2023 Virginia Commercial & Industrial Program EM&V Report

Volume I of II

Prepared for:
Appalachian Power Company

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Table of Contents

1. Introduction 1

1.1. Program Year 2023 Commercial and Industrial Program Offerings 1

1.2. Summary of Data Collection 4

1.3. Impact Evaluation Findings 5

1.4. Process Evaluation Findings 6

1.5. Cost Effectiveness Evaluation Findings 10

1.6. Organization of the Report 10

2. Business Energy Solutions Program 12

2.1. Program Description 12

2.2. Data Collection 13

2.3. Estimation of Realized Gross Savings 16

2.4. Estimation of Realized Net Savings 22

2.5. Process Evaluation 27

2.6. Findings and Recommendations 42

3. Custom Pilot Program 45

3.1. Program Description 45

3.2. Data Collection 46

3.3. Estimation of Realized Gross Savings 47

3.4. Estimation of Realized Net Savings 49

3.5. Process Evaluation 50

3.6. Findings and Recommendations 54

4. Small Business Direct Install Program 55

4.1. Program Description 55

4.2. Data Collection 56

4.3. Estimation of Realized Gross Savings 59

4.4. Estimation of Realized Net Savings 63

4.5. Process Evaluation 64

4.6. Findings and Recommendations 75

5. Opt Out Customers 77
6. Cost Effectiveness Evaluation 78
7. Carbon Emissions Reduction 80

Table of Tables

Table 1-1 Compliance with Case No. PUR-2017-00047 EM&V Rules 2
Table 1-2 Summary of Verification Site Analyses 5
Table 1-3 Summary of Participant Survey Data Collection Activities 5
Table 1-4 Summary of C&I Portfolio Energy Savings 5
Table 1-5 Summary of C&I Portfolio Peak Demand Impacts 6
Table 1-6 Summary of Benefit-Cost Ratios – PY2023 10
Table 2-1 Expected kWh Savings 12
Table 2-2 Summary of Savings by Eligible Rate Schedule 13
Table 2-3 Population Statistics Used for Sample Design 14
Table 2-4 Sampled Projects Expected Savings by Stratum 14
Table 2-5 Summary of Business Energy Solutions Survey Effort 15
Table 2-6 Final Dispositions of Trade Ally Interview Recruitment 16
Table 2-7 Gross Impact Attributes Tracked by Program – Business Energy Solutions 17
Table 2-8 Sources for Non-Lighting Realized Savings Analysis 18
Table 2-9 Sample Expected and Gross Realized kWh Savings by Sample Stratum 19
Table 2-10 Expected and Gross Realized kWh Savings by Project 19
Table 2-11 Business Energy Solutions Program Realized Gross Energy Savings 21
Table 2-12 Business Energy Solutions Program Realized Gross Peak kW Reductions 21
Table 2-13 Free Ridership Scores for Combinations of Indicator Variable Responses 25
Table 2-14 Business Energy Solutions Program Realized Net Energy Savings 26
Table 2-15 Business Energy Solutions Program Realized Peak kW Reductions 27
Table 2-16 Summary of Program Measures 27
Table 2-17 Number of Projects by Building Type 28
Table 2-18 Trade Ally Engagement 29
Table 2-19 Project Initiation 38
Table 2-20 Clarity of Application Information 39
Table 2-21 Participant Building Type 41
Table 3-1 Expected kWh Savings 45
Table 3-2 Summary of Savings by Eligible Rate Schedule 46

Table 3-3 Population Statistics Used for Sample Design 47
Table 3-4 Sample Expected and Gross Realized kWh Savings by Sample Stratum 48
Table 3-5 Expected and Gross Realized kWh Savings by Project 48
Table 3-6 Custom Pilot Program Realized Gross Energy Savings 48
Table 3-7 Custom Pilot Program Realized Gross Peak kW Reductions 49
Table 3-8 Custom Pilot Program Realized Net Energy Savings 49
Table 3-9 Custom Pilot Program Realized Peak kW Reductions 49
Table 3-10 Summary of Program Measures 50
Table 3-11 Number of Projects by Building Type 50
Table 4-1 Expected kWh Savings 55
Table 4-2 Summary of Savings by Eligible Rate Schedule 56
Table 4-3 Population Statistics Used for Sample Design 57
Table 4-4 Sampled Projects Expected Savings by Stratum 57
Table 4-5 Summary of SBDI Survey Effort 58
Table 4-6 Final Dispositions of Trade Ally Interview Recruitment 59
Table 4-7 Gross Impact Attributes Tracked by Program – SBDI 59
Table 4-8 Sources for Realized Savings Analysis 60
Table 4-9 Sample Expected and Gross Realized kWh Savings by Sample Stratum 61
Table 4-10 Expected and Gross Realized kWh Savings by Project 61
Table 4-11 Small Business Direct Install Program Realized Gross Energy Savings 62
Table 4-12 Average Realization Rate for Sample Project by Trade Ally 63
Table 4-13 SBDI Program Realized Gross Energy Savings 63
Table 4-14 SBDI Program Realized Net Energy Savings 64
Table 4-15 SBDI Program Realized Peak kW Reductions 64
Table 4-16 Summary of Program Measures 64
Table 4-17 Share of Sites and the Number of End-Uses Receiving Efficiency Improvements 65
Table 4-18 Number of Projects by Building Type 66
Table 4-19 Trade Ally Engagement 67
Table 4-20 How Participants Signed Up for the Program 71
Table 4-21 Awareness of QEC 72
Table 4-22 Number of Locations 75

Table 5-1 Summary of Opt Out Customer Reported Savings 77
Table 6-1 Summary of Benefits and Costs Included in each Cost Effectiveness Test 78
Table 6-2 Business Energy Solutions Program – Lighting Cost Effectiveness Test Results 78
Table 6-3 Business Energy Solutions Program – Non-Lighting Cost Effectiveness Test Results 79
Table 6-4 Business Energy Solutions Program - Total Cost Effectiveness Test Results 79
Table 6-5 Small Business Direct Install Program Cost Effectiveness Test Results 79
Table 7-1 Avoided Carbon Emissions (Metric Tons) 80

Table of Figures

Figure 2-1 Initial Source of Awareness of Incentives 38
Figure 2-2 Key Challenges in Enhancing Commercial and Industrial Energy Efficiency 39
Figure 2-3 Participant Satisfaction 41
Figure 4-1 Initial Source of Program Awareness 70
Figure 4-2 Barriers to Energy Efficiency 71
Figure 4-3 How the Company Can Assist Organizations with Energy Efficiency 72
Figure 4-4 Participant Satisfaction 74
Figure 4-5 Participant Building Types 75

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 2023. 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 2023 Commercial and Industrial Program Offerings

The Company offered three energy efficiency programs during Program Year 2023 (PY2023). A brief description of each program is provided below.

Business Energy Solutions: The Business Energy Solutions (BES) Program was designed to generate energy savings for C&I customers through the promotion and installation of high-efficiency measures. The measures include efficient lighting, refrigeration, kitchen, compressed air, variable frequency drive, and HVAC products.

Custom Pilot Program: The Custom Pilot Program targets large Commercial & Industrial (C&I) customers seeking to improve the energy efficiency for processes, systems, and measures outside those provided for in the Business Energy Solutions (BES) Program or Small Business Direct Install (SBDI) Program. Any energy efficiency measure already included in the BES and/or SBDI program are not eligible measures for this Program.

Incentives on custom measures are paid per kWh reduced:

- Savings resulting from the installation of non-prescriptive lighting measures are paid at $0.04 per annual kWh reduced.
- Savings from all other custom measures are paid at $0.09 per annual kWh reduced.

Small Business Direct Install Program: The Small Business Direct Install Program provides small businesses with a no-cost energy assessment and targeted cost-effective energy efficiency 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 this report, these impacts are defined as:

- **Expected Impacts:** Energy savings (kWh) and peak demand (kW) reduction estimates based on customer participation in PY2023, before program evaluation activities.

- **Realized Impacts:** Energy savings (kWh) and peak demand (kW) reduction estimates for PY2023 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

Subsection	*Requirement*	*Response*
20VAC5-318-40 (A)	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: 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: 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: (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.	The methods used to evaluate program impacts are 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.
20VAC5-318-40 (B)	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.	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.

Subsection	*Requirement*	*Response*
		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

Subsection	*Requirement*	*Response*
	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)	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: 1. Nameplate efficiency ratings; 2. Serial numbers; and 3. Model numbers. This information will be made available to commission staff upon request.	The program chapters include the following information as provided by the Company or otherwise determined through the evaluation effort: 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

The Evaluation Team used telephone interviews to collect project data for estimating project savings and leveraged AMI metering data. In addition, the Evaluation Team coordinated with the implementation contractor to specify data collection needs for the Custom Pilot Program projects. Table 1-2 summarizes the results of the site analyses.

Table 1-2 Summary of Verification Site Analyses

Program	*Number of Site Analyses*
Business Energy Solutions	22
Custom Participant Survey	3 (Census of projects)
Small Business Direct Install Participant Survey	17

Table 1-3 summarizes survey data collection activities that supported the PY2023 evaluation of the Company's C&I programs.

Table 1-3 Summary of Participant Survey Data Collection Activities

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Business Energy Solutions / Custom Participant Survey	Email	October 2023, January 2024	86	9
Small Business Direct Install Participant Survey	Email	October 2023, January 2024	107	19

1.3. Impact Evaluation Findings

The Evaluation Team performed EM&V activities for each of the C&I programs offered by the Company during PY2023.

As shown in Table 1-4, the Company's C&I programs achieved gross realized energy savings of 150,493,822 kWh, with a gross realization rate of 100%. The C&I programs achieved net realized energy savings of 146,519,469 kWh, with a portfolio-level net-to-gross ratio of 97%.

As shown in Table 1-5, Company's C&I programs achieved gross realized peak demand reductions of 5,109.69 kW, with a gross realization rate of 120%. The C&I programs achieved net realized peak demand reductions of 4,313.37 kW, with a portfolio-level net-to-gross ratio of 84%.

Table 1-4 Summary of C&I Portfolio Energy Savings

Program Name	*Ex Ante Annual kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Annual Net kWh Savings*	*Net-to-Gross Ratio*	*Lifetime Gross Ex Post kWh Savings*	*Lifetime Net Ex Post kWh Savings*
Business Energy Solutions Program	17,896,444	19,028,531	106%	15,129,753	80%	284,862,539	226,496,713
Small Business Direct Install Program	2,684,887	2,024,128	75%	2,024,128	100%	25,262,198	25,262,198
Custom C&I Pilot Program	370,968	368,855	99%	293,280	80%	5,022,905	3,993,756
Opt Out Customers	129,072,308	129,072,308	100%	129,072,308	100%	129,072,308	129,072,308
C&I Portfolio Totals	**150,024,607**	**150,493,822**	**100%**	**146,519,469**	**97%**	**444,219,950**	**384,824,975**

Table 1-5 Summary of C&I Portfolio Peak Demand Impacts

Program Name	*Expected kW Savings*	*Gross Realized kW Savings*	*Gross Realization Rate*	*Net Realized kW Savings*	*Net-to-Gross Ratio*
Business Energy Solutions Program	3,661.85	4,234.44	116%	3,450.45	81%
Small Business Direct Install Program	530.17	808.65	153%	808.65	100%
Custom C&I Pilot Program	77.18	66.60	86%	54.27	81%
Opt Out Customers	-	-	N/A	-	N/A
C&I Portfolio Totals	**4,269.21**	**5,109.69**	**120%**	**4,313.37**	**84%**

1.4. Process Evaluation Findings

1.4.1. Business Energy Solutions Program:

Lighting measures accounted for a majority of the program savings, particularly high-bay luminaries, linear lamp LEDs, and exterior LED luminaries, contributing significantly to overall savings. Non-lighting measures represented a smaller share of the program savings. Project distribution across various building types demonstrates the program's reach to diverse structures. Moreover, trade ally engagement data suggests that visibility on the program website positively correlates with increased project participation.

The BES Program has maintained its design and implementation without significant changes over the past year, focusing on prioritizing customer satisfaction and education. A notable success emerged from the BES program, highlighting the benefits of a six-year partnership with a hospital in the Roanoke area. This collaboration demonstrated ongoing benefits, with the hospital consistently completing projects on an annual basis and expanding its energy efficiency initiatives to include clinics.

To enhance awareness and engagement among small businesses, the program employed a multifaceted approach that included diverse strategies, utilizing participant feedback, targeted marketing, and outreach efforts. One campaign, run in both the SBDI and BES programs, increased restaurant participation through email outreach and distribution of a kitchen equipment flyer. Recognition initiatives, such as badges and window clings, were offered in PY2023, providing acknowledgment for participant businesses. The window cling badge will change annually, beginning in 2025, to allow for continuous recognition of participation.

Contractors joined BES for a variety of reasons and most specialize in lighting, while some offer broader services. Motivations for joining the contractor network ranged from prior experience with other similar utility programs to business expansion strategies, including serving national clients within the Company's territory. While four of the interviewed trade allies reported that they are listed on the BES program website, the impact on their business varies, with some reporting modest benefits and others noting no discernable effect. Most trade allies focus primarily on lighting, while two indicated that they offer additional services such as building automation systems and controls, HVAC, refrigeration, and more.

Trade allies employ diverse strategies to promote the BES program, integrating energy efficient solutions into project discussions and emphasizing benefits during on-site assessments. Contractors inform customers about incentives, utilizing word of mouth, verification processes, and proactive marketing before formal consultations. Access to marketing materials varies among trade allies, with approximately 57% having access, and 75% of them utilizing these materials effectively. Overall, trade allies emphasize the positive impact of marketing materials, such as pamphlets and incentive level listings, viewing them as valuable resources that effectively contribute to customer awareness and understanding of the program and its incentives.

- **Recommendation 1: Take steps to ensure that trade allies have access to marketing materials available through the program.** While trade allies had a positive view of the program marketing materials, not all had access to them. A tactic the program could use to ensure access is to send an email annually or quarterly to trade allies that have participated with information on the marketing materials available.

Trade allies utilize a turnkey approach in supporting customers with the BES application, managing all aspects from documentation preparation to submission and guiding them through the process. The support offered by contractors aims to simplify the experience for customers, minimizing their administrative tasks. While the majority find the BES application process effective, some areas for potential improvement were identified, including challenges with account number formats, accuracy of rebate estimations, and usability within the application portal. Trade allies appreciate the program's user-friendliness but suggest refinements to further streamline and enhance the overall application experience for program participants.

Nearly all respondents received training from either the Company or TRC for the BES program. Approximately 83% of trade allies indicated that the Company's training opportunities in 2023 were adequate. Training events throughout the year, including webinars, program navigation sessions, and general updates, contributed to the trade allies' understanding of the program. While some trade allies found the training to be very or somewhat effective, opinions varied. Mixed responses emerged regarding the need for additional training opportunities, with some expressing a desire for more comprehensive coverage, including aspects like lighting, HVAC, and application processes.

- **Recommendation 2: It may be useful to explore offering training on new technologies or maximizing the energy savings benefits of technologies.** Trade allies suggested an interest in this, but trade ally meetings could be used to explore the level of interest and topics of interest.

All trade allies expressed favorable views of their interactions with the Company or TRC. Trade allies reported diverse communication frequencies with program staff, influenced by factors like business volume and active projects, including quarterly updates and email communication. Various communication forms, such as email, phone calls, website updates, and in-person visits, were considered the most effective for disseminating program changes and updates among the interviewed trade allies.

Trade allies were generally satisfied with the BES program and its aspects. All trade allies were satisfied with the required paperwork. The Company's efforts to enhance the paperwork process, including streamlining the online system for user-friendliness and transitioning to a portal-based system, have been acknowledged positively by several trade allies. While incentive amounts received mixed ratings, ranging from somewhat dissatisfied to moderately satisfied, all trade allies are either extremely or somewhat satisfied with the range of program-qualifying equipment. The majority of trade allies are satisfied with the project turnaround time. Trade allies generally were satisfied with the BES Program overall.

Customers learned about the Company's incentives from various sources, with trade allies being the most common. About 25% of respondents acquired information from trade allies, contractors, equipment vendors, or energy consultants. Prior experience with the program influenced 38% of respondents in their decision to proceed with current projects. Two-thirds of participants indicated their organization took the lead in initiating discussions about participating in the program, and most completed the application independently. Feedback on organizational decisions to participate revealed that 44% initiated discussions, 22% credited their vendor or contractor, and another 22% reported collaborative discussions between their organization and the vendor or contractor.

Organizations commonly face barriers to energy efficiency improvements, with the most prominent concern being the high initial cost. Other challenges include the long payback period, competition for funding, limited staff time, and a lack of awareness about available incentives. However, a portion of respondents reported no significant obstacles. Recommendations for the Company included higher incentives, more technical or engineering support, improvements to the application process, and one respondent expressed a desire for free on-site consultations for businesses seeking efficiency improvements.

All respondents expressed high satisfaction with the program overall, including the steps involved and the time taken to receive incentives. The application process received generally positive feedback, with 57% of respondents rating it as somewhat or very clear. Pre-inspections and on-site planning assistance were infrequent. Most organizations relied on contractors for equipment installation, while less than a quarter had their own staff handle the installation. Most had positive interactions with staff when they had questions. While suggestions for improvement were limited, one participant recommended incorporating success stories or case studies from other companies to inspire management and enhance the program's impact on energy efficiency in commercial and industrial facilities.

- **Recommendation 3: Increase opportunities for on-site consultations and technical support.** Explore the feasibility of offering more on-site consultations for potential participants, providing personalized insights and recommendations. Respondents generally reported that they did not receive these, but many cited technical knowledge as a barrier to making efficiency improvements.

1.4.2. Custom Pilot Program

A significant portion of savings were attributed to a compressed air project, comprising nearly 70% of the total. The diversity of building types engaged, including retail, warehouses, industrial facilities, and banks/financial institutions, underscores the program's effectiveness in reaching various sectors within its service area. Focusing on both compressed air and HVAC measures has allowed the program to address a wide array of energy efficiency needs across diverse building types.

The interviewed trade ally found significant value in the Company's Custom Pilot Program. They indicated that they leveraged incentives to drive energy management system installations and offering diverse energy efficiency projects with a focus on optimizing equipment operation for substantial savings. The trade ally expressed high satisfaction with communication with the Company/TRC program staff. This trade ally was also somewhat satisfied with the required paperwork, while their rating of incentive amounts was lower. The trade ally was somewhat satisfied with project turnaround time and the Custom Pilot Program overall. Finally, they emphasized the need for faster pre-approval processes (e.g., within four weeks), recommended increased incentives in certain areas, and underscored the role of competitive incentives in driving program participation and success.

The interviewed trade ally acknowledges challenges in recommending high-efficiency equipment to customers, citing barriers such as high initial costs, limited technical knowledge, and difficulties in understanding savings methodology. To encourage adoption, this trade ally employs case studies and pilot programs, showcasing energy management systems to demonstrate actual savings and platform benefits, in addition to available program incentives. Incentives are incorporated into the company's business case that they develop for prospective projects. While the trade ally currently lacks specific materials for the Company's Custom Pilot Program, their existing materials successfully convey the advantages of energy efficiency incentives.

