Yes	38.5%	5
2	No	61.5%	8
	Total	100%	13

Q61 - Not including the project completed through the [Field-PROGRAM_NAME] program, has your organization purchased any significant energy efficient equipment in the last three years?

#	Answer	%	Count
1	Yes	16.7%	1
2	No	83.3%	5
	Total	100%	6

Q62 - Did you install any of that equipment WITHOUT applying for a financial incentive through an energy efficiency program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
	Total	100%	1

Q63 - Did a program representative provide on-site assistance in planning and specifying equipment for your project completed at [Field-LOCATION]?

#	Answer	%	Count
1	Yes	20.0%	2
2	No	80.0%	8
	Total	100%	10

Q64 - How did the site visit affect your decision to install the energy saving equipment that you received an incentive for?

#	Answer	%	Count
1	Critical effect – could not have made decision without it	0.0%	0
2	Moderate to large effect on decision	0.0%	0
3	Small effect on decision	100.0%	2
4	Input did not affect decision	0.0%	0
	Total	100%	2

**Q65 - Who installed your program-qualified equipment or efficiency upgrades?
Was it...**

#	Answer	%	Count
1	Your own staff	7.7%	1
2	A contractor you've worked with before	84.6%	11
3	A contractor recommended by your Appalachian Power incentives program	0.0%	0
4	A new contractor that someone else recommended	7.7%	1
5	Someone else	0.0%	0
	Total	100%	13

Q84 - The next questions are about your decision to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the facility located at [Field-LOCATION]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-MAJ_MEASURE_EFFICIENT1] [Field-INSTALLED1] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	30.8%	4
2	No	61.5%	8
98	Don't know	7.7%	1
	Total	100%	13

Q85 - Why did you decide to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1]? Please select all that apply

#	Answer	%	Count
1	To replace old or outdated equipment	69.2%	9
2	As part of a planned remodeling, build-out, or expansion	15.4%	2
3	To gain more control over how the equipment was used	0.0%	0
4	The maintenance downtime and associated expenses for the old equipment were too high	15.4%	2
5	Had process problems and were seeking a solution	0.0%	0
6	To improve equipment performance	46.2%	6
7	To improve the product quality	53.8%	7
8	To comply with codes set by regulatory agencies	0.0%	0
9	To comply with organizational policies regarding regular/normal	0.0%	0
10	maintenance/replacement policy	7.7%	1
11	To get an incentive from the program	30.8%	4
12	To protect the environment	23.1%	3
13	To reduce energy costs	84.6%	11
14	To reduce energy use	53.8%	7
15	Other (Please specify)	7.7%	1
	Total	100%	13

Q86 - When did you first learn about Appalachian Power's energy efficiency incentives? Was it BEFORE or AFTER you finalized the specifications of your project, including the efficiency level and the scope of the project?

#	Answer	%	Count
1	Before	76.9%	10
2	After	7.7%	1
98	Don't know	15.4%	2
	Total	100%	13

Q87 - Did you have plans to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location before participating in the program?

#	Answer	%	Count
1	Yes	91.7%	11
2	No	8.3%	1
	Total	100%	12

Q88 - Would you have gone ahead with this planned project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	63.6%	7
2	No	9.1%	1
98	Don't know	27.3%	3
	Total	100%	11

Q89 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	15.4%	2
2	No	84.6%	11
	Total	100%	13

Q91 - Did a program representative or other Appalachian Power representative recommend that you [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	20.0%	2
2	No	80.0%	8
	Total	100%	10

Q92 - If the program representative had not recommended [Field-INSTALLING1] the [Field-MAJ_MEASURE_EFFICIENT1], how likely is it that you would have [Field-INSTALLED1] it anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED1}	46.2%	6
2	Probably would have \${e://Field/INSTALLED1}	38.5%	5
3	Probably would not have \${e://Field/INSTALLED1}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED1}	0.0%	0
98	Don't know	15.4%	2
	Total	100%	13

Q93 - If the program energy advisor or trade ally that installed your equipment had not recommended [Field-INSTALLING1] the [Field-MAJ_MEASURE_EFFICIENT1], how likely is it that you would have [Field-INSTALLED1] it anyway?

#	Answer	%	Count
1	Definitely would have	0.0%	0
2	Probably would have	0.0%	0
3	Probably would not have	0.0%	0
4	Definitely would not have	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q94 - Would your organization been financially able to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	100.0%	9
2	No	0.0%	0
	Total	100%	9

Q95 - To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q96 - If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [Field-INSTALLED1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED1}	38.5%	5
2	Probably would have \${e://Field/INSTALLED1}	38.5%	5
3	Probably would not have \${e://Field/INSTALLED1}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED1}	0.0%	0
98	Don't know	23.1%	3
	Total	100%	13

Q98 - We would like to know whether the availability of information and financial incentives through the program affected the quantity of [Field-MAJ_MEASURE_EFFICIENT1] that you purchased and [Field-INSTALLED1] at the [Field-LOCATION] location. Did you purchase and install more [Field-MAJ_MEASURE_EFFICIENT1] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	53.8%	7
2	No, program did not affect quantity purchased and installed.	38.5%	5
98	Don't know	7.7%	1
	Total	100%	13

Q99 - We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location. Did you choose equipment that was more energy efficient than you would have chosen because of the program?

#	Answer	%	Count
1	Yes	23.1%	3
2	No, program did not affect level of efficiency chosen for equipment.	69.2%	9
3	Don't know	7.7%	1
	Total	100%	13

Q101 - We would like to know whether the availability of information and financial incentives through the program affected the timing of the [Field-MAJ_MEASURE_EFFICIENT1] project at the [Field-LOCATION]. Did you [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	53.8%	7
2	No, program did not affect did not affect timing of project.	38.5%	5
98	Don't know	7.7%	1
	Total	100%	13

Q102 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	14.3%	1
2	6-12 months later	28.6%	2
3	1-2 years later	14.3%	1
4	3-5 years later	28.6%	2
5	More than 5 years later	0.0%	0
98	Don't know	14.3%	1
	Total	100%	7

Q103 - Before PARTICIPATING in the program, had you completed a project similar to the [Field-MAJ_MEASURE_EFFICIENT2] [Field-INSTALL2] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q104 - Why did you decide to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2]? Please select all that apply

#	Answer	%	Count
1	To replace old or outdated equipment	0.0%	0
2	As part of a planned remodeling, build-out, or expansion	0.0%	0
3	To gain more control over how the equipment was used	0.0%	0
4	The maintenance downtime and associated expenses for the old equipment were too high	0.0%	0
5	Had process problems and were seeking a solution	0.0%	0
6	To improve equipment performance	0.0%	0
7	To improve the product quality	0.0%	0
8	To comply with codes set by regulatory agencies	0.0%	0
9	To comply with organizational policies regarding regular/normal	0.0%	0
10	maintenance/replacement policy	0.0%	0
11	To get an incentive from the program	0.0%	0
12	To protect the environment	0.0%	0
13	To reduce energy costs	0.0%	0
14	To reduce energy use	0.0%	0
15	Other (Please specify)	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q105 - When did you first learn about Appalachian Power's energy efficiency incentives? Was it BEFORE or AFTER you finalized the specifications of your project, including the efficiency level and the scope of the project?

#	Answer	%	Count
1	Before	0.0%	0
2	After	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q107 - Would you have gone ahead with this planned project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q108 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q109 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location? Would you say that it was...

#	Answer	%	Count
1	Very important	0.0%	0
2	Somewhat important	0.0%	0
3	Only slightly important	0.0%	0
4	Not at all important	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q110 - Did a program representative or other Appalachian Power representative recommend that you [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q111 - If the program representative had not recommended [Field-INSTALLING2] the [Field-MAJ_MEASURE_EFFICIENT2], how likely is it that you would have [Field-INSTALLED2] it anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED2}	0.0%	0
2	Probably would have \${e://Field/INSTALLED2}	0.0%	0
3	Probably would not have \${e://Field/INSTALLED2}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED2}	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q112 - If the program energy advisor or trade ally that installed your equipment had not recommended [Field-INSTALLING2] the [Field-MAJ_MEASURE_EFFICIENT2], how likely is it that you would have [Field-INSTALLED2] it anyway?