1.4.3. Small Business Direct Install Program

In several cases, the realized savings of the sampled projects were significantly less than the expected savings, leading to a lower gross realization rate for the SBDI Program. The most influential factor was the hours used to estimate energy savings. In some cases, the hours referenced in the MidAtlantic TRM were not appropriate for the building type and differed from hours captured on the application form.

- **Recommendation 1:** Review procedures for estimating hours to leverage application data or alternative sources when an applicable building type is not listed in the MidAtlantic TRM.

Lighting measures accounted for the majority of program savings. Expected savings for lighting measures accounted for 79% of total program expected savings. Linear lamp replacements and screw-in A-Type LED lighting emerged as the predominant contributors to lighting. The program completed the largest share of projects within churches, indicating a prevailing focus on

this sector. Additionally, twelve trade allies completed projects in 2023, with three of those accounting for the majority of projects.

The interviewed trade ally underscored the benefit of participating in the SBDI program. The interviewed trade ally specializes in lighting, lighting controls, VFDs, and other non-lighting energy efficiency projects. They joined the Company's contractor network with an initial motivation rooted in their expertise in lighting and controls. While listed on the SBDI program website, tracking specific impacts is challenging, yet they acknowledge the likely contribution to their business volume.

The interviewed trade ally expressed overall satisfaction with communication, required paperwork, incentive amounts, program-qualifying equipment, project turnaround time, and the program, overall. The Company has improved the SBDI program's paperwork process since the trade ally's initial engagement, resulting in an easier and more streamlined experience. The trade ally acknowledges the Company's increased involvement in administrative responsibilities, highlighting satisfaction with the current state of the program.

Participants expressed satisfaction with the program. A significant majority (95%) reported overall satisfaction. Furthermore, all respondents who interacted with program staff indicated satisfaction with these interactions. High levels of satisfaction were also noted for the process required to complete participation, the installed equipment, and the timeframe for receiving the rebate.

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 1-6.

Table 1-6 Summary of Benefit-Cost Ratios – PY2023

Program	*Total Resource Cost Test*	*Program Administrator Cost Test*	*Ratepayer Impact Measure*	*Participant Cost Test*
Business Energy Solutions Program - Lighting	5.46	10.01	0.75	9.21
Business Energy Solutions Program - Non-Lighting	2.10	2.68	0.48	9.05
Business Energy Solutions Program - Total	5.12	8.97	0.73	9.20
Small Business Direct Install Program	2.56	3.99	0.96	3.21

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 2023 program year. Volume I is organized as follows:

- Chapter 2: Business Energy Solutions Program
- Chapter 3: Custom Pilot Program
- Chapter 4: Small Business Direct Install Program
- Chapter 5: Opt Out Customers
- Chapter 6: Cost Effectiveness Evaluation
- Chapter 7: Carbon Emissions Reduction

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

2. Business Energy Solutions Program

2.1. Program Description

The Business Energy Solutions Program was designed to generate energy savings for all non-residential customers through the use of high-efficiency lighting and non-lighting measures. Customers receive incentives for the installation of approved energy efficiency equipment. Expected kWh savings are shown in Table 2-1. There were 180 projects completed during the 2023 program year that resulted in expected savings of 17,896,444 kWh.

Table 2-1 Expected kWh Savings

Number of Projects	*Total Expected kWh Savings*
180	17,896,444

2.1.1. Program Eligibility Requirements

The Business Energy Solutions 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);
- Customers who have reached the $25,000 ceiling for incentive payments for the project type; and
- Customers who opted out of the Company's energy efficiency programs.

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.

Lighting projects must meet Consortium for Energy Efficiency (CEE), Design Lights Consortium (DLC), or ENERGY STAR® specifications.

Non-lighting requirements must meet ENERGY STAR, AHRI, CEE, or other certifications as appropriate.

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 realized 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 realized energy savings as a percentage of average participant baseline (2022 calendar year) energy usage.

Table 2-2 Summary of Savings by Eligible Rate Schedule[1]

Rate Schedule Class	*Total Net Realized kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Realized kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage*
200	9,084,679	125	72,677	45,526	159.64%	10.08%
300	6,045,073	25	241,803	17,987,762	1.34%	1.36%

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 Business Energy Solutions Program. The evaluation team used telephone interviews to collect project data for estimating project savings and leveraged AMI metering data.

2.2.1.1. Sampling Plan

Data used to estimate the gross savings achieved through the Business Energy Solutions Program were collected for samples of projects completed during the period January 2023 through December 2023. Data provided by the implementation contractor and utility showed that during the 2023 program year, there were 180 projects completed under the program that resulted in expected savings of 17,896,444 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 program, the actual precision achieved for the sample was ± 9.3 percent.

[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 2022, not accounting for any accounts for which a full year of 2022 data was unavailable.

During the implementation of the program, sampling was conducted to collect M&V data in real time. As completed projects accumulated over time, sample selection was distributed throughout the program year. The selection of samples was dependent on the timing of project completion during the program year.

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

Variable	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	> 530000	300000 - 530000	100000 - 300000	40000 - 100000	< 40000	
Number of projects	7	5	39	39	90	180
Total Ex Ante Annual kWh	5,321,555	2,149,010	6,550,289	2,657,767	1,217,823	17,896,444
Average kWh Savings	760,222	429,802	167,956	68,148	13,531	1,439,660
Std. dev. of kWh savings	194,896	49,750	56,724	19,466	11,157	331,993
Coefficient of variation	0.26	0.12	0.34	0.29	0.82	
Final design sample	5	3	6	4	4	22

As shown in Table 2-4, the sample projects for the BES Program account for approximately 38% of the total expected kWh savings.

Table 2-4 Sampled Projects Expected Savings by Stratum

Stratum	*Sample Expected kWh Savings*	*Total Expected kWh Savings*
Stratum 1	4,096,028	5,321,555
Stratum 2	1,386,890	2,149,010
Stratum 3	965,954	6,550,289
Stratum 4	264,252	2,657,767
Stratum 5	93,555	1,217,823
Total	**6,806,679**	**17,896,444**

2.2.1.3. Verification Data Collection Procedures

Data collection for the C&I programs was accomplished through remote verification. Remote verification approaches included the following:

- Use telephone or email verification to perform remote verification and collect data on factors such as building operation schedules or heating and cooling types.
- For cases where Option B (retrofit isolation) would be applied, the Evaluation Team requested energy use data collected through EMS systems or other onsite monitoring efforts implemented by site staff or their contractors, if available. As needed, and if acceptable to the customer, the

Evaluation Team scheduled video conferencing with our experienced engineers and field staff to assist customers with getting this data.

- Application of IPMVP Option C (whole building analysis) for custom measures where feasible, supplemented by information collected by telephone or email on schedule and equipment changes that may have occurred during the pre-and post-installation period.
- Interval billing data was utilized to estimate operating hours, where applicable.

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 with contact information available to complete the survey. Customers were emailed up to three times and called up to two times. Table 2-5 summarizes the data collection effort.

Table 2-5 Summary of Business Energy Solutions Survey Effort

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Business Energy Solutions / Custom Participant Survey	Email with phone follow up	January 2024	35	7
Business Energy Solutions / Custom Participant Survey	Email with phone follow up	October 2023	51	2
Total			86	9

2.2.3. Trade Ally Interviews

The Evaluation Team contacted 13 C&I trade allies in August 2023 to solicit their participation in a phone interview. The trade allies were offered a $50 gift card in exchange for completing the approximately 30-minute interview. Four interviews with participating contractors were completed. Multiple attempts (2 emails and 2 phone calls) were made to schedule phone interviews with contractors. The summary of final dispositions from the recruitment attempts are provided in Table 2-6.

Table 2-6 Final Dispositions of Trade Ally Interview Recruitment

Final Disposition	*Count*
Complete	6
Soft refusal	0
No Answer	4
Not eligible	0
Hard refusal	0
Broken appointment	3
Total Contacts	**13**

2.3. Estimation of Realized 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 BES Program during the period January 2023 through December 2023. Section 2.3.1 describes the methodology used for estimating gross savings. Section 2.3.2 presents the results of 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.

2.3.1.1. Review of Documentation and Measure Attributes Tracked

After the samples of projects were selected for the program, 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 commercial projects in various project documents. The documents include measure spec sheets, invoices, and spreadsheets.

If there was uncertainty regarding a project, or seemingly 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 2-7 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 type, efficient/baseline connected load, efficient/baseline quantity, building type, and space conditioning equipment and other supporting documentation. The documentation included the following:

- Lighting: Equipment specification sheet.
- Packaged terminal heat pump: Capacity, model number.

- Water source heat pump: Capacity, model number.
- VFD Air Compressors: Equipment specification sheet.
- No-Loss Condensate Drains for Air Compressors: Equipment specification sheet.

Table 2-7 Gross Impact Attributes Tracked by Program – Business Energy Solutions

Measure	*Attributes Tracked*
All Measures	Project ID
	Measure Type (s)
	Expected Savings Per Measure Type
	Quantity Per Measure Type

2.3.1.2. Procedures for Estimating Savings from Measures Sampled through the Business Energy Solutions Program

2.3.1.2.1. Lighting Measures

The typical lighting M&V method used in the evaluation of this program is the 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 realized 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 rates[2] were calculated for each sampled project. 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.

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 on baseline and post-installation wattages and hours of operation for the retrofitted fixtures.

[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).

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 interviews with facility managers. Usage areas were defined to be those areas within a facility that were expected to have comparable average operating hours. AMI data was also reviewed to support the determination of hours of use.
- Savings from lighting measures in conditioned spaces were factored by the region-specific, building-type specific HCIF, calculated by the Evaluation Team, to calculate total savings attributable to lighting measures, inclusive of impacts on HVAC operation.

Stratum-level realization rates were calculated as the ratio of realized energy savings to expected energy savings for the sampled projects in the stratum. Each stratum-level realization rate was applied to all other (non-sampled) expected savings values within each stratum. The sum of these values produced the annual realized energy savings for the program.

2.3.1.2.2. Non-lighting Measures

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

As with lighting measures, energy savings realization rates[3] 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 discrepancies between expected and realized energy savings. This information for such sites is included in site-level M&V analyses presented in Volume II.

Table 2-8 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 2-8 Sources for Non-Lighting Realized Savings Analysis

Measure	*Saving Parameter Sources*
Packaged terminal heat pump	Project specific information, Mid Atlantic TRM V10.0, April 2020, p. 422-424.
Water source heat pump	Project specific information, Mid Atlantic TRM V10.0, April 2020, p. 422-424.
VFD Air Compressor	Project specific information.

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

[3] 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).

realization rate was applied to all other (non-sampled) expected 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

This section presents the results of the gross savings analysis.

2.3.2.1. Gross Realized kWh Savings

The sampled project realized gross kWh savings of the Business Energy Solutions Program during the period January 2023 through December 2023 are summarized by sampling stratum in Table 2-9. Project-level realization rates are displayed in Table 2-10 along with the overall program-level energy savings and realization rate. Overall, the achieved gross energy savings of 19,028,531 kWh were equal to 106% of the expected savings.

Table 2-9 Sample Expected and Gross Realized kWh Savings by Sample Stratum

Stratum	*Expected kWh Savings*	*Gross Realized kWh Savings*	*Gross Realization Rate*
Stratum 1	4,096,028	4,196,893	102%
Stratum 2	1,386,890	1,542,121	111%
Stratum 3	965,954	1,177,712	122%
Stratum 4	264,252	221,201	84%
Stratum 5	93,555	74,929	80%
Total	6,806,679	7,212,856	106%

Table 2-10 Expected and Gross Realized kWh Savings by Project

Stratum	*Program Number*	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Project Gross Realization Rate*
4	BES2022_000407	95,681	95,681	100%
3	BES2022_000846	116,164	264,694	228%
3	BES2022_000976	169,102	167,041	99%
3	BES2022_001035	194,461	177,448	91%
1	BES2022_001076	1,132,038	1,134,337	100%
1	BES2022_001426	688,489	848,264	123%
3	BES2022_001971	158,424	156,723	99%
1	BES2022_002003	904,842	1,062,494	117%
3	BES2022_002018	185,007	392,043	212%
5	BES2023_002176	35,905	25,629	71%
1	BES2023_002390	750,242	531,495	71%
2	BES2023_002402	447,306	447,306	100%

Stratum	*Program Number*	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Project Gross Realization Rate*
5	BES2023_002425	4,587	5,269	115%
5	BES2023_002499	39,548	27,872	70%
4	BES2023_002500	50,919	60,527	119%
5	BES2023_002509	13,515	16,159	120%
4	BES2023_002510	50,687	45,873	91%
3	BES2023_002545	142,796	19,763	14%
4	BES2023_002546	66,965	19,120	29%
1	BES2023_002957	620,417	620,303	100%
2	BES2023_003753	469,448	322,282	69%
2	BES2023_003853	470,136	772,533	164%
All Non-Sample Projects		11,089,765	11,815,675	107%
Total		17,896,444	19,028,531	106%

Table 2-11 Business Energy Solutions Program Realized Gross Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*
Compressed Air	251,659	205,627	82%
Exterior Lighting LED	1,283,482	1,241,756	97%
Kitchen Commercial Dishwasher	7,899	6,326	80%
LED Linear Lamp Replacement	3,974,234	4,476,656	113%
Lighting (R, PAR, ER, BR, BPAR)	15,040	13,164	88%
Lighting Delamping	884,801	1,022,052	116%
Lighting Dimming Control	6,790	5,684	84%
Lighting Exit Sign	34,393	35,559	103%
Lighting High-Bay Luminaires	8,332,286	8,766,295	105%
Lighting LED Decorative	102,925	89,952	87%
Lighting LED Pin Based	301,772	299,113	99%
Lighting LED Recessed Downlight Luminaire	111,030	126,826	114%
Lighting LED Standard A-Type	31,617	32,258	102%
Lighting LED Troffer	1,480,283	1,618,652	109%
Lighting Occupancy Sensor	243,270	172,631	71%
Packaged Terminal Heat Pump	38,640	30,947	80%
Refrigerated Case Lighting	116	93	80%
VFD for HVAC Application	304,616	361,826	119%
VFD for Pump Application	410,815	456,459	111%
VSD Air Compressor	80,775	66,655	83%
Total	17,896,444	19,028,531	106%

2.3.3. Results of Peak Savings Estimation

The realized gross peak kW reductions of the Business Energy Solutions Program during the period January 2023 through December 2023 totaled 4,234.44 kW.

Table 2-12 Business Energy Solutions Program Realized Gross Peak kW Reductions

Measure Name	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*
Compressed Air	47.19	55.22	117%
Exterior Lighting LED	30.40	53.79	177%
Kitchen Commercial Dishwasher	1.26	1.56	123%
LED Linear Lamp Replacement	919.16	1,129.56	123%

Measure Name	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*
Lighting (R, PAR, ER, BR, BPAR)	3.51	4.37	124%
Lighting Delamping	211.93	186.60	88%
Lighting Dimming Control	2.12	2.37	112%
Lighting Exit Sign	4.92	5.98	122%
Lighting High-Bay Luminaires	1,837.98	2,099.17	114%
Lighting LED Decorative	27.35	29.99	110%
Lighting LED Pin Based	56.69	59.42	105%
Lighting LED Recessed Downlight Luminaire	29.43	39.50	134%
Lighting LED Standard A-Type	7.50	8.48	113%
Lighting LED Troffer	343.60	416.78	121%
Lighting Occupancy Sensor	62.60	58.15	93%
Packaged Terminal Heat Pump	4.12	5.08	123%
Refrigerated Case Lighting	1.53	1.89	123%
VFD for HVAC Application	(0.94)	(1.23)	131%
VFD for Pump Application	51.93	55.18	106%
VSD Air Compressor	19.57	22.60	115%
Total	3,661.85	4,234.44	116%

2.4. Estimation of Realized 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. Spillovers occur when the program influences the implementation of measures that do not receive program incentives and may add to the total program net savings.

Information collected from a sample of program participants through a customer survey was used for the net-to-gross analysis. Chapter 3 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 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 they intended 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, the program did not affect the timing of purchase and installation" to the following question: "Did you purchase and install the 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 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?" 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 2-13 shows these values.

Table 2-13 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 have completed the [MEASURE] project even if you had not participated in the program?"

Respondents that provided 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?

2.4.1.2. Procedures used to Estimate Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because they participated 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 seven. 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.

No spillover savings were identified for the C&I programs.

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 Business Energy Solutions Program for the period January 2023 through December 2023.

The program realized net energy savings totaling 15,129,753 kWh. The net-to-gross ratio for the program is 80%.

Table 2-14 Business Energy Solutions Program Realized Net Energy Savings

Ex Ante Annual kWh Savings	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kWh Savings*	*Ex Post Spillover kWh Savings*	*Ex Post Annual Net kWh Savings*	*Net-to-Gross Ratio*	*Lifetime Net Ex Post kWh Savings*
17,896,444	19,028,531	106%	3,898,779	0	15,129,753	80%	226,496,713

The realized net peak demand reductions are summarized for the Business Energy Solutions Program in Table 2-15.

Table 2-15 Business Energy Solutions Program Realized Peak kW Reductions

Ex Ante Gross kW Savings	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kW Savings*	*Ex Post Spillover kW Savings*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
3,661.85	4,234.44	116%	783.99	0.00	3,450.45	81%

2.5. Process Evaluation

The Evaluation Team completed a process evaluation of the Business Energy Solutions Program. The following sections summarize the findings of the process evaluation.

2.5.1. Summary of Program Participation

Table 2-16 summarizes the program expected savings by end-use and measure type. Lighting measures accounted for the majority of program savings (98%). High-bay luminaries accounted for 48% of lighting savings, linear lamp LEDs for 23%, and exterior LED luminaries for 7%. Collectively, non-lighting measures accounted for 2% of the program expected savings.

Table 2-16 Summary of Program Measures

End Use	*Measure*	*Project Count*	*Percent of Ex Ante kWh Savings*
Lighting	Lighting High-Bay Luminaires	69	48%
	Linear Lamp LED Linear Replacement Lamp	66	23%
	Exterior Lighting LED Luminaires	32	7%
	Lighting Delamping	8	5%
	Lighting 2 x 4 LED Troffer Retrofit Kit	22	4%
	Variable Frequency Drive VFD	5	4%
	Lighting 2 x 4 LED Troffer	24	3%
	Lighting LED Pin Based	7	2%
	Controls Occupancy Sensor	11	1%
	Lighting 2 x 2 LED Troffer	14	1%
	Lighting LED Recessed Downlight Luminaire	14	1%
	Lighting 2 x 2 LED Troffer Retrofit Kit	16	1%
	Lighting LED Decorative	2	1%
	Lighting Exit Sign	12	<1%
	Lighting LED Standard A-Type	8	<1%
	Exterior Lighting LED Directional	4	<1%

End Use	*Measure*	*Project Count*	*Percent of Ex Ante kWh Savings*
	Lighting 1 x 4 LED Troffer	10	<1%
	Lighting LED Other R, PAR, ER, BR, BPAR , or similar bulb	3	<1%
	Controls Daylight Dimming Control	1	<1%
	Lighting 1 x 4 LED Troffer Retrofit Kit	2	<1%
	Refrigerated Case Lighting Refrigerated Case Lighting	1	<1%
Compressed Air	Compressed Air Storage Tank Storage Tanks for Load/No Load Screw Compressors	5	34%
	Compressed Air Condensate Drains Compressed Air No-Loss Condensate Drains	19	25%
	Compressed Air VSD Air Compressor VSD Air Compressor	4	24%
	Compressed Air Thermal Mass Dryer Cycling Refrigerated Thermal Mass Dryer	9	17%
Heating and Cooling	HVAC Packaged Terminal Heat Pump Packaged Terminal Heat Pump	4	100%
Kitchen	Kitchen Commercial Dishwasher	1	100%

Retail, warehouses, industrial facilities, and manufacturing facilities accounted for the largest number of projects for specified building types (see Table 2-17). Overall, the program reached a diverse range of building types in the service area.

Table 2-17 Number of Projects by Building Type

Building Type	*Project Count*
Industrial - 3 Shift	29
Retail	19
Manufacturing Facility	16
Warehouse (Not Refrigerated)	16
Industrial - 2 Shift	13
Auto Related	11
Industrial - 1 Shift	11
Hospitals	7
Office (General Office Types)	7
NA	6
Convenience Stores	5
Dining: Cafeteria / Fast Food	5
Food Stores	5
Hospitals / Health Care	4
Lodging (Hotels/Motels)	4

Building Type	*Project Count*
Museum	3
Church	2
Dining: Family	2
Exercise Center	2
Restaurants	2
Fast Food Restaurants	1
Garage	1
Gymnasium	1
Light Manufacturers	1
Medical Offices	1
Multi-Family (Common Areas)	1
Office/Retail	1
Parking Garages & Lots	1
Religious Building	1
Schools (Jr./Sr. High)	1
Workshop	1

Trade ally engagement in terms of the number of projects completed during the year is summarized in Table 2-18. The data shows that more projects were completed by trade allies listed on the program website than those who were not listed.

Table 2-18 Trade Ally Engagement

Listed on Program Website	*Number of Projects Completed*	*Number of Trade Allies*
Yes	19	1
	9	1
	8	1
	5	1
	4	1
	3	3
	1	5
No	22	1
	1	7
Self-install/Not listed	91	1

2.5.2. Program Operations

The Evaluation Team conducted an in-depth interview with the Company energy efficiency and consumer programs manager. The energy efficiency and consumer programs manager is responsible for overseeing the program, marketing, and working with the implementation team.

TRC staff oversee the implementation of the program, measure development, and assessing the cost-effectiveness of measures.

The purpose of the interview was to understand any changes made to the C&I programs, including the new Custom Pilot Program.

This section presents cross-cutting information and information specific to the BES Program. Section 3.5.2 presents information that is specific to the Custom Pilot Program and Section 4.5.2 presents information that is specific to the Small Business Direct Install Program.

2.5.2.1. Program Design and Operations

There have been no significant changes to the design or implementation of the Business Energy Solutions Program in the past year.

The primary program goal for each program is to achieve energy saving. Apart from energy savings, there are additional objectives aimed at ensuring the effectiveness of the programs for customers and promoting customer education regarding energy efficiency and consumption. These goals emphasize the importance of providing valuable services to customers and equipping them with knowledge and understanding to make informed decisions about their energy usage. The commercial programs strive to prioritize customer satisfaction, education, and engagement in energy efficiency.

A successful project completed through the BES program involved a hospital located in the Roanoke area. The program manager discussed the collaboration and longstanding partnership with this hospital, which had spanned six years. Throughout this period, the hospital has undertaken multiple projects, typically completing projects on an annual basis. Recently, the hospital expanded its energy efficiency initiatives to include clinics. The hospital's continued engagement with the BES program and their track record of completing projects demonstrate the success and ongoing benefits for commercial customers. Other successful projects that program staff highlighted included several lighting projects and the installation of VFD.

2.5.2.2. Outreach & Customer Engagement

The engagement process for businesses with commercial programs typically involves several steps and key personnel. The Company marketing coordinator and TRC (implementer) oversee marketing efforts to support the commercial programs. Additionally, there are dedicated outreach teams within Virginia and a customer service team responsible for engaging with businesses. The customer service team consists of three management levels catering to various types of businesses, ranging from small businesses to large industrial customers. This customer service team conducts outreach activities, actively contacting businesses to discuss different aspects related to energy efficiency, the available programs, business development opportunities, and other relevant promotions.

The outreach team sets targets for the number of businesses they need to engage with each year, aiming to have conversations about energy efficiency and the programs offered. Through these

efforts, businesses are recruited and informed about the benefits and opportunities provided by the commercial programs.

The commercial programs actively engage with various stakeholders, including regulators, policymakers, and community organizations, to advance energy efficiency goals in the service territory. There are regular stakeholder meetings held in Virginia which serve as a platform for dialogue and collaboration between regulators, stakeholders, and program implementers. Additionally, the commercial programs actively reach out to various organizations, such as the City of Roanoke, as well as various business organizations within the area.

2.5.2.3. Trade Ally Network

The contractor selection process to become part of the approved trade ally network has not changed. New trade allies have been added to the programs this year, but exact numbers were not available at the time of the interview. The training for trade allies is primarily provided by TRC, which provides webinars, one-on-one meetings, and quarterly calls to provide necessary training and support.

Staff noted that larger industrial customers completing Custom Pilot Program projects often rely on their own maintenance teams, electricians, and energy efficiency teams to carry out self-installation of projects rather than trade allies.

2.5.2.4. Application and Project Completion

The typical timeline between submitting an application and project completion can vary depending on the program and the complexity of the project. For programs like BES and the Custom Pilot Program, the timeline is often influenced by factors beyond the application process, such as customer requirements and project complexity. Therefore, the timeline can extend beyond the standard 90 days for more complex projects. On the other hand, SBDI projects are typically quicker, as the contractors handle the installations and application process for the customers.

During the application process, businesses may face challenges in accurately describing the measures being installed. To address these challenges, the program offers one-on-one assistance to applicants, and TRC provides support in navigating the application process. For newer contractors or specific measures like spray valves, TRC works closely with them to ensure successful completion of the applications. To ensure projects are completed on time and within budget, the BES program allows 90 days for project completion from the date of application approval. TRC sends reminders to contractors at the 60-day mark to assess project progress and determine if an extension is needed. For custom projects, time frames are discussed upfront, considering the complexity and duration of the project. Budget-wise, the program provides estimated rebates upfront, and if there are additional qualifying measures or costs exceeding the rebate amount, those are evaluated at the end of the project. Overall, the program uses tracking methods such as email communication, monitoring project timelines, and providing support to ensure projects are completed as planned.

The commercial programs prioritize project funding on a first-come, first-served basis within the allocated budget. Projects are evaluated based on the description of the measures being installed

and the eligibility for rebates and incentives. The BES Program has approved 100% of the projects to date.

2.5.2.5. Data Collection & Monitoring

The program collects data on a weekly basis when invoices are submitted, including project details, savings, and rebates. The data is accessible to the program staff. Preliminary analysis of the data is planned to begin in June, and TRC is working on developing dashboards and tracking mechanisms, including a QA/QC dashboard, to enhance program management and reporting. Currently, there are no reports or dashboards used to share data with stakeholders, and there are no mentioned limitations or areas for improvement identified with the current tracking system.

2.5.2.6. Quality Control and Project Verification

Applications are submitted electronically, by email, or through the program portal. Each application is reviewed to confirm that all data is provided and that the eligibility requirements are met. The implementation contractor contacts the submitter if any data is incomplete or missing.

Pre-approval engineering reviews of the projects are required for any project with an estimated incentive payment of $3,000 or more.

For projects with less than $10,000 in incentives, 10% of the projects are inspected after installation to confirm the equipment installation and project specifications. For projects with greater than $10,000 in incentives, all projects are pre-and/or post-inspected.

Additionally, pre- and post-installation inspections are performed for the first five (5) projects implemented by each trade ally.

Program staff also stated that contractors are gathering customer feedback from their customer contacts on a monthly and quarterly basis and the Company is working on establishing a survey to send out to participants after projects are completed.

2.5.3. Trade Ally Interview Findings

The Evaluation Team conducted six interviews with trade allies who participated in the Business Energy Solutions (BES) program in 2023. The primary objective of these interviews was to gain insights into their respective experiences with the Business Energy Solutions (BES) program. Through these conversations, the Evaluation Team sought to understand how these individuals interacted with and perceived the BES program, aiming to gather valuable feedback and perspectives to inform their evaluation.

Trade Allies' Experience with BES, Motivations to Participate, and Services Offered

The trade allies' years of experience working with the BES program varied. The provided responses indicate that the average number of years of experience was approximately 4.5. Their roles varied within their respective organizations, including VP of Lighting, Rebate Analyst, VP/Partner, and Executive Assistant. The motivations for joining the Company's contractor network varied among interviewees. Some joined due to their experience with similar programs administered by other utilities, aiming to offer value-added solutions to customers. Others joined

to expand their business into the Company's coverage area or to serve national clients with locations within the Company's territory. Additionally, some respondents joined to access rebate incentives for ongoing projects.

Four trade allies indicated that their business is listed on the BES program website, while two were unsure. The impact of being listed on the BES program website varied among respondents, with some experiencing modest benefits, while others did not observe significant changes in their business as a result of the website listing. For one respondent, the website listing led to a small increase in business volume, particularly in the areas of the C&I program and small business program. However, another respondent reported no discernable differences in their business due to the listing. A third interviewee noted that most of their projects secured through the program came from their own cold-calling efforts rather than the website listing.

Responses regarding whether businesses offer services for other types of energy efficiency measures in addition to the mentioned measure types were mixed. Two respondents affirmed that their businesses do provide such services, with one specifying building automation systems and controls, HVAC, refrigeration/commercial kitchens, chillers, the other indicating lighting controls, and additional services such as plumbing, EV chargers, and VFDs. In contrast, the majority, comprising four respondents, stated that their businesses do not extend their offerings beyond the initially mentioned measures, which mainly consisted of lighting.

Trade allies had varying views on the potential of adding measures to the incentive list for BES. One trade ally would like to see the inclusion of variable or adjustable LEDs, emphasizing their cost-effectiveness for manufacturers and the need for utility programs to account for customer-selectable wattage settings. Another trade ally mentioned the limited scope of existing measures within the program, suggesting a broader range of lighting options. A third respondent recommended expanding HVAC offerings, particularly rooftop units, as a valuable addition to the program's offerings.

Recommendations and Challenges in Promoting High-Efficiency Equipment

Trade allies indicated varying frequencies for recommending high-efficiency equipment over less efficient options among the Company's customers. Four trade allies stated that they always recommend high-efficiency equipment to the Company's customers, while one trade ally mentioned doing so most of the time, and another trade ally does it some of the time. The trade ally who recommended high-efficiency equipment some of the time explained that their recommendations depended on the current efficiency of the equipment and the specific needs of the customer. They emphasized that the decision hinged on factors such as the customer's existing equipment efficiency, the need for increased lighting levels to meet Institute of Electrical and Electronics Engineers (IEEE) standards, and the environmental context in which the equipment would be used.

Trade allies identified various barriers and obstacles that customers face when considering the installation of efficient equipment. The most commonly mentioned obstacle was high initial cost, with two trade allies highlighting this factor. Additionally, long payback periods and concerns about the return on investment were mentioned by two trade allies. Other challenges included a

lack of technical knowledge about potential areas for improvement and a scarcity of staff time dedicated to energy efficiency upgrades, both mentioned by one respondent. One trade ally reported not observing any barriers or obstacles for customers considering efficient equipment installation.

Trade allies outlined various effective approaches to ensure customers choose efficient equipment over standard options. One approach involves educating customers about the long-term cost-effectiveness and longevity of efficient equipment, stressing the value of upfront investment for reduced long-term costs. Another strategy is to shift from operational budgets to capital budgets, enabling proactive equipment replacement instead of reactive repairs. Additionally, demonstrating the return on investment (ROI) by highlighting energy cost savings, reduced heat generation, lower maintenance expenses, and overall financial benefits is key. Emphasizing the long-term savings potential and providing customers with data-backed options also contribute to informed decision-making in favor of efficient equipment. Customers frequently choose to install the recommended high-efficiency equipment, with the majority of respondents noting that this occurs most of the time or always.

Incentive Cost Coverage and Installation Timing

The share of project costs covered by the Company' incentives for small business program participants varies, with responses indicating a range of percentages. These include between 10 and 30%, with an average of approximately 22%.

Trade allies overwhelmingly indicated that they typically do not install program-qualifying equipment in the Company's service territory without applying for a program incentive. However, one respondent mentioned that they might forgo applying for an incentive due to timing constraints when immediate action is required.

Promotion Strategies and Customer Awareness of Incentives

Trade allies employ a range of strategies to promote the BES program to their customers. They integrate energy efficient solutions into project discussions, ensuring that customers are aware of the program's benefits whenever they consider a lighting project. This approach is not heavily reliant on advertising but involves the active involvement of specialists when other divisions, like electrical and plumbing, have customer inquiries related to lighting. Additionally, rebate analysts play a pivotal role in the process, with every project routed through them to connect incentives with project planning. The program's benefits are emphasized during on-site assessments, where customers receive comprehensive insights into the financial and operational aspects of a project, with rebates factored into the financial assessment. Trade allies also noted that they inform customers about available incentives when entering new areas, especially with national clients. Moreover, they use marketing-approved materials and incentive level lists during proposal presentations, ensuring that customers are well-informed about the incentives.

Trade allies use a variety of methods to make customers aware of the availability of incentives provided by the Company. Word of mouth referrals and recommendations play a significant role in spreading awareness among potential customers. Additionally, the verification process involves requesting utility bills for projects to ensure eligibility within the Company's service territory.

Trade allies proactively utilize information from the utility to market projects to customers before formal consultations, influencing their decisions positively. Sales teams stay informed about available programs through direct communication, website access, and promotional updates, ensuring they can effectively communicate these incentives to potential customers. Incentives are seamlessly integrated into the bidding process, emphasizing their availability to potential customers. These multifaceted approaches reflect companies' proactive efforts to ensure customers are well-informed about the incentives offered by the Company.

The frequency with which customers are aware of the Company's incentives before they are mentioned varies. Three trade allies indicate that it happens sometimes, while two others indicated this happens most of the time, and one said it never happens. In some cases, customers are already informed about the incentives, while in others, it may require the trade allies to bring it to their attention.

Among the interviewed trade allies, approximately 57% indicated that they have access to Companies' or BES program marketing materials that they can use with customers, while the remaining 43% stated that they do not have access to such materials. Among those who have access to program marketing materials, approximately 75% stated that they do use these materials when discussing the program with customers. One respondent among this group indicated that they do not use marketing materials in their customer interactions.

Respondents described the marketing materials they use with customers, and in general, these materials include pamphlets, handouts, printouts from the program's website, and incentive level listings. These materials are often provided by representatives from the Company or the program itself. Respondents generally had positive feedback, stating that the materials are effective and don't require any improvements. Trade allies indicated that they find them to be valuable resources when discussing the program and its incentives with customers.

Energy Efficiency Acceptance

Based on the trade allies interviewed, approximately 60% of them have seen an increased acceptance of energy efficiency among businesses compared to the previous 5 years, indicating an uptick in interest in improving the energy efficiency of their buildings.

Trade allies shared insights into potential actions that the Company could undertake to boost businesses' interest in energy efficiency. These suggestions included enhancing incentives to better align with the economic climate, improving promotional efforts, expanding the range of incentives, and raising the cap threshold for incentives.[4]

BES Application Process

Trade allies provided feedback about their support for customers in completing the BES application. Most trade allies emphasized a turnkey approach, taking on the responsibility of preparing all necessary documentation, completing the application, and submitting it on the customer's behalf. This level of support extends to guiding the customer through the process,

[4] Businesses can receive up to $25,000 each for lighting and non-lighting projects, for a total of $50,000.

including clarifying where signatures are required. Additionally, some respondents engage in direct interactions with the Company, managing pre-inspections and addressing project-related inquiries, further streamlining the application process. Overall, the goal for trade allies is to simplify the process for customers, minimizing their involvement in administrative tasks and ensuring a hassle-free experience when applying for the BES program.

Respondents provided suggestions to improve the BES application process. While most found the process straightforward and effective, a few specific areas for potential improvement were highlighted. These include addressing challenges with the account number format required in the application, improving the accuracy of rebate estimations, and enhancing the usability of certain features within the application portal. Overall, respondents appreciate the program's user-friendliness but believe that these refinements could further streamline and enhance the application experience for program participants.

Training and Communication with Program Staff

All but one of the respondents indicated that they have received training from either the Company or TRC for the BES program. Approximately 83% indicated that the Company offered adequate training opportunities in 2023, while the remaining 17% did not specify whether they found the training opportunities adequate or not. Respondents attended various training events in 2023, which included webinars focused on new improvements and changes in measure incentives, training on navigating the Company's energy efficient program, and general program update sessions. Some respondents also mentioned team meetings and one-on-one sessions with program representatives. Respondents generally found the training they received to be effective and useful to varying degrees, with some describing it as very or somewhat effective.

Trade allies had mixed responses regarding the need for additional training opportunities. Some respondents expressed the desire for more training opportunities, with one respondent providing examples of the types of training they believe would be beneficial, such as webinars covering various program aspects like lighting, HVAC, and application processes. Another respondent emphasized the importance of control-related training and staying updated with program changes. On the other hand, a few respondents indicated that they did not believe additional training opportunities were necessary.

Trade allies reported various types of communication with program staff, ranging from quite regular communication to occasional check-ins and email updates. Most of the respondents indicated that they had effective communication channels with program staff, enabling them to address issues, submit applications, and receive updates as needed. These interactions appeared to be primarily conducted via email or phone, with some respondents mentioning specific contacts they rely on for communication.

Trade allies reported varying frequencies of communication with program staff, with some indicating monthly interactions, while others communicated on an as-needed basis. The frequency of communication appeared to be influenced by factors such as the volume of business in the program's area and whether there were active projects. It was also noted that quarterly communication and email updates were common practices.

Trade allies occasionally provided feedback to program staff about the program. Some feedback related to the need for increased incentives, while others expressed appreciation for the program's assistance and adaptability. Additionally, feedback was sometimes given when discussing specific aspects of the program during communication with staff.

Trade allies indicated that various forms of communication were effective for providing information about program changes and updates. These forms included email, phone calls from program representatives, website updates, and in-person visits. Some specified a preference for in-person visits, while others emphasized the importance of email communication. All interviewed trade allies expressed a high level of satisfaction, rating their communication with the Company or TRC as extremely satisfied.