#	Answer	%	Count
1	Definitely would have	0.0%	0
2	Probably would have	0.0%	0
3	Probably would not have	0.0%	0
4	Definitely would not have	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q113 - Would your organization been financially able to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q114 - To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q115 - If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [Field-INSTALLED2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED2}	0.0%	0
2	Probably would have \${e://Field/INSTALLED2}	0.0%	0
3	Probably would not have \${e://Field/INSTALLED2}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED2}	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q117 - We would like to know whether the availability of information and financial incentives through the program affected the quantity of [Field-MAJ_MEASURE_EFFICIENT2] that you purchased and [Field-INSTALLED2] at the [Field-LOCATION] location. Did you purchase and install more [Field-MAJ_MEASURE_EFFICIENT2] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect quantity purchased and installed.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q118 - We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location. Did you choose equipment that was more energy efficient than you would have chosen because of the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect level of efficiency chosen for equipment.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q120 - We would like to know whether the availability of information and financial incentives through the program affected the timing of the [Field-MAJ_MEASURE_EFFICIENT2] project at the [Field-LOCATION]. Did you [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect did not affect timing of project.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q121 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	0.0%	0
2	6-12 months later	0.0%	0
3	1-2 years later	0.0%	0
4	3-5 years later	0.0%	0
5	More than 5 years later	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q122 - Since you completed the incentive project, have you installed any energy efficient equipment at a facility that receives electrical service from Appalachian Power and that you DID NOT get a rebate or discount for from Appalachian Power?

#	Answer	%	Count
1	Yes	7.7%	1
2	No, not that you are aware of	92.3%	12
	Total	100%	13

Q123 - What additional energy efficient equipment have you installed?

#	Answer	%	Count
1	Lighting	100.0%	1
2	Lighting controls or occupancy sensors	0.0%	0
3	LED exit signs	0.0%	0
4	Unitary or split air conditioning system or chiller	0.0%	0
5	ENERGY STAR Room air conditioners	0.0%	0
6	Efficient motors	0.0%	0
7	Refrigeration equipment (including LED case lighting)	0.0%	0
8	Kitchen equipment	0.0%	0
96	Something else (Please describe)	0.0%	0
99	Didn't implement any measures	0.0%	0
	Total	100%	1

Q124 - Why didn't you receive incentives for those items?

#	Answer	%	Count
1	Didn't know whether equipment qualified for financial incentives	0.0%	0
2	Equipment did not qualify for financial incentives	0.0%	0
3	Too much paperwork for the financial incentive application	0.0%	0
4	Financial incentive was insufficient	0.0%	0
5	Didn't have time to complete paperwork for financial incentive application	0.0%	0
6	Didn't know about financial incentives until after equipment was purchased	0.0%	0
7	We did receive an incentive	0.0%	0
8	The program was out of funds	0.0%	0
96	Other (Please specify)	0.0%	0
	Total		0

Q214 - After your project was completed, did a program representative inspect the work done through the program?

#	Answer	%	Count
1	Yes	42.9%	3
2	No	57.1%	4
	Total	100%	7

Q215 - Using the scale where 1 means you completely disagree and 5 means you completely agree, please rate your agreement with the following statements:

#	Question	1 - Completely disagree		2		3		4		Completely agree		Total
1	The inspector was courteous	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	3	3
2	The inspector was efficient	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	3	3

Q217 - In the course of doing this project did you have any interactions with program staff?

#	Answer	%	Count
1	Yes	72.7%	8
2	No	27.3%	3
	Total	100%	11

Q218 - Using a scale where 1 means completely dissatisfied and 5 means very satisfied, how satisfied are you with:

#	Question	Very dissatisfied/1		2		3		4		Very satisfied/5		Total
1	how long it took program staff to address your questions or concerns	0.0%	0	0.0%	0	0.0%	0	12.5%	1	87.5%	7	8
2	how thoroughly they addressed your question or concern	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	8	8
3	the equipment that was installed	0.0%	0	0.0%	0	0.0%	0	9.1%	1	90.9%	10	11
4	the quality of the installation	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	undefined
5	the steps you had to take to get through the program	0.0%	0	0.0%	0	9.1%	1	0.0%	0	90.9%	10	11
6	the amount of time it took to get your rebate or incentive	0.0%	0	0.0%	0	16.7%	2	16.7%	2	66.7%	8	12
7	the range of equipment that qualifies for incentives	0.0%	0	0.0%	0	0.0%	0	30.0%	3	70.0%	7	10
8	the program, overall	0.0%	0	0.0%	0	0.0%	0	33.3%	4	66.7%	8	12

Q220 - Not including lighting equipment, is there any other energy efficient technology or equipment that the program DOES NOT offer an incentive for that you would like to install in your facility?