Trade Allies' Satisfaction with BES

Trade allies have provided favorable ratings for the required paperwork for projects. All six trade allies were either somewhat or extremely satisfied with the required paperwork (one respondent rated it as 4 and five rated it as a 5). Trade allies have provided mixed ratings for the incentive amounts. While one respondent rated it as somewhat dissatisfied (rated as a 2), others rated it as 3 or 4, indicating a relatively moderate level of satisfaction. All six trade allies were either extremely or somewhat satisfied with the range of program-qualifying equipment.

Trade allies generally seem to be satisfied with the project turnaround time offered by the program. The majority of trade allies were extremely satisfied with the speed at which projects are processed, while one respondent rated it as 3. Trade allies generally seem to have a favorable view of the Business Energy Solutions Program overall, with most respondents rating it as either extremely or somewhat satisfied.

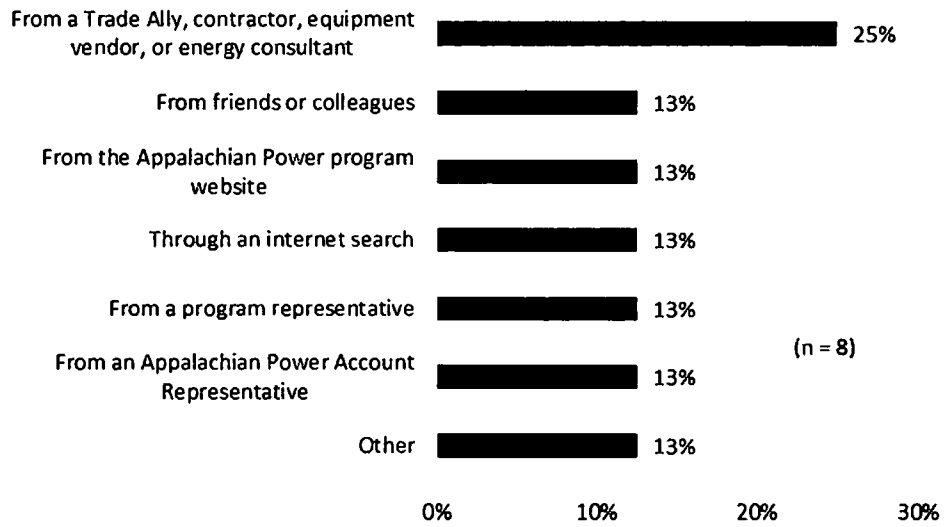
The Company has taken steps to improve the paperwork process for its BES Program, as noted by several trade allies. These enhancements include streamlining the online process to make it more user-friendly and transitioning to a portal-based system.

2.5.4. Participant Survey Findings

2.5.4.1. Project Initiation

Customers learned of the incentives through varied sources, with trade allies being a common source. Participants provided feedback about their initial awareness of the Company's incentives for efficient equipment or upgrades. About a quarter of respondents learned about the incentives from trade allies, contractors, equipment vendors, or energy consultants, making it the most frequently mentioned source. Other sources include the Company's account representatives, a program representative, an internet search, the Company's program website, and friends or colleagues (see Figure 2-1). Thirty-eight percent of survey respondents (not shown) indicated they had prior experience with the program before undertaking their current project and stated that this previous experience was highly influential in their decision to proceed with the project.

Figure 2-1 Initial Source of Awareness of Incentives



Two thirds of respondents stated that their organization took the lead in initiating discussions about participating in the program and most completed the application themselves. Participants provided feedback on their organization's decision to participate in the incentive program. Among the responses, 44% indicated that their organization initiated the discussion, while 22% mentioned that the initiative came from their vendor or contractor. Another 22% reported that the idea arose through discussions between their organization and the vendor or contractor.

Table 2-19 Project Initiation

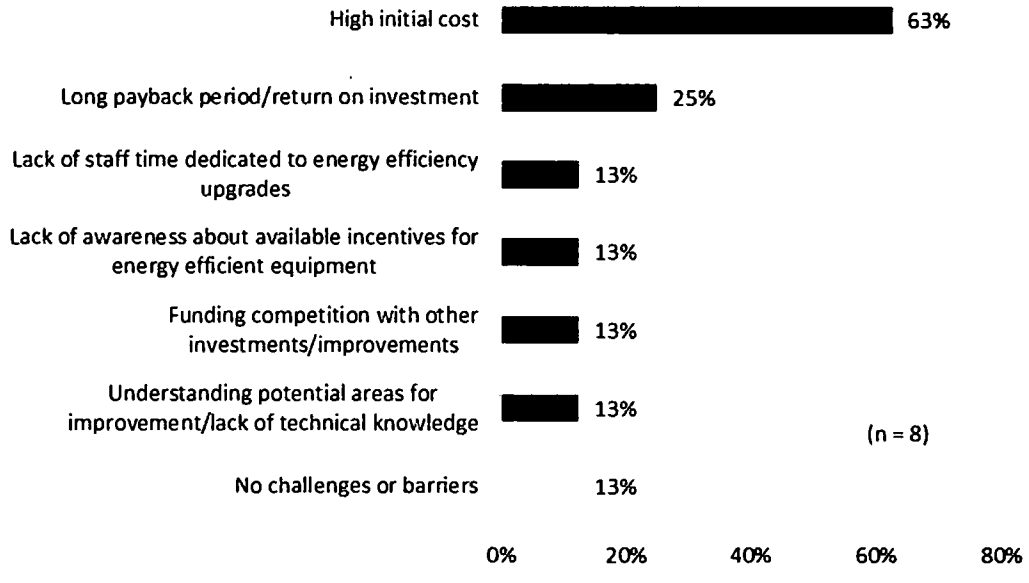
Who Initiated the Decision to Participate	*Percent of Respondents (n = 9)*
Your organization initiated it	44%
A contractor initiated it	22%
An equipment vendor	22%
A program representative	11%

2.5.4.2. Barriers to Efficiency

Cost factors were the most common barrier to energy efficiency. Survey respondents highlighted various challenges faced by their organization in considering improvements to increase commercial and industrial energy efficiency. The most prevalent concern was the high initial cost associated with such improvements, with 63% indicating this. Additionally, 25% expressed concerns about the long payback period and return on investment. Other challenges identified by respondents included funding competition with other investments or improvements, lack of staff time dedicated to energy efficiency upgrades, lack of awareness about available incentives for

energy-efficient equipment, understanding potential areas for improvement. Thirteen percent of respondents indicated that they do not face any significant challenges or barriers. See Figure 2-2 for more information.

Figure 2-2 Key Challenges in Enhancing Commercial and Industrial Energy Efficiency



Participants provided suggestions for how the Company could assist organizations in overcoming challenges when investing in energy efficient equipment. Forty-two percent of survey respondents recommended higher incentives, while 25% suggested providing more technical or engineering support. Additionally, 17% proposed improvements to the application process. One respondent mentioned a desire for the Company to send someone to businesses for a free consultation on improving efficiency.

2.5.4.3. Application Process and Equipment Installation

Most respondents thought that the application process was fairly clear. As summarized in Table 2-20, 57% of respondents rated the clarity of the application as a 4 or 5 on a 5-point scale where five (5) meant completely clear. Another third rated it a three (3) and 14% rated it as a two (2). No respondents indicated that the application was not at all clear. One participant expressed confusion about fixture rate numbers, describing them as "just too confusing."

Table 2-20 Clarity of Application Information

How Clear was the Information on How to Complete the Application	*Percent of Respondents (n = 7)*
1 (Not at all clear)	0%
2	14%
3	29%
4	14%

5 (Completely clear)	43%

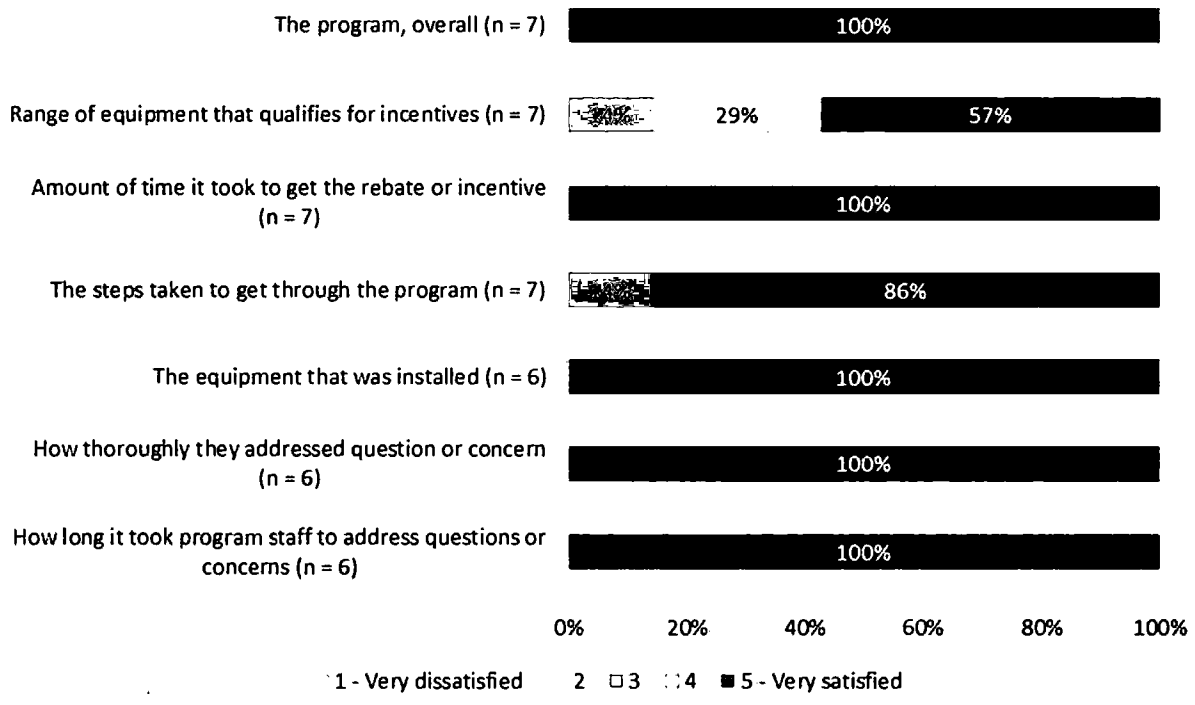
According to survey results, pre-inspections and on-site planning were not common. Less than a quarter (22%) indicated that a program representative completed a pre-inspection of their facility before equipment was installed. Among the two who indicated that a pre-inspection was performed, all stated that it was conducted within an acceptable amount of time. The majority of respondents (88%) indicated that no on-site assistance in planning and specifying equipment for the project was provided, while a minority (13%) indicated that it was. The one participant who received on-site planning assistance stated that the impact on their decision to install energy-saving equipment had a moderate to large effect.

Most survey respondents (78%) relied on a contractor they worked with before to install their equipment or efficiency upgrades, while 22% of participants had their own staff handle the installation.

2.5.4.4. Participant Satisfaction

Participants were satisfied with the program. All respondents were very satisfied with the program overall. As shown in Figure 2-3 below, respondents were generally satisfied with the steps to get through the program and the time it took to get the rebate or incentive –none reported dissatisfaction with these aspects. Respondents also reported high levels of satisfaction with the interactions they had with staff to get questions addressed. Some survey participants provided suggestions to improve the program. One participant suggested that incorporating successful stories or case studies of other companies would be inspirational for management and could enhance the program or energy efficiency in commercial and industrial facilities.

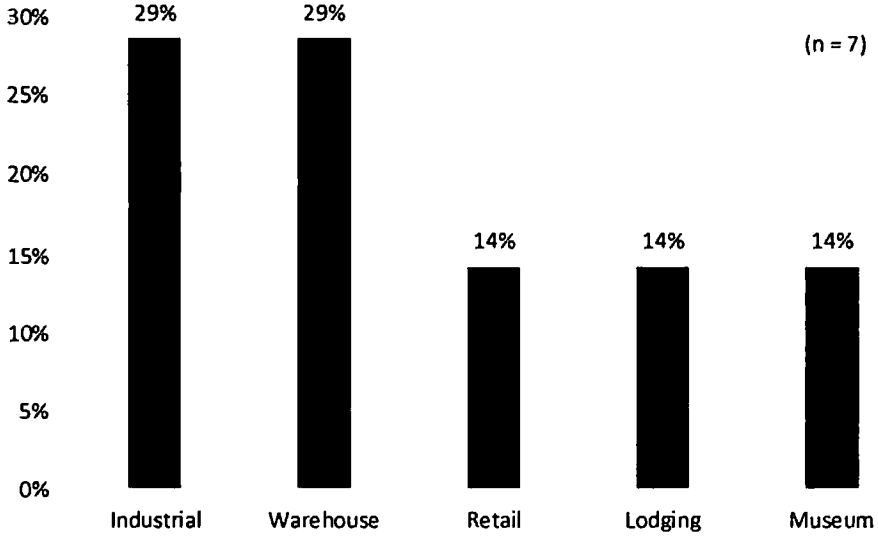
Figure 2-3 Participant Satisfaction



2.5.4.5. Firmographic

Survey respondents held various roles, with 57% identifying as president/CEO, and 14% each in roles such as facilities manager, administrative, and property manager. Industrial buildings were the most common among responding participants, but a range of building types were represented in the survey sample.

Table 2-21 Participant Building Type



2.6. Findings and Recommendations

Lighting measures accounted for a majority of the program savings, particularly high-bay luminaries, linear lamp LEDs, and exterior LED luminaries, contributing significantly to overall savings. Non-lighting measures represented a smaller share of the program savings. Project distribution across various building types demonstrates the program's reach to diverse structures. Moreover, trade ally engagement data suggests that visibility on the program website positively correlates with increased project participation.

The BES Program has maintained its design and implementation without significant changes over the past year, focusing on prioritizing customer satisfaction and education. A notable success emerged from the BES program, highlighting the benefits of a six-year partnership with a hospital in the Roanoke area. This collaboration demonstrated ongoing benefits, with the hospital consistently completing projects on an annual basis and expanding its energy efficiency initiatives to include clinics.

To enhance awareness and engagement among small businesses, the program employed a multifaceted approach that included diverse strategies, utilizing participant feedback, targeted marketing, and outreach efforts. One campaign, run in both the SBDI and BES programs, increased restaurant participation through email outreach and distribution of a kitchen equipment flyer. Recognition initiatives, such as badges and window clings, were offered in PY2023, providing acknowledgment for participant businesses. The window cling badge will change annually, beginning in 2025, to allow for continuous recognition of participation.

Contractors joined BES for a variety of reasons and most specialize in lighting, while some offer broader services. Motivations for joining the contractor network ranged from prior experience with other similar utility programs to business expansion strategies, including serving national clients within the Company's territory. While four of the interviewed trade allies reported that they are listed on the BES program website, the impact on their business varies, with some reporting modest benefits and others noting no discernable effect. Most trade allies focus primarily on lighting, while two indicated that they offer additional services such as building automation systems and controls, HVAC, refrigeration, and more.

Trade allies employ diverse strategies to promote the BES program, integrating energy efficient solutions into project discussions and emphasizing benefits during on-site assessments. Contractors inform customers about incentives, utilizing word of mouth, verification processes, and proactive marketing before formal consultations. Access to marketing materials varies among trade allies, with approximately 57% having access, and 75% of them utilizing these materials effectively. Overall, trade allies emphasize the positive impact of marketing materials, such as pamphlets and incentive level listings, viewing them as valuable resources that effectively contribute to customer awareness and understanding of the program and its incentives.

- **Recommendation 1: Take steps to ensure that trade allies have access to marketing materials available through the program.** While trade allies had a positive view of the program marketing materials, not all had access to them. A tactic the program could use to

ensure access is to send an email annually or quarterly to trade allies that have participated with information on the marketing materials available.

Trade allies utilize a turnkey approach in supporting customers with the BES application, managing all aspects from documentation preparation to submission and guiding them through the process. The support offered by contractors aims to simplify the experience for customers, minimizing their administrative tasks. While the majority find the BES application process effective, some areas for potential improvement were identified, including challenges with account number formats, accuracy of rebate estimations, and usability within the application portal. Trade allies appreciate the program's user-friendliness but suggest refinements to further streamline and enhance the overall application experience for program participants.

Nearly all respondents received training from either the Company or TRC for the BES program. Approximately 83% of trade allies indicated that the Company's training opportunities in 2023 were adequate. Training events throughout the year, including webinars, program navigation sessions, and general updates, contributed to the trade allies' understanding of the program. While some trade allies found the training to be very or somewhat effective, opinions varied. Mixed responses emerged regarding the need for additional training opportunities, with some expressing a desire for more comprehensive coverage, including aspects like lighting, HVAC, and application processes.

- **Recommendation 2: It may be useful to explore offering training on new technologies or maximizing the energy savings benefits of technologies.** Trade allies suggested an interest in this, but trade ally meetings could be used to explore the level of interest and topics of interest.

All trade allies expressed favorable views of their interactions with the Company or TRC. Trade allies reported diverse communication frequencies with program staff, influenced by factors like business volume and active projects, including quarterly updates and email communication. Various communication forms, such as email, phone calls, website updates, and in-person visits, were considered the most effective for disseminating program changes and updates among the interviewed trade allies.

Trade allies were generally satisfied with the BES program and its aspects. All trade allies were satisfied with the required paperwork. The Company's efforts to enhance the paperwork process, including streamlining the online system for user-friendliness and transitioning to a portal-based system, have been acknowledged positively by several trade allies. While incentive amounts received mixed ratings, ranging from somewhat dissatisfied to moderately satisfied, all trade allies are either extremely or somewhat satisfied with the range of program-qualifying equipment. The majority of trade allies are satisfied with the project turnaround time. Trade allies generally were satisfied with the BES Program overall.

Customers learned about the Company's incentives from various sources, with trade allies being the most common. About 25% of respondents acquired information from trade allies, contractors, equipment vendors, or energy consultants. Prior experience with the program influenced 38% of respondents in their decision to proceed with current projects. Two-thirds of

participants indicated their organization took the lead in initiating discussions about participating in the program, and most completed the application independently. Feedback on organizational decisions to participate revealed that 44% initiated discussions, 22% credited their vendor or contractor, and another 22% reported collaborative discussions between their organization and the vendor or contractor.

Organizations commonly face barriers to energy efficiency improvements, with the most prominent concern being the high initial cost. Other challenges include the long payback period, competition for funding, limited staff time, and a lack of awareness about available incentives. However, a portion of respondents reported no significant obstacles. Recommendations for the Company included higher incentives, more technical or engineering support, improvements to the application process, and one respondent expressed a desire for free on-site consultations for businesses seeking efficiency improvements.