#	Answer	%	Count
1	Yes	25.0%	3
2	No	75.0%	9
	Total	100%	12

Q221 - What energy efficient technology or equipment are you interested in installing that the program does not offer an incentive for? (Select all that apply)

#	Answer	%	Count
1	Heating, cooling, and ventilation equipment	33.3%	1
2	Motors or drives	0.0%	0
3	Refrigeration equipment	33.3%	1
4	Kitchen equipment	0.0%	0
5	Agricultural equipment	0.0%	0
6	Compressed air equipment	33.3%	1
7	Some other type of equipment	0.0%	0
	Total	100%	3

Q224 - What is the type of work that your firm or organization does at [Field-LOCATION]?

#	Answer	%	Count
1	Industrial	25.0%	3
2	Restaurant - not fast food	0.0%	0
3	Fast food restaurant	0.0%	0
4	Retail	25.0%	3
5	Office	0.0%	0
6	Grocery and convenience	8.3%	1
7	School	8.3%	1
8	Lodging	0.0%	0
9	Warehouse	0.0%	0
10	Other	33.3%	4
	Total	100%	12

Q226 - Including all the properties, how many separate work locations does your organization own or lease space in, in Appalachian Power territory? (A work location may consist of multiple buildings in close proximity to each other, such as a university campus – please indicate the number of locations)

#	Answer	%	Count
0	0	22.2%	2
1	1	22.2%	2
2	2	22.2%	2
3	3	11.1%	1
13	13	11.1%	1
50	50	11.1%	1

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Total

100%

9

Q227 - How many square feet (indoor space) is the part of the property at [Field-LOCATION] that your firm or organization occupies? (If your firm or organization occupies the entire property, indicate the total size of that property.)

#	Answer	%	Count
1	Less than 5,000	0.0%	0
2	5,001 to 10,000	25.0%	2
3	10,001 to 20,000	12.5%	1
4	20,001 to 50,000	37.5%	3
5	50,001 to 75,000	0.0%	0
6	75,001 to 100,000	12.5%	1
7	100,001 to 250,000	12.5%	1
8	250,001 to 500,000	0.0%	0
9	500,001 to 1,000,000	0.0%	0
10	More than 1,000,000	0.0%	0
	Total	100%	8

4.2. C&I Standard

Q1 - What is your job title or role?

#	Answer	%	Count
1	Facilities Manager	25.0%	1
2	Energy Manager	0.0%	0
3	Other facilities management/maintenance position	0.0%	0
4	Chief Financial Officer	25.0%	1
5	Other financial/administrative position	0.0%	0
6	Proprietor/Owner	25.0%	1
7	President/CEO	0.0%	0
8	Manager	25.0%	1
9	Other	0.0%	0
	Total	100%	4

Q49 - How did you FIRST learn about Appalachian Power's incentives for efficient equipment or upgrades?

#	Answer	%	Count
1	From a Trade Ally, contractor, equipment vendor, or energy consultant	75.0%	3
2	A Small Business Direct Install Energy Advisor	0.0%	0
3	From an Appalachian Power Account Representative	25.0%	1
4	From a program representative	0.0%	0
5	Through an internet search	0.0%	0
6	At an event or trade show	0.0%	0
7	Received an email blast or electronic newsletter from Appalachian Power	0.0%	0
8	From social media post (Facebook, Twitter, LinkedIn)	0.0%	0
9	From the Appalachian Power program website	0.0%	0
10	From friends or colleagues	0.0%	0
11	Other	0.0%	0
	Total	100%	4

Q55 - Regarding your organization's decision to participate in the incentive program, who initiated the discussion about the incentive opportunity?

#	Answer	%	Count
1	Your organization initiated it	25.0%	1
2	Your vendor or contractor initiated it	75.0%	3
3	The idea arose in discussion between your organization and your vendor or contractor	0.0%	0
4	Other (Please specify)	0.0%	0
	Total	100%	4

Q56 - Which of the following people worked on completing your application for program incentives, including gathering required documentation? Select all that apply.