All respondents expressed high satisfaction with the program overall, including the steps involved and the time taken to receive incentives. The application process received generally positive feedback, with 57% of respondents rating it as somewhat or very clear. Pre-inspections and on-site planning assistance were infrequent. Most organizations relied on contractors for equipment installation, while less than a quarter had their own staff handle the installation. Most had positive interactions with staff when they had questions. While suggestions for improvement were limited, one participant recommended incorporating success stories or case studies from other companies to inspire management and enhance the program's impact on energy efficiency in commercial and industrial facilities.

- **Recommendation 3: Increase opportunities for on-site consultations and technical support.** Explore the feasibility of offering more on-site consultations for potential participants, providing personalized insights and recommendations. Respondents generally reported that they did not receive these, but many cited technical knowledge as a barrier to making efficiency improvements.

3. Custom Pilot Program

3.1. Program Description

The Custom Pilot Program targets large Commercial & Industrial (C&I) customers seeking to improve the energy efficiency for processes, systems, and measures outside those provided for in the Business Energy Solutions (BES) Program or Small Business Direct Install (SBDI) Program. Any energy efficiency measure already included in the BES and/or SBDI program are not eligible measures for this Program.

Incentives on custom measures are paid per kWh reduced:

- Savings resulting from the installation of non-prescriptive lighting measures are paid at $0.04 per annual kWh reduced.
- Savings from all other custom measures are paid at $0.09 per annual kWh reduced.

Expected kWh savings are shown in Table 3-1. There were 3 projects completed during the 2023 program year that resulted in expected savings of 370,968 kWh.

Table 3-1 Expected kWh Savings

Number of Projects	*Total Expected kWh Savings*
3	370,968

3.1.1. Program Eligibility Requirements

The Custom Pilot 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);
- Customers who opted out of the Company's energy efficiency programs.

Eligible measures must not be available in other programs. Add-on and end-of-life measures must provide energy savings beyond criteria established by state and local codes, as applicable.

Projects must save a minimum of 50,000 kWh and pass any requisite cost-effectiveness screening criteria.

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 realized 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 realized energy savings as a percentage of average participant baseline (2022 calendar year) energy usage.

Table 3-2 Summary of Savings by Eligible Rate Schedule[5]

Rate Schedule Class	*Total Net Realized kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Realized kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage*
200	293,280	3	97,760	190,121	51.42%	8.08%

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 Custom Pilot Program. The evaluation team employed remote data collection methods to gather project data for estimating savings. Analyses were supported by AMI metering data.

3.2.1.1. Sampling Plan

Data used to estimate the gross savings achieved through the Custom Pilot Program were collected for samples of projects completed during the period January 2023 through December 2023. Data provided by the implementation contractor and utility showed that during the 2023 program year, there were three (3) projects completed under the program that resulted in expected savings of 370,968 kWh annually. The Evaluation Team included a census of projects for verification and ex post savings analysis.

During the implementation of the program, sampling was conducted to collect M&V data in real time. As completed projects accumulated over time, sample selection was distributed throughout the program year. The selection of samples was dependent on the timing of project completion during the program year.

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.

[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 September 1, 2022. 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 2022, not accounting for any accounts for which a full year of 2022 data was unavailable.

Table 3-3 Population Statistics Used for Sample Design

Variable	*Stratum 1*
Strata boundaries (kWh)	> 0
Number of projects	3
Total Expected Annual kWh	370,968
Average kWh Savings	123,656
Std. dev. of kWh savings	116,476
Coefficient of variation	0.94
Final design sample	3

3.2.1.3. Verification Data Collection Procedures

The Evaluation Team used the procedures outlined in Section 2.2.1.3 to collect Custom Pilot Program project data. For custom projects, the team discussed the measurement and verification (M&V) approach with the program implementation contractor before project initiation. In this discussion, the team outlined the data collection requirements for the M&V, which the implementation contractor then collected. Following installation, the team conducted a review of the savings analysis with the implementation contractor.

3.2.2. Participant Survey

The Evaluation Team surveyed program participants to collect data to estimate the net savings of the program. The survey sample is described in Section 2.2.2.

3.3. Estimation of Realized 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 Custom Pilot Program during the period January 2023 through December 2023. Section 2.3.1 describes the methodology used for estimating gross savings. Section 3.3.1 presents the results of 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. Results of Gross Savings Estimation

This section presents the results of the gross savings analysis.

3.3.1.1. Gross Realized kWh Savings

The gross kWh savings achieved by the sampled project under the Custom Pilot Program for the period from January 2023 through December 2023 are summarized by sampling stratum in Table 3-4. Project-level realization rates, along with the overall program-level energy savings and

realization rate, are presented in Table 3-5. In total, the program achieved gross energy savings of 368,855 kWh, which represents 99% of the expected savings.

Table 3-4 Sample Expected and Gross Realized kWh Savings by Sample Stratum

Stratum	*Expected kWh Savings*	*Gross Realized kWh Savings*	*Gross Realization Rate*
Stratum 1	370,968	368,855	99%
Total	370,968	368,855	99%

Table 3-5 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	CCIP2023_002628	257,073	254,960	99%
1	CCIP2023_003092	42,230	42,230	100%
1	CCIP2023_003637	71,665	71,665	100%
All Non-Sample Projects		0	0	n/a
Total		370,968	368,855	99%

Table 3-6 Custom Pilot Program Realized Gross Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*
Compressed Air - Retrofit or Replacement	257,073	254,960	99%
Custom HVAC - Unitary Air Conditioners and Condensing Units	71,665	71,665	100%
Custom HVAC - Water-Source Heat Pumps	42,230	42,230	100%
Total	370,968	368,855	99%

3.3.2. Results of Peak Savings Estimation

The realized gross peak kW reductions of the Custom Pilot Program during the period January 2023 through December 2023 totaled 66.60 kW.

Table 3-7 Custom Pilot Program Realized Gross Peak kW Reductions

Measure Name	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*
Compressed Air - Retrofit or Replacement	39.68	29.10	73%
Custom HVAC - Unitary Air Conditioners and Condensing Units	10.30	10.30	100%
Custom HVAC - Water-Source Heat Pumps	27.20	27.20	100%
Total	77.18	66.60	86%

3.4. Estimation of Realized Net Savings

The procedures for estimating the net savings of the Custom Pilot Program are discussed in Section 2.4.1.

3.4.1. 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 Custom Pilot Program for the period January 2023 through December 2023.

The program realized net energy savings totaling 293,280 kWh. The net-to-gross ratio for the program is 80%.

Table 3-8 Custom Pilot Program Realized Net Energy Savings

Ex Ante Annual kWh Savings	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kWh Savings*	*Ex Post Spillover kWh Savings*	*Ex Post Annual Net kWh Savings*	*Net-to-Gross Ratio*	*Lifetime Net Ex Post kWh Savings*
370,968	368,855	99%	75,575	0	293,280	80%	3,993,756

The realized net peak demand reductions are summarized for the Custom Pilot Program in Table 2-15.

Table 3-9 Custom Pilot Program Realized Peak kW Reductions

Ex Ante Gross kW Savings	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kW Savings*	*Ex Post Spillover kW Savings*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
77.18	66.60	86%	12.33	0.00	54.27	81%

3.5. Process Evaluation

The Evaluation Team completed a process evaluation of the Custom Pilot Program. A summary of program activity based on analysis of program tracking data is presented in Section 3.5.1. Findings related to program operations, participant survey findings, and feedback from trade allies is presented with the findings for the BES Program in Section 2.5.

3.5.1. Summary of Program Participation

Table 3-10 summarizes the program expected savings by end-use and measure type. A compressed air project accounted for nearly 70% of expected savings and the remaining projects involved HVAC measure installations.

Table 3-10 Summary of Program Measures

End Use	*Measure*	*Project Count*	*Percent of Ex Ante kWh Savings*
Compressed Air	Compressed Air - Retrofit or Replacement	1	100%
HVAC	Custom HVAC - Unitary Air Conditioners and Condensing Units	1	63%
	Custom HVAC - Water-Source Heat Pumps	1	37%

Retail, warehouses, industrial facilities, and banks/financial institutions accounted for the largest number of projects for specified building types (see Table 3-11). Overall, the program reached a diverse range of building types in the service area.

Table 3-11 Number of Projects by Building Type

Building Type	*Project Count*
College - Classes/Administrative	1
Retail	1
Not listed	1

3.5.2. Program Operations

Section 2.5.2 summarizes the findings on program operations for the BES, Custom, and SBDI Programs. This section presents information specific to the Custom Pilot Program.

The Custom Pilot Program was launched in January of PY2023, and it is specifically designed for larger industrial customers or larger projects. To qualify for the program, projects must have an expected savings of 50,000 kWh and pass the total resource cost test.

The Custom Pilot Program was designed to meet the unique needs of industrial customers, particularly those in manufacturing and large industrial sectors. Many of their energy-saving

opportunities and processes do not align with the standardized approaches provided by prescriptive programs. These customers require custom designed projects that address their specific energy challenges and opportunities. According to program staff, offering the Custom Pilot Program ensures that these C&I customers have access to energy efficiency solutions that are specifically tailored to their operations, allowing them to maximize their energy savings potential.

The program manager discussed a project in the pipeline involving the design of a tomato grow warehouse. The focus of this project is to encourage the use of efficient grow lights, whose initial high cost will be offset by the program incentives. Although the project had not been formally submitted yet, the company had acquired land and was planning to establish a tomato vegetation grow house. If they opt for the most efficient grow lights, they estimate that over the next five years, they could achieve significant energy savings and realize potential long-term benefits of implementing energy efficient technologies in their operations. By working closely with the company and supporting them in their energy-saving endeavors, the Custom Pilot Program aims to facilitate the adoption of sustainable practices and technologies, resulting in substantial energy savings over time.

3.5.2.1. Quality Control and Project Verification

Applications are submitted electronically, by email, or through the program portal. Each application is reviewed to confirm that all data is provided and that the eligibility requirements are met. The implementation contractor contacts the submitter if any data is incomplete or missing.

Engineering staff then conduct an initial desk review of 1) the proposed measure technologies and verify savings are calculated using accepted engineering principles and source data, 2) that all impactful variables are substantiated by site observations or measurements, and 3) that all project costs and cost sources are accurate and appropriate. Engineering staff then provides a report that summarizes the project scope, calculation methodology, assumptions, discrepancies identified and resolved, initial and revised savings, cost, and incentive. This information is then reviewed further by either a peer or senior engineering staff depending upon level of complexity and incentive value. All projects with an incentive greater than $10,000 undergo a pre-inspection.

Post-inspections are done for 10% of projects and for the first three (3) projects submitted by a Trade Ally.

3.5.3. Trade Ally Interview Findings

The Evaluation Team interviewed one trade ally who participated in the Custom Pilot Program. The purpose of the interview was to gather their insights into the Custom Pilot Program. The following section summarizes the findings from that interview.

Trade Allies' Experience with the Custom Pilot Program, Motivations to Participate, and Service Offerings

The interviewed trade ally's position at their organization is a program manager for their utility solutions. The trade ally provides various business energy efficiency projects and services, including energy management systems, smart thermostats, zone sensors, and duct probe sensors.

They use scheduling, set points, and algorithms to optimize the start and stop of equipment, resulting in energy savings for their customers. Additionally, they sometimes incorporate lighting load controllers for on/off scheduling of lighting, typically at the panel level.

The respondent's initial motivation to become part of the Company's contractor network was driven by the incentives offered by other utilities and the utility incentives, which they believe motivate customers to proceed with energy management system installations. They emphasize that without these incentives, many customers might not pursue their energy efficiency projects, making the incentive programs crucial in driving adoption.

The respondent's business is listed on the Custom Pilot Program website, but they haven't noticed a significant impact in terms of increased volume of calls or emails from customers. However, they do believe that participating in the program has provided benefits, particularly in terms of making their equipment eligible for custom incentives. This eligibility allows them to approach both new and existing customers to encourage them to consider installing an Energy Management System (EMS). They can highlight the impact these incentives can have on reducing the overall project cost for their customers.

Recommendations and Challenges in Promoting High-Efficiency Equipment

The respondent always recommends high-efficiency equipment over less efficient options to their customers within the Company's service territory (efficiency is their primary business focus). The primary barriers or obstacles they observe for customers considering installing efficient equipment include the high initial cost, understanding the potential areas for improvement or lack of technical knowledge, and difficulties in understanding their saving methodology.

To ensure that customers choose efficient equipment over standard equipment, the respondent mentioned that they use case studies and pilot programs. By implementing their energy management system in a few customer locations and demonstrating actual savings and the benefits of their online platform, they aim to encourage customers to adopt efficient equipment and potentially roll it out to the rest of their stores.

Promotion Strategies and Customer Awareness of Incentives

The trade ally uses a tool in collaboration with their salespeople to promote the Custom Pilot Program with the Company's customers. Initially, their salespeople collect site information from the customers, and then they use their tool to identify available incentives. This information is provided to the customers in the early stages of discussions about energy management systems (EMS). They emphasize incentives as part of their value proposition, especially for large national customers who may be eligible for incentives from multiple utility programs. Once the customer decides to move forward, they break down the incentives offered by each utility program and guide the customer through the necessary documentation and preapprovals. For some regional customers, they have more specific conversations about the Company's program, depending on the customer's location and utility programs available.

Customers are made aware of the availability of incentives through the company's business case presented to them. They emphasize incentives as part of their sales strategy, letting customers

know that their projects may qualify for incentives. Customers sometimes know about the Company's incentives before the contractor mentions them.

The trade ally has some generic marketing materials related to the benefits of energy efficiency incentives, but they don't have any specific materials for the Custom Pilot Program. Their current materials are either very generic or specific to other programs they've coordinated with. They didn't mention any improvements that could be made to these materials.

Energy Efficiency Acceptance

The average business's interest in improving the energy efficiency of their buildings has increased compared to the previous 5 years, according to the interviewed trade ally. They do not believe there is anything more the Company could be doing to increase businesses' interest in energy efficiency, but they mentioned that more incentive dollars would always be helpful. Additionally, getting pre-approval quickly can be a challenge due to customers' readiness to install as soon as possible.

Application Process

The trade ally provides support to customers by completing the application on their behalf. They ensure they have the customer's utility account information and have the customer sign the application, which is submitted directly via the portal. In terms of opportunities for improvement in the Custom application process, they mentioned that while the online application is straightforward, there were some issues related to the minimum savings requirement. The program allows combining multiple sites to meet this requirement, but when submitting the application at the per-site level, it doesn't calculate the minimum savings correctly. They suggested improving this aspect of the application process.

Training and Communication with Program Staff

The trade ally received one-on-one training for the Custom Pilot Program, which included a virtual meeting discussing program requirements, a slide deck, and flyers detailing the available programs. They also had a follow-up training session focusing on the online application portal. They found the training to be extremely effective and did not have any suggestions for improvement.

The trade ally's communication with program staff is primarily project-specific, focusing on recent applications, pre-approval requirements, and the status of applications. They communicate with program staff on a monthly basis and have provided feedback during the online portal training. They find email to be the most effective form of communication for receiving information about program changes and updates.

Satisfaction with the Custom Pilot Program

The trade ally was extremely satisfied with their communication with the Company/TRC program staff, giving it a rating of 5. The trade ally was somewhat satisfied with the required paperwork for projects (cited as a 4 on a 5-point Likert scale). However, they rated the incentive amounts lower, with a score of 3. This trade ally was extremely satisfied with the range of program-

qualifying equipment, somewhat satisfied with project turnaround time, and somewhat satisfied with the Custom Pilot Program, overall.

The trade ally provided suggestions for improving the Company's Custom Pilot Program. They emphasized the importance of faster pre-approval processes, ideally within four weeks, to expedite project timelines. Additionally, they recommended increasing incentive amounts, especially in areas with lower incentives, to make the program more attractive to customers. They also mentioned that their sales team tends to focus more on areas with higher incentives and faster pre-approval timeframes, which highlights the significance of competitive incentives in driving program participation and success.

3.6. Findings and Recommendations

A significant portion of savings were attributed to a compressed air project, comprising nearly 70% of the total. The diversity of building types engaged, including retail, warehouses, industrial facilities, and banks/financial institutions, underscores the program's effectiveness in reaching various sectors within its service area. Focusing on both compressed air and HVAC measures has allowed the program to address a wide array of energy efficiency needs across diverse building types.

The interviewed trade ally found significant value in the Company's Custom Pilot Program. They indicated that they leveraged incentives to drive energy management system installations and offering diverse energy efficiency projects with a focus on optimizing equipment operation for substantial savings. The trade ally expressed high satisfaction with communication with the Company/TRC program staff. This trade ally was also somewhat satisfied with the required paperwork, while their rating of incentive amounts was lower. The trade ally was somewhat satisfied with project turnaround time and the Custom Pilot Program overall. Finally, they emphasized the need for faster pre-approval processes (e.g., within four weeks), recommended increased incentives in certain areas, and underscored the role of competitive incentives in driving program participation and success.

The interviewed trade ally acknowledges challenges in recommending high-efficiency equipment to customers, citing barriers such as high initial costs, limited technical knowledge, and difficulties in understanding savings methodology. To encourage adoption, this trade ally employs case studies and pilot programs, showcasing energy management systems to demonstrate actual savings and platform benefits, in addition to available program incentives. Incentives are incorporated into the company's business case that they develop for prospective projects. While the trade ally currently lacks specific materials for the Company's Custom Pilot Program, their existing materials successfully convey the advantages of energy efficiency incentives.

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, called a Quick Energy Checkup (QEC) and targeted cost-effective efficiency measures. The program was open to small businesses with peak monthly demand of 200 kW or less.

Expected kWh savings are shown in Table 4-1. There were 149 projects completed during the 2023 program year that resulted in expected savings of 2,684,887 kWh.

Table 4-1 Expected kWh Savings

Number of Projects	*Total Expected kWh Savings*
149	2,684,887

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 peak demand of 200 kW or less. 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);
- Customers who have reached the $25,000 ceiling for incentive payments; and
- Customers who opted out of the Company's energy efficiency programs.

Lighting projects must meet Consortium for Energy Efficiency (CEE), Design Lights Consortium (DLC), or ENERGY STAR® specifications.

Non-lighting requirements must meet ENERGY STAR, AHRI, CEE, or other certifications as appropriate.

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 4-2 compares the average participant realized 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 realized energy savings as a percentage of average participant baseline (2022 calendar year) energy usage.

Table 4-2 Summary of Savings by Eligible Rate Schedule[6]

Rate Schedule Class	*Total Net Realized kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Realized kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Realized kWh Savings as Percentage of Average Participant Baseline Account-Level kWh Usage*
200	2,022,332	143	14,142	45,526	31.06%	15.08%
300	1,796	1	1,796	17,987,762	0.01%	0.71%

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 telephone communications to collect project data supporting the impact evaluation of the program.

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 2023 through December 2023. Data provided by the implementation contractor showed that during the 2023 program year, there were 149 projects completed under the program which were expected to provide savings of 2,684,887 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 program, the actual precision achieved for the sample was ± 8.2 percent.

[6] 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 2022, not accounting for any accounts for which a full year of 2022 data was unavailable.

4.2.1.2. Population Statistics and Expected Savings

Table 4-3 shows the number of projects, expected energy savings, and sampling statistics, by stratum, of the program sample.

Table 4-3 Population Statistics Used for Sample Design

Variable	*Stratum 1*	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	> 33000	24000 - 33000	12000 - 24000	7000 - 12000	< 7000	
Number of projects	17	19	51	14	48	149
Total Expected Annual kWh	898,892	535,773	911,740	137,273	201,209	2,684,887
Average kWh Savings	52,876	28,199	17,877	9,805	4,192	112,949
Std. dev. of kWh savings	17,363	2,444	2,950	1,523	1,529	25,809
Coefficient of variation	0.33	0.09	0.17	0.16	0.36	
Final design sample	9	2	3	2	1	17

As shown in Table 4-4, the sample projects for the Small Business Direct Install Program account for approximately 25% of total expected kWh savings.

Table 4-4 Sampled Projects Expected Savings by Stratum

Stratum	*Sample Expected kWh Savings*	*Total Expected kWh Savings*
Stratum 1	552,161	898,892
Stratum 2	54,469	535,773
Stratum 3	38,388	911,740
Stratum 4	21,482	137,273
Stratum 5	4,311	201,209
Total	**670,811**	**2,684,887**

4.2.1.3. Verification Data Collection Procedures

The Evaluation Team used telephone interviews to collect data for 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 and reviewed the project documentation.

Staff accomplished three major tasks during the 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 additional documentation needed to analyze the energy savings that have been realized from the installed improvements and measures.

- Third, they obtained additional information on the installed system to complement the data collected from other sources.

The Evaluation Team leveraged AMI metered data to assess operating hours and equipment loads, and in the supplementary IPMVP Option C analysis of the project impacts on building energy use.

4.2.2. Participant Survey

The Evaluation Team surveyed program participants to collect data on the participant's experience with the program and estimate the net savings of the program.

4.2.2.1. Sampling Plan

The Evaluation Team contacted a census of unique customers with contact information available to complete the survey. The list of contacts with projects completed in early December was contacted by email, up to three (3) times, with targeted telephone follow-up with those who did not respond to the email invitations. Customers who completed projects at the end of the year were contacted by email in January 2023 and received up to three (3) emails asking them to complete the survey. Table 4-5 summarizes the data collection effort.

Table 4-5 Summary of SBDI Survey Effort

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Small Business Direct Install Participant Survey	Email	January 2024	46	13
Small Business Direct Install Participant Survey	Email	October 2023	61	6
Total			107	19

4.2.3. Trade Ally Interviews

The Evaluation Team contacted nine C&I trade allies in August 2023 to solicit their participation in a phone interview. The trade allies were offered a $50 gift card in exchange for completing the approximately 30-minute interview. One interview with participating contractors was completed. Multiple attempts (2 emails and 2 phone calls) were made to schedule phone interviews with contractors. The summary of final dispositions from the recruitment attempts are provided in Table 4-6.

Table 4-6 Final Dispositions of Trade Ally Interview Recruitment

Final Disposition	*Count*
Complete	1
Soft refusal	0
No Answer	6
Not eligible	1
Hard refusal	0
Broken appointment	1
Total Contacts	**9**

4.3. Estimation of Realized 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 2023 through December 2023. Section 4.3.1 describes the methodology used for estimating gross savings. Section 4.3.2 presents the results of 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.

4.3.1.1. Review of Documentation and Measure Attributes Tracked

The first step in the evaluation effort was to review project documentation for sampled projects 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.

- Lighting: Equipment specification sheet.
- Pre-rinse spray valve: Project specification sheet.

Table 4-7 presents information on the equipment specification data tracked by the program.

Table 4-7 Gross Impact Attributes Tracked by Program – SBDI

Measure	*Attributes Tracked*
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 (2) 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 rates[7] were calculated for the sampled project for which site-specific data collection and engineering analysis were conducted.

Table 4-8 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 4-8 Sources for Realized Savings Analysis

Measure	*Saving Parameter Sources*
Lighting measures	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) expected 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 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 results of the analysis are reported in this section.

[7] 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).

4.3.2.1. Gross Realized kWh Savings

The sampled project realized gross kWh savings of the SBDI Program during the period January 2023 through December 2023 is summarized by sampling stratum in Table 4-9. Project-level realization rates are displayed in Table 4-10 along with the overall program-level energy savings and realization rate. Overall, the total program-level achieved gross savings of 2,024,128 kWh were equal to less than 75% of the expected savings.

Table 4-9 Sample Expected and Gross Realized kWh Savings by Sample Stratum

Stratum	*Ex Ante kWh Savings*	*Ex Post Annual Gross kWh Savings*	*kWh Gross Realization Rate*
1	552,161	332,657	60%
2	54,469	36,446	67%
3	38,388	35,518	93%
4	21,482	18,995	88%
5	4,311	3,409	79%
Total	670,811	427,025	64%

Table 4-10 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	SBDI2022_001386	54,317	27,540	51%
1	SBDI2022_001886	78,093	23,835	31%
1	SBDI2022_002010	107,301	30,363	28%
3	SBDI2022_002027	12,694	15,398	121%
2	SBDI2022_002059	26,293	9,269	35%
1	SBDI2022_002101	56,720	58,740	104%
1	SBDI2023_002205	56,573	16,862	30%
2	SBDI2023_002479	28,176	27,177	96%
1	SBDI2023_002490	51,731	44,020	85%
1	SBDI2023_002515	53,008	40,451	76%
4	SBDI2023_002653	10,293	10,293	100%
5	SBDI2023_002702	4,311	3,409	79%
3	SBDI2023_002703	12,943	10,204	79%
1	SBDI2023_002912	37,211	32,908	88%
4	SBDI2023_002921	11,189	8,702	78%
3	SBDI2023_002922	12,751	9,916	78%
1	SBDI2023_002962	57,207	57,938	101%

Stratum	*Program Number*	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Project Gross Realization Rate*
All Non-Sample Projects		2,014,076	1,597,103	79%
Total		2,684,887	2,024,128	75%

Table 4-11 Small Business Direct Install Program Realized Gross Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*
Exterior Lighting LED	26,648	22,329	84%
LED Linear Lamp Replacement	1,654,683	1,171,887	71%
Lighting (R, PAR, ER, BR, BPAR)	46,827	31,823	68%
Lighting Delamping	29,524	22,859	77%
Lighting LED Decorative	55,083	38,569	70%
Lighting LED Pin Based	3,162	2,255	71%
Lighting LED Standard	251,598	195,217	78%
Lighting LED Troffer	41,278	29,216	71%
Pre-Rinse Spray Valve	576,084	509,972	89%
Total	2,684,887	2,024,128	75%

In several cases, the realized savings of the sampled projects were significantly less than the expected savings, leading to a lower gross realization rate for the SBDI Program. The factors contributing to the realization rate were:

- Several projects used hours that were greater than the hours developed from information provided by the site contacts. In two cases the sites were churches and the hours used in the expected savings analysis appear to be developed from the space types for "All" buildings listed in the MidAtlantic TRM. These hours are greater than would typically be found for religious buildings and the hours are also larger than the building type hours reported on the project application. Given the prevalence of churches participation in the program the last two years, use of custom hours or the application building type hours in the savings estimations would be preferable in such cases.
- For one project, the baseline energy use was based on the energy use for the fixtures whereas the efficient energy use was based on the energy used by a single lamp in the fixture.
- Wattages from the lamp documentation differed some from the wattages used in the expected savings analysis.
- A subset of lamps was not installed for one project.

We observed some differences in realization rates by trade ally Table 4-12. Although the differences are not statistically significant, and there isn't a financial incentive to provide

information that leads to an overestimation of hours of use (incentives are paid per unit, not for kWh savings), review of trade ally performance may be warranted and in some cases.

Table 4-12 Average Realization Rate for Sample Project by Trade Ally

Trade Ally	*Count of Projects in Sample*	*Average Unweighted Realization Rate*
TA1	8	63%
TA2	8	82%
TA3	1	101%

4.3.3. Results of Peak Savings Estimation

As shown in Table 4-13, the realized gross peak kW reductions of the SBDI Program during the period January 2023 through December 2023 totaled 559.03 kW.

Table 4-13 SBDI Program Realized Gross Energy Savings

Measure Name	*Expected kWh Savings*	*Gross Realized kWh Savings*	*Gross Realization Rate*
Exterior Lighting LED	0.04	0.06	148%
LED Linear Lamp Replacement	290.00	368.21	127%
Lighting (R, PAR, ER, BR, BPAR)	16.60	26.53	160%
Lighting LED Decorative	18.90	32.00	169%
Lighting LED Pin Based	0.93	1.24	134%
Lighting LED Standard	64.45	92.10	143%
Lighting LED Troffer	0.63	0.93	148%
Refrigerated Case Lighting	6.00	8.90	148%
Refrigeration Door Gasket	20.12	29.05	144%
Total	417.67	559.03	134%

4.4. Estimation of Realized Net Savings

The procedures for estimating net savings for the SBDI program were the same as the procedures used for estimating the net savings of the BES program described in Section 2.4.

The free ridership scores calculated following the algorithm outlined above were reviewed by the Evaluation Team.

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 2023 through December 2023.

SBDI Program realized net energy savings totaling 2,024,128 kWh. The net-to-gross ratio for the program is 100%.

Table 4-14 SBDI Program Realized Net Energy Savings

Ex Ante Annual kWh Savings	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kWh Savings*	*Ex Post Spillover kWh Savings*	*Ex Post Annual Net kWh Savings*	*Net-to-Gross Ratio*	*Lifetime Net Ex Post kWh Savings*
2,684,887	2,024,128	75%	0	0	2,024,128	100%	25,262,198

The realized net peak demand reductions are summarized for the SBDI Program in Table 4-15.

Table 4-15 SBDI Program Realized Peak kW Reductions

Ex Ante Gross kW Savings	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Free Ridership kW Savings*	*Ex Post Spillover kW Savings*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
530.17	808.65	153%	0.00	0.00	808.65	100%

4.5. Process Evaluation

The Evaluation Team completed a process evaluation of the Small Business Direct Install Program. The following sections summarize the findings of the process evaluation.

4.5.1. Summary of Program Participation

Table 4-16 summarizes the program savings by measure. Seventy-nine percent of program ex-ante savings resulted from lighting measures, primarily linear lamp replacements (78% of savings) and screw-in A-Type LED lighting (12% of savings).

Table 4-16 Summary of Program Measures

End Use	*Measure*	*Project Count*	*Percent of Ex Ante kWh Savings*
Lighting	Lighting LED Linear Replacement Lamp	101	78%
	Lighting LED Standard A-Type	56	12%
	Lighting LED Other R, PAR, ER, BR, BPAR , or similar bulb	36	2%

End Use	*Measure*	*Project Count*	*Percent of Ex Ante kWh Savings*
	Lighting LED Decorative	16	2%
	Lighting 2 x 4 LED Troffer	3	2%
	Lighting Delamping	4	1%
	Exterior Lighting LED Directional	10	1%
	Lighting LED Globe	9	<1%
	Exterior Lighting LED Omnidirectional	9	<1%
	Lighting LED Pin Based	4	<1%
	Lighting 2 x 2 LED Troffer	2	<1%
	Exterior Lighting LED Decorative	2	<1%
Hot water	Kitchen Pre-Rinse Spray Valve 1.15 GPM	40	100%

Table 4-17 summarizes the share of sites by the number of end-uses that received program improvements. Nearly all sites had measures implemented for a single end-use.

Table 4-17 Share of Sites and the Number of End-Uses Receiving Efficiency Improvements

Number of End Uses	*Share of Sites*
1	99%
2	1%

As shown in the table below, churches accounted for most projects. Aside from those projects, office, restaurants, and retail locations were the most common types of participating business types. accounted for most program projects.

Table 4-18 Number of Projects by Building Type

Building Type	*Project Count*
Church	39
Office (General Office Types)	28
Restaurants	18
Retail	16
Dining: Cafeteria / Fast Food	9
Not listed	7
Dining: Bar Lounge/Leisure	5
Dining: Family	4
Lodging (Hotels/Motels)	4
Office/Retail	3
Warehouse (Not Refrigerated)	3
Workshop	2
Entertainment	2
Schools (Technical/Vocational)	1
Exercise Center	1
Industrial - 1 Shift	1
Hospitals / Health Care	1
Transportation	1
Fast Food Restaurants	1
Manufacturing Facility	1
Small Services	1
Medical Offices	1

Twelve (12) trade ally businesses completed projects during PY2023. As shown, three (3) firms accounted for most program activity.

Table 4-19 Trade Ally Engagement

Trade Ally	*Project Count*	*Listed on Program Website*
Trade Ally 1	47	Yes
Trade Ally 2	4	Yes
Trade Ally 3	1	Yes
Trade Ally 4	1	Yes
Trade Ally 5	1	Yes
Trade Ally 6	1	Yes
Trade Ally 7	1	Yes
Trade Ally 8	1	Yes
Trade Ally 9	54	No
Trade Ally 10	31	No
Trade Ally 11	4	No
Trade Ally 12	3	No

4.5.2. Program Operations

Section 2.5.2 summarizes the findings on program operations for the BES, Custom, and SBDI Programs. This section presents information specific to the SBDI Program.

There have been no significant changes to the design or implementation of the Small Business Direct Program in the past year. However, in April 2023, SBDI lighting incentives were temporarily halted due to concerns about the incentive cost per kWh saved. The company worked with its implementation contractor to establish caps on the incentive cost per kWh saved, which led to the resumption of lighting incentive projects.

4.5.2.1. Small Business Marketing and Engagement

To ensure small businesses are aware of and engaged with the program, several approaches are employed. Feedback from surveys sent to participants is used to gauge their awareness and engagement. The program also strives to have a diverse range of participants across different business types, such as offices and restaurants. Marketing campaigns and ongoing outreach efforts are key strategies to promote awareness and engagement.

An effort was made to increase restaurant participation in the Small Business Direct Install Program. These efforts included an email campaign and the distribution of a kitchen equipment flyer, with a specific focus on promoting the installation of spray valves. As a result of these efforts, a contractor was able to successfully install spray valves in several restaurants that had not participated in the program previously.

Recognition for small business participants was offered in PY2023 in the form of a badge and a window cling. The badge can be displayed on the participants' websites, while the window cling can be displayed in their physical locations. The design of the badge and window cling will be

changed annually, beginning in 2025, to indicate the year of participation, allowing businesses to accumulate multiple window clings over time.

4.5.2.2. Quality Control and Project Verification

Trade allies submit applications electronically, by email, or through the program portal. Each application is reviewed to confirm that all data is provided and that the eligibility requirements are met. The implementation contractor contacts the submitter if any data is incomplete or missing.

Projects with more than $1,000 in incentives undergo a project review by the implementation contractor for approval.

All projects with greater than $10,000 in incentives receive pre-and/or post-inspections and 10% of projects below $10,000 in incentives are inspected.

Additionally, pre- and post-installation inspections are performed for the first five (5) projects implemented by each trade ally.

4.5.3. Trade Ally Interview Findings

The Evaluation Team interviewed one trade ally who participated in the Small Business Direct Install (SBDI) program. The purpose of the interview was to gather their insights into the SBDI program. The following section summarizes the findings from that interview.

Experience with SBDI, Motivations to Participate, and Service Offerings

The trade ally's business primarily focuses on lighting, lighting controls, VFDs (Variable Frequency Drives), and other non-lighting energy efficiency projects and services.

The trade ally's initial motivation to join the Company's contractor network was primarily driven by their background in lighting and controls. The SBDI program presented an opportunity to further enhance their work in energy efficiency, specifically lighting focused projects. Their role included conducting payback studies to demonstrate the potential energy cost savings associated with LED lighting upgrades. Partnering with the program provided an additional incentive and complemented their existing efforts in promoting energy-efficient solutions. The process to become a qualified contractor involved working closely with the local representative and attending meetings where the necessary steps were explained.

The interviewed trade ally's business is listed on the SBDI program website. While the trade ally mentioned that they are listed on the SBDI program website they expressed difficulty in tracking the specific impact on their business since they do not closely monitor the sources of their leads. They acknowledged being a prominent distributor in their area and suggested that their listing on the website likely contributes to their business volume, although they do not have concrete data to confirm this.

The trade ally highlighted the significant benefits of participating in the program, emphasizing that it provides added value to their customers. They mentioned that it helps them secure deals and

encourage customers to take advantage of energy-saving opportunities offered through the program.

Small Business Recruitment and Program Navigation

The trade ally takes the lead in recruiting small businesses for the program. When they receive an inquiry from a potential customer interested in upgrading their lighting, they provide quotes, conduct layouts, and perform payback studies. During this process, they include information about the Company's incentives and how they impact project costs. If the customer expresses interest, the trade ally assists in completing the online application.

Once the application is prepared, the trade ally engages with the customer to provide more detailed program information and assist with paperwork. The project is then submitted for program approval. Once received, the trade ally works closely with the customer to complete the installation and ensure that all necessary steps are taken for the rebate.

To market the program, the trade ally integrates it into payback studies and quotes for energy-efficient lighting upgrades. They emphasize energy savings achievable with new fixtures and highlight the added Companies' incentives. They also share relevant information from the Company's website, including program overviews and useful links. Leveraging their trust and expertise, they inform customers about the program and potential rebates, generating interest and guiding them through the process. Customers typically respond positively, with eligibility and the application process being their main concerns. The trade ally assists with paperwork and qualification steps.

The trade ally thinks that SBDI program marketing materials are effective for customer recruitment. When recruiting customers, they explain the program requirements for the lighting fixtures (i.e., DLC listing and ENERGY STAR certification) and stress the benefits of investing in quality, long-lasting, and efficient fixtures. They also guide customers through the application process, sometimes opening the application with them for a visual guide. They highlight the valuable assistance provided by the Company's representative, who contacts customers for guidance and to address any questions they may have.

The program eligibility checks are typically done through the Company. The trade ally provides project information and locations, with the Company verifying customer eligibility.

The trade ally suggests that larger projects, particularly those done with higher energy users are more likely to be interested in participating in the program due to the incentives available, and for this reason they tend to target larger qualifying companies to participate.

Training and Communication with Program Staff

The trade ally received training for the SBDI program in 2023 through online sessions and Zoom calls. They found the training to be effective. They did not believe additional training opportunities were necessary at this time. The trade ally suggests that while the training for lighting is sufficient, there may be room for improvement in the training for non-lighting aspects of the program.

Trade Allies' Satisfaction with SBDI

The interviewed trade ally was satisfied with the communication with the Company/TRC program staff, the required paperwork for projects, the incentive amounts, the range of program-qualifying equipment, the project turnaround time, and the program, overall (cited as a 4 or 5 on a 5-point Likert scale).