#	Answer	%	Count
1	Yourself	50.0%	2
2	Another member of your company	25.0%	1
3	A contractor	0.0%	0
4	An equipment vendor	50.0%	2
5	A designer or architect	0.0%	0
6	Program Representative	0.0%	0
	Total	100%	4

Q57 - Thinking back to the application process, please rate the clarity of information on how to complete the application using a scale where 1 means not at all clear and 5 means completely clear.

#	Answer	%	Count
1	1 – Not at all clear	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	50.0%	1
5	5 – Completely clear	50.0%	1
	Total	100%	2

Q59 - Did you know that Appalachian Power provides standard incentives for non-lighting equipment such as compressed air efficiency improvements, efficient refrigeration equipment, and efficient heating and cooling equipment?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q60 - Would you like the C&I Standard Program team member to contact you about these other energy efficiency opportunities?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q61 - Not including the project completed through the [Field-PROGRAM_NAME] program, has your organization purchased any significant energy efficient equipment in the last three years?

#	Answer	%	Count
1	Yes	75.0%	3
2	No	25.0%	1
	Total	100%	4

Q62 - Did you install any of that equipment WITHOUT applying for a financial incentive through an energy efficiency program?

#	Answer	%	Count
1	Yes	100.0%	2
2	No	0.0%	0
	Total	100%	2

Q63 - Did a program representative provide on-site assistance in planning and specifying equipment for your project completed at [Field-LOCATION]?

#	Answer	%	Count
1	Yes	75.0%	3
2	No	25.0%	1
	Total	100%	4

Q64 - How did the site visit affect your decision to install the energy saving equipment that you received an incentive for?

#	Answer	%	Count
1	Critical effect – could not have made decision without it	33.3%	1
2	Moderate to large effect on decision	0.0%	0
3	Small effect on decision	33.3%	1
4	Input did not affect decision	33.3%	1
	Total	100%	3

**Q65 - Who installed your program-qualified equipment or efficiency upgrades?
Was it...**

#	Answer	%	Count
1	Your own staff	0.0%	0
2	A contractor you've worked with before	100.0%	4
3	A contractor recommended by your Appalachian Power incentives program	0.0%	0
4	A new contractor that someone else recommended	0.0%	0
5	Someone else	0.0%	0
	Total	100%	4

Q84 - The next questions are about your decision to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the facility located at [Field-LOCATION]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-MAJ_MEASURE_EFFICIENT1] [Field-INSTALLED1] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	4
98	Don't know	0.0%	0
	Total	100%	4

Q85 - Why did you decide to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1]? Please select all that apply

#	Answer	%	Count
1	To replace old or outdated equipment	75.0%	3
2	As part of a planned remodeling, build-out, or expansion	25.0%	1
3	To gain more control over how the equipment was used	25.0%	1
4	The maintenance downtime and associated expenses for the old equipment were too high	0.0%	0
5	Had process problems and were seeking a solution	0.0%	0
6	To improve equipment performance	25.0%	1
7	To improve the product quality	25.0%	1
8	To comply with codes set by regulatory agencies	0.0%	0
9	To comply with organizational policies regarding regular/normal	0.0%	0
10	maintenance/replacement policy	0.0%	0
11	To get an incentive from the program	0.0%	0
12	To protect the environment	0.0%	0
13	To reduce energy costs	25.0%	1
14	To reduce energy use	25.0%	1
15	Other (Please specify)	0.0%	0
	Total	100%	4

Q86 - When did you first learn about Appalachian Power's energy efficiency incentives? Was it BEFORE or AFTER you finalized the specifications of your project, including the efficiency level and the scope of the project?

#	Answer	%	Count
1	Before	50.0%	2
2	After	25.0%	1
98	Don't know	25.0%	1
	Total	100%	4

Q87 - Did you have plans to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location before participating in the program?