The Company has made improvements to the SBDI program's paperwork process since the trade ally's initial involvement. According to the trade ally, the process has become significantly easier and more streamlined over time. Initially, they felt they had to handle much of the legwork themselves, but now, the Company has taken on more of the administrative responsibilities. When asked about suggestions for further improvements, the trade ally expressed satisfaction with the current state of the program and did not have any specific recommendations for enhancement.

4.5.4. Participant Survey Findings

4.5.4.1. Project Initiation

Program awareness often originated from trade allies and word-of-mouth referrals. Trade allies and friends or colleagues were the initial source of awareness for 56% of respondents (Figure 4-1). Other sources included program representatives, the Company's account representatives, and the Company's website. In most cases (68%) participants reported that the trade ally they worked with signed them up for the program, while others (16%) reported that they used the online portal (Table 4-20)

Figure 4-1 Initial Source of Program Awareness

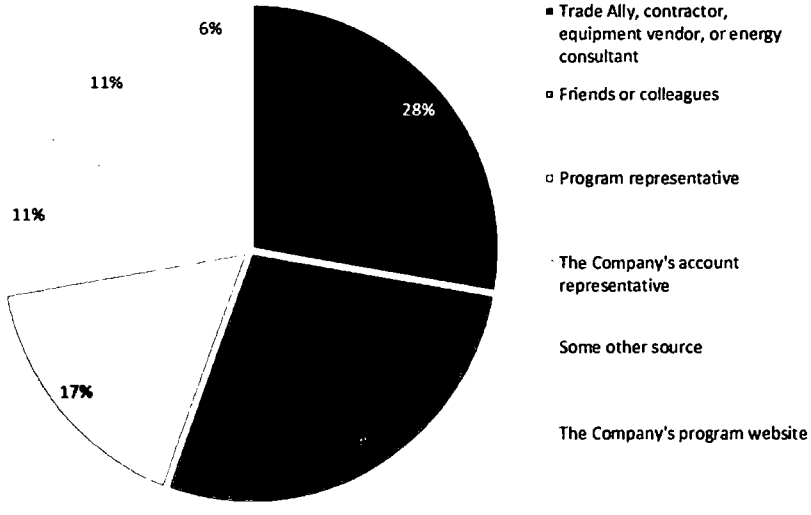


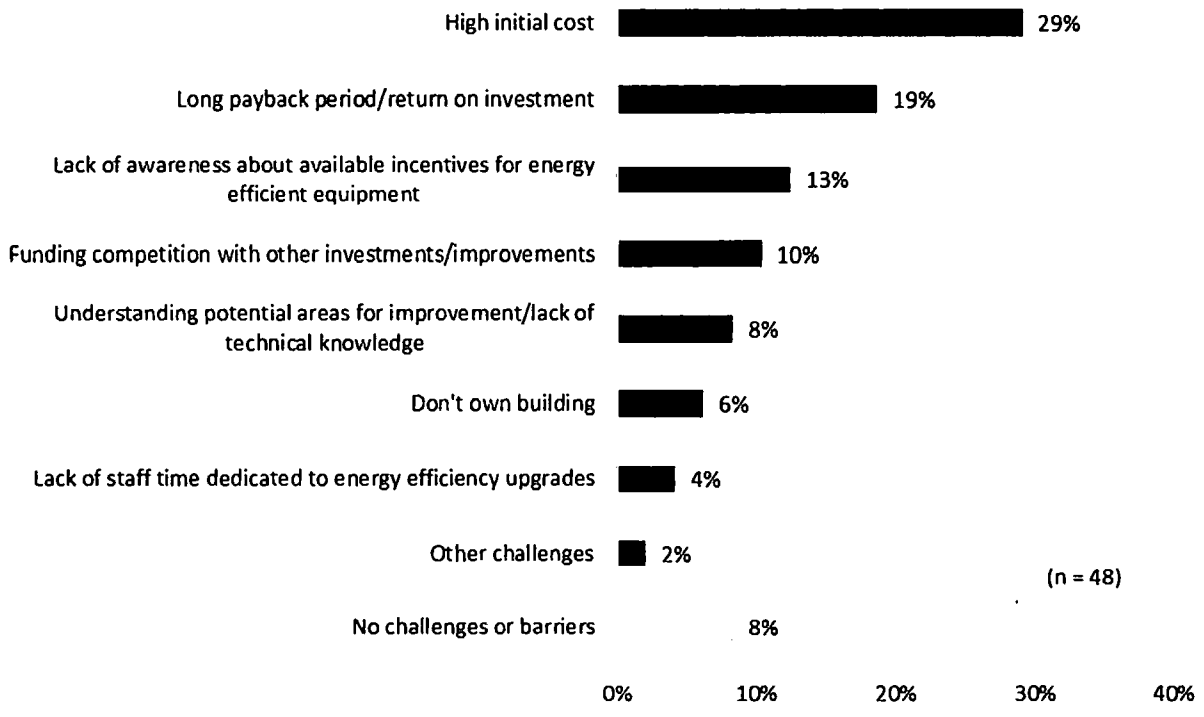
Table 4-20 How Participants Signed Up for the Program

How Participants Signed Up for the Program	*Percent of Respondents (n = 19)*
The contractor or trade ally you hired signed you up	68%
Used the online portal	16%
Program representative assisted	11%

4.5.4.2. Barriers to Efficiency

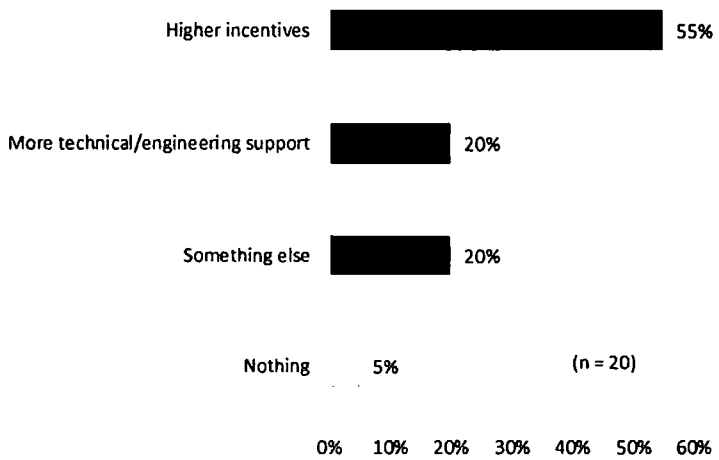
The most frequently mentioned barrier to energy efficiency was the perceived high initial cost; however, participants also identified the long payback period/ROI as an additional obstacle. The most common identified barrier was high initial cost, as mentioned by 29% of respondents (see Figure 4-2). The long payback period/return on investment was mentioned by 19%, while 13% highlighted a lack of awareness about available incentives. Other challenges mentioned by some survey participants included funding competition with other investments/improvements, understanding potential areas for improvement/lack of technical knowledge, not owning the building, and a lack of staff time dedicated to energy efficiency upgrades. Eight percent stated that they faced no challenges or barriers. The SBDI program aims to overcome these barriers by offering incentives to lower costs and providing energy assessments to assist customers in identifying and designing efficiency improvement projects.

Figure 4-2 Barriers to Energy Efficiency



Participants shared their recommendations for the Company to assist organizations in overcoming challenges when investing in energy efficient equipment. The responses revealed that 55% recommended higher incentives levels, while 20% suggested more technical/engineering support (see Figure 4-3). Other suggestions included a desire for more options on qualifying equipment and efforts to increase awareness of existing programs. One participant emphasized the need to avoid cost increases, stating that efficiency gains should not result in higher overall costs if energy rates continue to rise. Five percent said nothing could be done to overcome the challenges.

Figure 4-3 How the Company Can Assist Organizations with Energy Efficiency



4.5.4.3. Experience with the Quick Energy Check-Up (QEC)

Less than half of the participants recalled that the contractor they worked with completed the QEC and all said it provided them with the information they needed to act on the recommendations. As shown in Table 4-21, 55% of respondents were not sure if a QEC was done or said that the contractor didn't complete one. This may be due to the respondents not being the individuals interacting with the contractor because they do not recognize the service provided as a "QEC." Regardless, among those that recalled the QEC, 88% thought it provided the information they needed to act on the recommendations, while 13% were not sure.

Table 4-21 Awareness of QEC

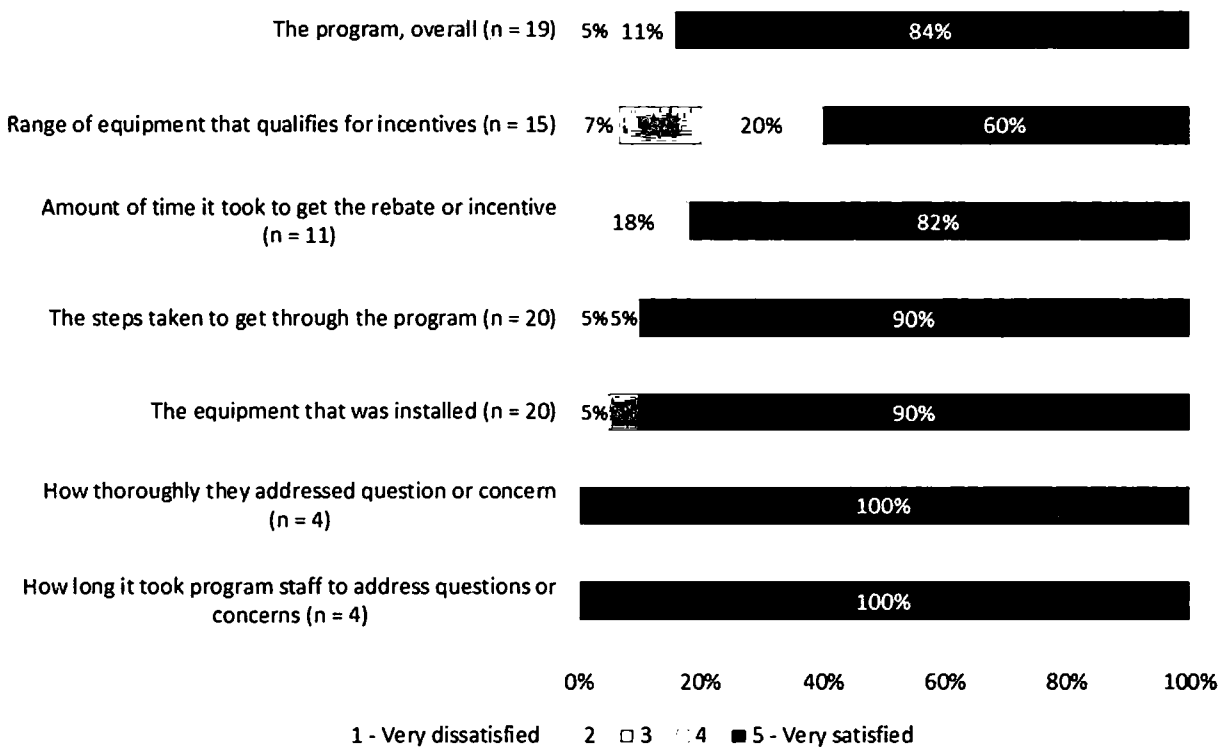
Awareness of Quick Energy Check-Up	*Percent of Respondents (n = 20)*
Contractor completed a QEC	45%
Contractor did not complete QEC	25%
Not sure	30%

Most respondents reported that they implemented all the measures recommended to them. Sixty-three percent of respondents said they implemented all the measures recommended, while 25% did not and 13% were unsure. One customer did not choose to move forward with lighting improvements, and another did not choose the hot water heater improvements (such as hot water pipe insulation or low flow devices). The reasons provided for not choosing to make the improvements included not wanting to spend the money and that there was not a program incentive for the recommended improvements.

4.5.4.4. Participant Satisfaction

Participants were generally satisfied with the program. As shown in Figure 4-4, 95% of participants were satisfied with the program overall, while 5% (one respondent) reported that they were dissatisfied with it. Eighty percent of participants were satisfied with the range of equipment that qualifies for the program. Additionally, all respondents were satisfied with the time to get the rebates. Every respondent who engaged with program staff expressed high satisfaction with the responsiveness and thoroughness of the program staff in addressing their questions. The participant who expressed dissatisfaction with certain aspects of the program was disappointment in being informed that the program only covered 4-foot 4-bulb fixtures, leaving 2-foot fixtures untouched. This issue may have resulted from a misinformed contractor because the program does include 2 foot lamps and fixtures. Additionally, there was disappointment in funds running out, which resulted in their project not being fully completed, which may reference the hold placed on lighting measures needed to control the program incentive budget.

Figure 4-4 Participant Satisfaction



Survey participants provided a few suggestions for improving the program or enhancing energy efficiency in commercial and industrial facilities. These included a desire for expanded program eligibility to cover items like 2x2 LED Troffer (which are included in the program) and fixtures with translucent faces. Another suggestion was an extension of the completion period, proposing an increase from six months to a year for installing equipment.

4.5.4.5. Firmographics

The building types of respondents are shown in Figure 4-5. The distribution of respondents by industry sectors is as follows: 45% were churches, 20% were retail, 10% were restaurants (not fast food), 10% were offices, 5% were industrial, 5% were fast food, and 5% were funeral homes. Additionally, as shown in Table 4-22 a majority of participants operated a single location in the Company's service area.

Figure 4-5 Participant Building Types

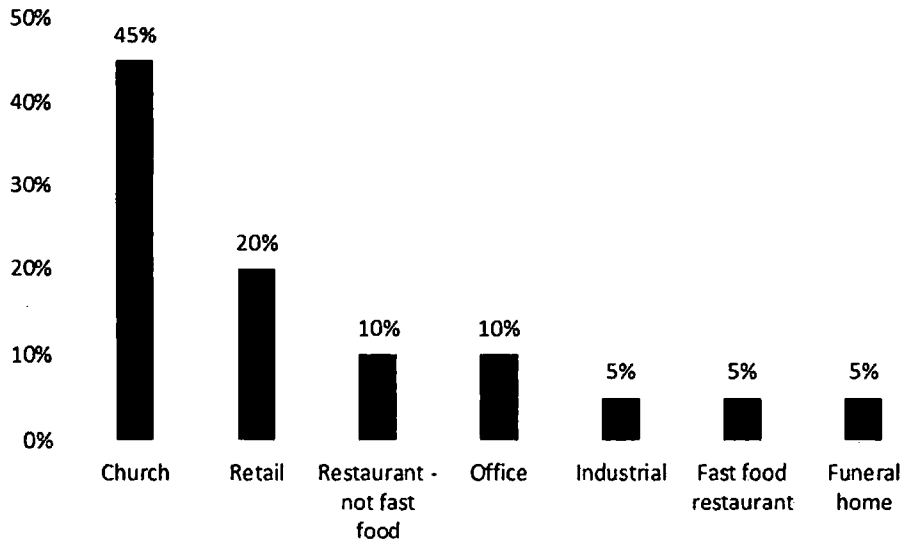


Table 4-22 Number of Locations

Number of Locations	*Percent of Respondents (n = 15)*
1	67%
2	7%
3	7%
4	7%
19	7%
20	7%

4.6. Findings and Recommendations

In several cases, the realized savings of the sampled projects were significantly less than the expected savings, leading to a lower gross realization rate for the SBDI Program. The most influential factor was the hours used to estimate energy savings. In some cases, the hours referenced in the MidAtlantic TRM were not appropriate for the building type and differed from hours captured on the application form.

- **Recommendation 1:** Review procedures for estimating hours to leverage application data or alternative sources when an applicable building type is not listed in the MidAtlantic TRM.

Lighting measures accounted for the majority of program savings. Expected savings for lighting measures accounted for 79% of total program expected savings. Linear lamp replacements and screw-in A-Type LED lighting emerged as the predominant contributors to lighting. The program completed the largest share of projects within churches, indicating a prevailing focus on

this sector. Additionally, twelve trade allies completed projects in 2023, with three of those accounting for the majority of projects.

The interviewed trade ally underscored the benefit of participating in the SBDI program. The interviewed trade ally specializes in lighting, lighting controls, VFDs, and other non-lighting energy efficiency projects. They joined the Company's contractor network with an initial motivation rooted in their expertise in lighting and controls. While listed on the SBDI program website, tracking specific impacts is challenging, yet they acknowledge the likely contribution to their business volume.

The interviewed trade ally expressed overall satisfaction with communication, required paperwork, incentive amounts, program-qualifying equipment, project turnaround time, and the program, overall. The Company has improved the SBDI program's paperwork process since the trade ally's initial engagement, resulting in an easier and more streamlined experience. The trade ally acknowledges the Company's increased involvement in administrative responsibilities, highlighting satisfaction with the current state of the program.

Participants expressed satisfaction with the program. A significant majority (95%) reported overall satisfaction. Furthermore, all respondents who interacted with program staff indicated satisfaction with these interactions. High levels of satisfaction were also noted for the process required to complete participation, the installed equipment, and the timeframe for receiving the rebate.

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 (5) 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

Program Year	*Number of Projects*	*Reported kWh Savings*	*Reported kW Savings*
PY2023	13	129,072,308	-

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.				✓		✓		✓

Detailed results of program-level cost effectiveness testing is presented below in Table 6-2 through Table 6-5.