#	Answer	%	Count
1	Yes	75.0%	3
2	No	25.0%	1
	Total	100%	4

Q88 - Would you have gone ahead with this planned project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	66.7%	2
2	No	0.0%	0
98	Don't know	33.3%	1
	Total	100%	3

Q89 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	25.0%	1
2	No	75.0%	3
	Total	100%	4

Q91 - Did a program representative or other Appalachian Power representative recommend that you [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	25.0%	1
2	No	75.0%	3
	Total	100%	4

Q92 - If the program representative had not recommended [Field-INSTALLING1] the [Field-MAJ_MEASURE_EFFICIENT1], how likely is it that you would have [Field-INSTALLED1] it anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED1}	0.0%	0
2	Probably would have \${e://Field/INSTALLED1}	75.0%	3
3	Probably would not have \${e://Field/INSTALLED1}	25.0%	1
4	Definitely would not have \${e://Field/INSTALLED1}	0.0%	0
98	Don't know	0.0%	0
	Total	100%	4

Q93 - If the program energy advisor or trade ally that installed your equipment had not recommended [Field-INSTALLING1] the [Field-MAJ_MEASURE_EFFICIENT1], how likely is it that you would have [Field-INSTALLED1] it anyway?

#	Answer	%	Count
1	Definitely would have	0.0%	0
2	Probably would have	0.0%	0
3	Probably would not have	0.0%	0
4	Definitely would not have	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q94 - Would your organization been financially able to [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	75.0%	3
2	No	25.0%	1
	Total	100%	4

Q95 - To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
	Total	100%	1

Q96 - If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [Field-INSTALLED1] the [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED1}	25.0%	1
2	Probably would have \${e://Field/INSTALLED1}	50.0%	2
3	Probably would not have \${e://Field/INSTALLED1}	25.0%	1
4	Definitely would not have \${e://Field/INSTALLED1}	0.0%	0
98	Don't know	0.0%	0
	Total	100%	4

Q98 - We would like to know whether the availability of information and financial incentives through the program affected the quantity of [Field-MAJ_MEASURE_EFFICIENT1] that you purchased and [Field-INSTALLED1] at the [Field-LOCATION] location. Did you purchase and install more [Field-MAJ_MEASURE_EFFICIENT1] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	100.0%	2
2	No, program did not affect quantity purchased and installed.	0.0%	0
98	Don't know	0.0%	0
	Total	100%	2

Q99 - We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [Field-MAJ_MEASURE_EFFICIENT1] at the [Field-LOCATION] location. Did you choose equipment that was more energy efficient than you would have chosen because of the program?

#	Answer	%	Count
1	Yes	33.3%	1
2	No, program did not affect level of efficiency chosen for equipment.	33.3%	1
3	Don't know	33.3%	1
	Total	100%	3

Q101 - We would like to know whether the availability of information and financial incentives through the program affected the timing of the [Field-MAJ_MEASURE_EFFICIENT1] project at the [Field-LOCATION]. Did you [Field-INSTALL1] the [Field-MAJ_MEASURE_EFFICIENT1] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	25.0%	1
2	No, program did not affect did not affect timing of project.	75.0%	3
98	Don't know	0.0%	0
	Total	100%	4

Q102 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	0.0%	0
2	6-12 months later	0.0%	0
3	1-2 years later	0.0%	0
4	3-5 years later	0.0%	0
5	More than 5 years later	0.0%	0
98	Don't know	100.0%	1
	Total	100%	1

Q103 - Before PARTICIPATING in the program, had you completed a project similar to the [Field-MAJ_MEASURE_EFFICIENT2] [Field-INSTALL2] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	100.0%	1
	Total	100%	1

Q104 - Why did you decide to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2]? Please select all that apply

#	Answer	%	Count
1	To replace old or outdated equipment	0.0%	0
2	As part of a planned remodeling, build-out, or expansion	100.0%	1
3	To gain more control over how the equipment was used	100.0%	1
4	The maintenance downtime and associated expenses for the old equipment were too high	0.0%	0
5	Had process problems and were seeking a solution	0.0%	0
6	To improve equipment performance	100.0%	1
7	To improve the product quality	0.0%	0
8	To comply with codes set by regulatory agencies	0.0%	0
9	To comply with organizational policies regarding regular/normal	0.0%	0
10	maintenance/replacement policy	0.0%	0
11	To get an incentive from the program	0.0%	0
12	To protect the environment	0.0%	0
13	To reduce energy costs	0.0%	0

14	To reduce energy use	0.0%	0
15	Other (Please specify)	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

Q105 - When did you first learn about Appalachian Power's energy efficiency incentives? Was it BEFORE or AFTER you finalized the specifications of your project, including the efficiency level and the scope of the project?

#	Answer	%	Count
1	Before	0.0%	0
2	After	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q107 - Would you have gone ahead with this planned project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q108 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q109 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location? Would you say that it was...

#	Answer	%	Count
1	Very important	0.0%	0
2	Somewhat important	0.0%	0
3	Only slightly important	0.0%	0
4	Not at all important	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q110 - Did a program representative or other Appalachian Power representative recommend that you [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0

Total	0
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Q111 - If the program representative had not recommended [Field-INSTALLING2] the [Field-MAJ_MEASURE_EFFICIENT2], how likely is it that you would have [Field-INSTALLED2] it anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED2}	0.0%	0
2	Probably would have \${e://Field/INSTALLED2}	0.0%	0
3	Probably would not have \${e://Field/INSTALLED2}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED2}	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q112 - If the program energy advisor or trade ally that installed your equipment had not recommended [Field-INSTALLING2] the [Field-MAJ_MEASURE_EFFICIENT2], how likely is it that you would have [Field-INSTALLED2] it anyway?

#	Answer	%	Count
1	Definitely would have	0.0%	0
2	Probably would have	0.0%	0
3	Probably would not have	0.0%	0
4	Definitely would not have	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q113 - Would your organization been financially able to [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q114 - To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q115 - If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [Field-INSTALLED2] the [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location anyway?

#	Answer	%	Count
1	Definitely would have \${e://Field/INSTALLED2}	0.0%	0
2	Probably would have \${e://Field/INSTALLED2}	0.0%	0
3	Probably would not have \${e://Field/INSTALLED2}	0.0%	0
4	Definitely would not have \${e://Field/INSTALLED2}	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q117 - We would like to know whether the availability of information and financial incentives through the program affected the quantity of [Field-MAJ_MEASURE_EFFICIENT2] that you purchased and [Field-INSTALLED2] at the [Field-LOCATION] location. Did you purchase and install more [Field-MAJ_MEASURE_EFFICIENT2] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect quantity purchased and installed.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q118 - We would like to know whether the availability of information and financial incentives through the program affected the level of energy efficiency you chose for [Field-MAJ_MEASURE_EFFICIENT2] at the [Field-LOCATION] location. Did you choose equipment that was more energy efficient than you would have chosen because of the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect level of efficiency chosen for equipment.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q120 - We would like to know whether the availability of information and financial incentives through the program affected the timing of the [Field-MAJ_MEASURE_EFFICIENT2] project at the [Field-LOCATION]. Did you [Field-INSTALL2] the [Field-MAJ_MEASURE_EFFICIENT2] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, program did not affect did not affect timing of project.	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q121 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	0.0%	0
2	6-12 months later	0.0%	0
3	1-2 years later	0.0%	0
4	3-5 years later	0.0%	0
5	More than 5 years later	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q122 - Since you completed the incentive project, have you installed any energy efficient equipment at a facility that receives electrical service from Appalachian Power and that you DID NOT get a rebate or discount for from Appalachian Power?

#	Answer	%	Count
1	Yes	100.0%	3
2	No, not that you are aware of	0.0%	0
	Total	100%	3

Q123 - What additional energy efficient equipment have you installed?

#	Answer	%	Count
1	Lighting	66.7%	2
2	Lighting controls or occupancy sensors	33.3%	1
3	LED exit signs	33.3%	1
4	Unitary or split air conditioning system or chiller	0.0%	0
5	ENERGY STAR Room air conditioners	33.3%	1
6	Efficient motors	33.3%	1
7	Refrigeration equipment (including LED case lighting)	0.0%	0
8	Kitchen equipment	33.3%	1
96	Something else (Please describe)	0.0%	0
99	Didn't implement any measures	0.0%	0
	Total	100%	3

Q124 - Why didn't you receive incentives for those items?

#	Answer	%	Count
1	Didn't know whether equipment qualified for financial incentives	0.0%	0
2	Equipment did not qualify for financial incentives	33.3%	1
3	Too much paperwork for the financial incentive application	33.3%	1
4	Financial incentive was insufficient	0.0%	0
5	Didn't have time to complete paperwork for financial incentive application	0.0%	0
6	Didn't know about financial incentives until after equipment was purchased	0.0%	0
7	We did receive an incentive	0.0%	0
8	The program was out of funds	0.0%	0
96	Other (Please specify)	33.3%	1
	Total	100%	3

Q214 - After your project was completed, did a program representative inspect the work done through the program?

#	Answer	%	Count
1	Yes	66.7%	2
2	No	33.3%	1
	Total	100%	3

Q215 - Using the scale where 1 means you completely disagree and 5 means you completely agree, please rate your agreement with the following statements:

#	Question	1 - Completely disagree	2	3	4	Completely agree	Total
1	The inspector was courteous	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 2	2
2	The inspector was efficient	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 2	2

Q217 - In the course of doing this project did you have any interactions with program staff?

#	Answer	%	Count
1	Yes	33.3%	1
2	No	66.7%	2
	Total	100%	3

Q218 - Using a scale where 1 means completely dissatisfied and 5 means very satisfied, how satisfied are you with:

#	Question	Very dissatisfied1	2	3	4	Very satisfied/5	Total
1	how long it took program staff to address your questions or concerns	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 1	1
2	how thoroughly they addressed your question or concern	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 1	1
3	the equipment that was installed	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 3	3
4	the quality of the installation	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	undefined
5	the steps you had to take to get through the program	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 3	3
6	the amount of time it took to get your rebate or incentive	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 3	3
7	the range of equipment that qualifies for incentives	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 3	3
8	the program, overall	0.0% 0	0.0% 0	0.0% 0	0.0% 0	100.0% 3	3

Q220 - Not including lighting equipment, is there any other energy efficient technology or equipment that the program DOES NOT offer an incentive for that you would like to install in your facility?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	3
	Total	100%	3

Q221 - What energy efficient technology or equipment are you interested in installing that the program does not offer an incentive for? (Select all that apply)

#	Answer	%	Count
1	Heating, cooling, and ventilation equipment	0.0%	0
2	Motors or drives	0.0%	0
3	Refrigeration equipment	0.0%	0
4	Kitchen equipment	0.0%	0
5	Agricultural equipment	0.0%	0
6	Compressed air equipment	0.0%	0
7	Some other type of equipment	0.0%	0
	Total		0

Q224 - What is the type of work that your firm or organization does at [Field-LOCATION]?

#	Answer	%	Count
1	Industrial	66.7%	2
2	Restaurant - not fast food	0.0%	0
3	Fast food restaurant	0.0%	0
4	Retail	0.0%	0
5	Office	0.0%	0
6	Grocery and convenience	0.0%	0
7	School	0.0%	0
8	Lodging	33.3%	1
9	Warehouse	0.0%	0
10	Other	0.0%	0
	Total	100%	3

Q226 - Including all the properties, how many separate work locations does your organization own or lease space in, in Appalachian Power territory? (A work location may consist of multiple buildings in close proximity to each other, such as a university campus – please indicate the number of locations)

#	Answer	%	Count
4	4	100.0%	1
	Total	100%	1

Q227 - How many square feet (indoor space) is the part of the property at [Field-LOCATION] that your firm or organization occupies? (If your firm or organization occupies the entire property, indicate the total size of that property.)

#	Answer	%	Count
1	Less than 5,000	0.0%	0
2	5,001 to 10,000	0.0%	0
3	10,001 to 20,000	0.0%	0
4	20,001 to 50,000	33.3%	1
5	50,001 to 75,000	33.3%	1
6	75,001 to 100,000	0.0%	0
7	100,001 to 250,000	33.3%	1
8	250,001 to 500,000	0.0%	0
9	500,001 to 1,000,000	0.0%	0
10	More than 1,000,000	0.0%	0
	Total	100%	3

5. Confidential: EM&V Costs

Information relating to PY2021 EM&V costs is presented in Table 5-1.

Table 5-1 PY2021 EM&V Costs

<i>Program</i>	<i>EM&V Cost</i>
C&I Standard Program	
C&I Lighting Program	
Small Business Direct Install Program	
C&I Portfolio Total	

220450003