Table 6-2 Business Energy Solutions Program – Lighting Cost Effectiveness Test Results

Variable	*PCT*		*UCT*		*RIM*		*TRC*	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 866,230			$ 866,230		$ 866,230		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 18,625,248							
Lost Revenue (NPV)						$ 18,625,248		
Avoided Energy Costs (NPV)			$ 6,231,537		$ 6,231,537		$ 6,231,537	
Avoided Capacity Costs (NPV)			$ 3,690,533		$ 3,690,533		$ 3,690,533	
Avoided T&D Costs (NPV)			$ 5,126,597		$ 5,126,597		$ 5,126,597	
Incremental Costs		$ 2,116,613						$ 2,116,613
Program Overhead Costs				$ 637,784		$ 637,784		$ 637,784
Total Benefits	$ 19,491,478		$ 15,048,667		$ 15,048,667		$ 15,048,667	
Total Costs	$ 2,116,613		$ 1,504,014		$ 20,129,262		$ 2,754,397	
Test Score	9.21		10.01		0.75		5.46	

Table 6-3 Business Energy Solutions Program – Non-Lighting Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 65,188			$ 65,188		$ 65,188		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 1,152,835							
Lost Revenue (NPV)						$ 1,152,835		
Avoided Energy Costs (NPV)			$ 383,314		$ 383,314		$ 383,314	
Avoided Capacity Costs (NPV)			$ 117,493		$ 117,493		$ 117,493	
Avoided T&D Costs (NPV)			$ 165,047		$ 165,047		$ 165,047	
Incremental Costs		$ 134,536						$ 134,536
Program Overhead Costs				$ 183,045		$ 183,045		$ 183,045
Total Benefits	$ 1,218,024		$ 665,854		$ 665,854		$ 665,854	
Total Costs	$ 134,536		$ 248,234		$ 1,401,069		$ 317,581	
Test Score	9.05		2.68		0.48		2.10	

Table 6-4 Business Energy Solutions Program - Total Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 931,419			$ 931,419		$ 931,419		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 19,778,083							
Lost Revenue (NPV)						$ 19,778,083		
Avoided Energy Costs (NPV)			$ 6,614,851		$ 6,614,851		$ 6,614,851	
Avoided Capacity Costs (NPV)			$ 3,808,027		$ 3,808,027		$ 3,808,027	
Avoided T&D Costs (NPV)			$ 5,291,644		$ 5,291,644		$ 5,291,644	
Incremental Costs		$ 2,251,148						$ 2,251,148
Program Overhead Costs				$ 820,829		$ 820,829		$ 820,829
Total Benefits	$ 20,709,502		$ 15,714,521		$ 15,714,521		$ 15,714,521	
Total Costs	$ 2,251,148		$ 1,752,248		$ 21,530,331		$ 3,071,978	
Test Score	9.20		8.97		0.73		5.12	

Table 6-5 Small Business Direct Install Program Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 434,809			$ 434,809		$ 434,809		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 2,258,705							
Lost Revenue (NPV)						$ 2,258,705		
Avoided Energy Costs (NPV)			$ 738,644		$ 738,644		$ 738,644	
Avoided Capacity Costs (NPV)			$ 894,310		$ 894,310		$ 894,310	
Avoided T&D Costs (NPV)			$ 1,242,305		$ 1,242,305		$ 1,242,305	
Incremental Costs		$ 838,448						$ 838,448
Program Overhead Costs				$ 286,032		$ 286,032		$ 286,032
Total Benefits	$ 2,693,514		$ 2,875,259		$ 2,875,259		$ 2,875,259	
Total Costs	$ 838,448		$ 720,841		$ 2,979,546		$ 1,124,480	
Test Score	3.21		3.99		0.96		2.56	

7. Carbon Emissions Reduction

The Evaluation Team developed estimates of avoided carbon emissions associated with estimates of program energy savings impacts. This was accomplished by applying the utility-specific residual mix emissions rate of approximately 1,384 lbs CO2/MWh to the applicable estimates of energy savings.[8]

Separate estimates of avoided carbon emissions are developed for each of the four energy savings estimates:

- Annual ex post gross;
- Annual ex post net;
- Lifetime ex post gross; and
- Lifetime ex post net.

Avoided emissions (*avoided_emissions*) estimates are calculated as follows:

avoided_emissions = emissions_rate * *energy_savings* / 2,204.62

where:

energy_savings is the applicable energy savings value, in megawatt-hours;

emissions_rate is the estimated pounds of carbon emissions per megawatt-hour; and

2,204.62 is the number of pounds per metric ton.

Table 7-1 presents the estimates of avoided carbon emissions

Table 7-1 Avoided Carbon Emissions (Metric Tons)

Program Name	*MWh Savings Referenced*			
	Annual Ex Post Gross	*Annual Ex Post Net*	*Lifetime Ex Post Gross*	*Lifetime Ex Post Net*
Business Energy Solutions Program	11,947	9,499	178,848	142,203
Small Business Direct Install Program	1,271	1,271	15,861	15,861
Custom C&I Pilot Program	232	184	3,154	2,507
Opt Out Customers	81,037	81,037	81,037	81,037
C&I Portfolio Totals	**94,486**	**91,991**	**278,898**	**241,608**

[8] Edison Electric Institute, *Emissions Electric Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers* (May 2023). Value referenced is applicable to Appalachian Power Company.

Part 1

2023 Virginia Commercial & Industrial Program EM&V Report

Volume II of II

Prepared for:

Appalachian Power Company

February 2024

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Table of Contents

1. Introduction 1
2. Site-Level Estimation of Ex Post Gross Energy Impact 2
2.1. BES, CCIP and BES Projects 4
3. C&I Program Participant Survey Instrument 108
4. C&I Program Participant Survey Results 138
4.1. BES 138
4.2. SBDI 171
5. Confidential: EM&V Costs 201

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 2023.

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 2023 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 Realized Gross Energy Impact
- Chapter 3: C&I Program Participant Survey Instrument
- Chapter 4: C&I Program Participant Survey Results

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 expected and realized kWh savings of sampled PY2023 BES, CCIP, and SBDI program projects. Following the table are individual site reports, which are provided in the order in which the applicable project IDs are listed in the table below.

BES, SBDI Program Realized Energy Savings

Project ID	*Ex Ante kWh*	*Ex Post kWh*	*Gross Realization Rate*	*Ex Post kW*
BES				
BES2022_000407	95,681	95,681	100%	18.75
BES2022_000846	116,164	264,694	228%	48.31
BES2022_000976	169,102	167,041	99%	53.37
BES2022_001035	194,461	177,448	91%	33.25
BES2022_001076	1,132,038	1,134,337	100%	268.05
BES2022_001426	688,489	848,264	123%	133.83
BES2022_001971	158,424	156,723	99%	45.22
BES2022_002003	904,842	1,062,494	117%	210.14
BES2022_002018	185,007	392,043	212%	65.64
BES2023_002176	35,905	25,629	71%	8.33
BES2023_002390	750,242	531,495	71%	170.82
BES2023_002402	447,306	447,306	100%	78.96
BES2023_002425	4,587	5,269	115%	1.02
BES2023_002499	39,548	27,872	70%	8.93
BES2023_002500	50,919	60,527	119%	13.86
BES2023_002509	13,515	16,159	120%	3.75
BES2023_002510	50,687	45,873	91%	10.56
BES2023_002545	142,796	19,763	14%	19.76
BES2023_002546	66,965	19,120	29%	19.12
BES2023_002957	620,417	620,303	100%	146.58
BES2023_003753	469,448	322,282	69%	93.24
BES2023_003853	470,136	772,533	164%	115.53
BES Total	**6,806,679**	**7,212,856**	**106%**	**1,566.98**
CCIP				
CCIP2023_002628	257,073	254,960	99%	29.10
CCIP2023_003092	42,230	42,230	100%	27.2
CCIP2023_003637	71,665	71,665	100%	10.3
CCIP Total	**370,968**	**368,855**	**99%**	**66.60**
SBDI				
SBDI2022_001386	54,317	27,540	51%	13.82
SBDI2022_001886	78,093	23,835	31%	23.41
SBDI2022_002010	107,301	30,363	28%	26.67
SBDI2022_002027	12,694	15,398	121%	5.92

Project ID	*Ex Ante kWh*	*Ex Post kWh*	*Gross Realization Rate*	*Ex Post kW*
SBDI2022_002059	26,293	9,269	35%	4.58
SBDI2022_002101	56,720	58,740	104%	21.36
SBDI2023_002205	56,573	16,862	30%	13.93
SBDI2023_002479	28,176	27,177	96%	22.96
SBDI2023_002490	51,731	44,020	85%	15.59
SBDI2023_002515	53,008	40,451	76%	33.85
SBDI2023_002653	10,293	10,293	100%	3.74
SBDI2023_002702	4,311	3,409	79%	2.00
SBDI2023_002703	12,943	10,204	79%	6.00
SBDI2023_002912	37,211	32,908	88%	16.61
SBDI2023_002921	11,189	8,702	78%	5.22
SBDI2023_002922	12,751	9,916	78%	5.95
SBDI2023_002962	57,207	57,938	101%	13.04
SBDI Total	**670,811**	**427,025**	**64%**	**234.65**
Program Total	***7,848,458***	***8,008,736***	***102%***	***1,868.26***

2.1. BES, CCIP and BES Projects

2.1.1. Project Number: BES2022_000407

Executive Summary

Under project BES2022_000407, a program participant received incentives from Appalachian Power for replacing high bay linear lamp fixtures with LED high bay fixtures.

The verified annual energy savings are 95,681 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for replacing (125) Fluorescent fixtures with (125) LED high bay fixtures.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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 fixture to LED high bay fixture	125	125	405	255	5,103	1	95,681	95,681	100%
Total							95,681	95,681	100%

Results

BES2022_000407 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	95,681	95,681	100%	18.75	714,000
Total	**95,681**	**95,681**	**100%**	**18.75**	

The realized energy savings are 95,681 kWh, resulting in a gross energy savings realization rate of 100%. All the factors used to estimate the savings were collected, with the same values as found in the application.

The realized energy savings estimate is equal to 13% of 2022 annual usage.

Ancillary Econometric Analysis

The econometric analysis is not presented. A visual review of the billing data indicates a continuous increase in energy usage each month. The energy is independent of the available variables, such as weather and occupancy. Production data was not provided for the evaluation.

2.1.2. Project Number: BES2022_000846

Executive Summary

Under project BES2022_000846, a program participant received incentives from Appalachian Power for replacing high bay fixtures and exit signs with LED fixtures and occupancy sensors.

The realized energy savings are 264,694 kWh resulting in a gross energy savings realization rate of 228%.

Project Description

The participant received incentives for replacing (9) 2x4 troffers, (115) high bay fixtures, (8) incandescent exit signs with (9) 32W LED high bay fixtures, (115) 43.9W LED strip fixtures, (8) 1W LED exit signs and (33) occupancy sensors in a warehouse facility operating on a 24/7 schedule.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the product installed, operating hours, and heating and cooling in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*

Occupancy sensor energy savings are calculated as:

$$kWh_{savings} = kW_{connected} \text{ x Hours x } SVG_e \text{ x ISR x } WHF_e$$

Where:

$kWh_{connected}$	*= Assumed kW lighting load connected to control*
Hours	*= Deemed average hours of use per year*
SVG_e	*= Percentage of annual lighting energy saved by lighting control*
	=.28
ISR	*= In Service Rate*
	=1.00
WHF_e	*= Waste Heat Factor for Energy to account for cooling and heating impacts from efficient lighting*

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					
Troffer to LED high bay	9	9	128	32	8,760	1.02	3,030	7,720	255%
high bay to LED Strip	115	115	279	43.9	8,760	1.02	94,770	241,577	255%
incandescent Exit Sign to LED Exit Sign	8	8	30	1	8,760	1.02	2,195	2,073	94%
Total							99,995	251,356	251%

Occupancy Sensor Energy Savings Calculations

Measure	Quantity (Occ Sens)	Controlled Wattage	Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Efficient	Efficient					
Occupancy Sensor	33	161.4	8,760	1.02	16,169	13,324	82%
Total					16,169	13,324	82%

Results

BES2022_000846 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	99,995	251,356	251%	34.60	Not available
Occupancy Sensor	16,169	13,324	82%	13.70	
Total	**116,164**	**264,694**	**228%**	**48.31**	

The realized energy savings are 264,694 kWh, resulting in a gross energy savings realization rate of 228%. The difference between the expected and realized savings estimates is due to the following factors:

- The ex post savings analysis confirmed that the site operates 24/7/365, the annual hours of use are 8,760 and not 3,438 hours used in the ex ante savings estimate. The 8,760 hours were applied to all measures but noticeably to the exit signs which automatically remain in use.
- The occupancy sensor savings were overestimated. The TRM savings are based on a 28% savings on the usage. In addition, the ex post savings analysis found that a higher connected load was used in the ex-ante instead of the connected load confirmed with the site contact.

Ancillary Econometric Analysis

The new lighting is associated with the change of usage of an existing space that was remodeled for the new tenant. Without similar baseline usage data, the Option A method provides the best estimate of energy savings.

2.1.3. Project Number: BES2022_000976

Executive Summary

Under project BES2022_000976, a program participant received incentives from Appalachian Power for installing LED lamps to the interior and exterior of their facility.

The realized energy savings are 167,041 kWh, resulting in a gross energy savings realization rate of 99%.

Project Description

The participant received incentives for installing (858) LED downlights, (7) LED recessed fixtures, (18) LED garage luminaires, (11) LED area lights, (8) LED exit signs, (570) LED candelabra lamps, and (39) LED A-19 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
Downlight to LED Downlight	826	826	32	16	4,380	0.93	45,777	53,834	118%
Downlight to LED Downlight	32	32	32	17	4,380	0.93	1,773	1,955	110%
Troffer to LED Recessed	7	7	128	30.4	4,380	0.94	1,881	2,813	150%
Exterior Lighting to LED Garage Luminaire	11	11	95	54	8,678	1	3,914	3,914	100%
Exterior Lighting to LED Garage Luminaire	4	4	95	54	8,678	1	1,423	1,423	100%
Area Light to LED Area Light	7	7	295	73	3,604	1	5,676	5,601	99%
Area Light to LED Area Light	4	4	295	73	3,604	1	3,244	3,200	99%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Exit Sign to LED Exit Sign	8	8	30	1	8,760	0.94	1,910	1,910	100%
Candelabra to LED Candelabra	570	570	43	5.5	4,380	0.93	99,325	87,069	88%
incandescent to LED A-19	39	39	43	9.5	4,380	0.93	4,177	5,322	127%
Total							169,102	167,041	99%

Results

BES2022_000976 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	169,102	167,041	99%	53.37	5,075,000
Total	**169,102**	**167,041**	**99%**	**53.37**	

The realized annual energy savings are 167,041 kWh, resulting in a gross energy savings realization rate of 99%. The expected savings estimate differed from the realized savings for the following reasons:

- The ex post savings analysis confirmed the interior hours as 7 days a week/ 12 hours per day (4,380) which are greater than the ex-ante hours (3,438).
- There was no documentation for the base wattage of the first 2 measures. The site contact could not remember what the base lamps were. The ex-post used a reasonable wattage of 32W for the base recessed lamps.
- The efficient specification for the second measure (17W) is greater than the ex-ante efficient wattage (16W).

The realized energy savings estimate is equal to 3% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	11,002	0.6
HDD	65	0.0
Days	11,724	3.4
Post_Flag	3,476	0.0
Intercept	96,288	0.7

The *Post_Flag* coefficient was not statistically significant. The lack of statistical significance is likely due to the efficiency project savings accounting for a small portion of total energy use.

2.1.4. Project Number: BES2022_001035

Executive Summary

Under project BES2022_001035, a program participant received incentives from Appalachian Power for upgrading to LED lighting in their facility.

The realized energy savings are 177,448 kWh, resulting in a gross energy savings realization rate of 91%.

Project Description

The participant received incentives for installing (6) LED 2x2 panels. (31) LED 2x4 panels, (8) LED 4' high bays, (1) LED 4' linear kits, (11) LED 8' high bays, (328) LED 8' linear kits, (10) LED 4' lamps, and (11) LED 8' lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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					
Troffer to LED 2x2 Panel	6	6	60	40.26	4,380	1.08	956	560	59%
Troffer to LED 2x4 Panel	27	27	105	53.9	8,760	1.08	10,988	13,054	119%
Troffer to LED 2x4 Panel	2	2	80.8	53.9	2,920	1.08	428	170	40%
Troffer to LED 2x4 Panel	2	2	118	53.9	6,205	1.08	1,021	859	84%
Luminaire to LED 4' lamp	1	1	52	23.8	6,205	1.08	217	189	87%
high bay to LED 4' Linear Kit	10	10	52	26.65	6,570	1.08	2,047	1,799	88%
high bay to LED 8' Linear Kit	25	25	124	50.8	6,570	0	14,952	12,985	87%
Luminaire to LED 8' lamp	11	11	124	47.7	6,570	1.08	6,614	5,955	90%
high bay to LED 8' Linear Kit	303	303	124	60.33	6,570	1.08	152,795	136,888	90%
high bay to LED high bay	8	8	59	37.8	6,570	1.08	1,072	1,203	112%
high bay to LED 8' high bay	11	11	124	75.5	6,570	1.08	3,371	3,786	112%
Total							194,461	177,448	91%

Results

BES2022_001035 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	194,461	177,448	91%	33.25	1,256,640
Total	**194,461**	**177,448**	**91%**	**33.25**	

The realized energy savings are 177,448 kWh, resulting in a gross energy savings realization rate of 91%. The expected savings estimate differed from the realized savings for the following reasons:

- The site verified hours of operation (2,920, 4,380, 6,570, and 8,760) differ from the hours used in the ex ante analysis (5,851 and 7,374).
- The specification wattages verified from the expected. The efficient wattages for the first, fifth, sixth, seventh, eighth, and ninth measures (40.26W, 23.8W, 26.65W, 50.8W, 47.7W, and 60.33W, respectively) varied from the ex-ante wattages (40W, 24.75W, 26.3W, 48.9W, 48.5W, and 60.68W, respectively).

The realized energy savings estimate is equal to 14% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	8	2.2
HDD	(3)	(1.6)
Days	4,108	7.6
Post_Flag	(4,827)	(2.8)
Intercept	(14,836)	(0.9)

The *Post_Flag* coefficient is associated with an estimate of 57,924 kWh savings, which is lower than the engineering analysis of savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.5. Project Number: BES2022_001076

Executive Summary

Under project BES2022_001076, a program participant received incentives from Appalachian Power for upgrading interior lighting.

The realized energy savings are 1,134,337 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (1,104) LED high bay fixtures.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, a phone interview with the site contact was conducted to verify the 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 were 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*					
Fluorescent fixture to LED high bay fixture	1104	1104	351	153.6	5,103	1.02	1,132,038	1,134,337	100%
Total							1,132,038	1,134,337	100%

Results

BES2022_001076 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	1,132,038	1,134,337	100%	268.05	Not available
Total	**1,132,038**	**1,134,337**	**100%**	**268.05**	

The realized energy savings are 1,134,337 kWh, resulting in a gross energy savings realization rate of 100%.

The account data was not located for a complete year.

Ancillary Econometric Analysis

This project implemented by the property manager was associated with a new tenant. Because of the change in occupancy, available baseline data was not adequate to model the energy usage.

2.1.6. Project Number: BES2022_001426

Executive Summary

Under project BES2022_001426, a program participant received incentives from Appalachian Power for installing LED lighting in the interior of their facility.

The realized energy savings are 848,264 kWh, resulting in a gross energy savings realization rate of 123%.

Project Description

The participant received incentives for installing (317) LED troffers and the permanent removal of (770) 8' 2L fixtures.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
high bay to LED Troffer	317	317	227	85.1	8,760	0.89	284,643	350,700	123%
8' 2L to Delamping	770	770	83	0	8,760	0.89	403,845	497,564	123%
Total							688,489	848,264	123%

Results

BES2022_001426 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	688,489	848,264	123%	133.83	7,936,000
Total	**688,489**	**848,264**	**123%**	**133.83**	

The realized energy savings are 848,264 kWh, resulting in a gross energy savings realization rate of 123%. The difference between the expected and realized energy savings was primarily due to the hours of use. The verified ex-post hours (8,760) are greater than the ex-ante hours of use (7,110).

The realized energy savings estimate is equal to 11% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	282	14.9
HDD	(64)	(10.3)
Days	19,989	10.4
Post_Flag	(28,074)	(4.6)
Intercept	75,708	1.3

The *Post_Flag* coefficient is associated with an estimate of 336,888 kWh savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.7. Project Number: BES2022_001971

Executive Summary

Under project BES2022_001971, a program participant received incentives from Appalachian Power for installing LED lighting in the interior of their facility.

The realized energy savings are 156,723 kWh, resulting in a gross energy savings realization rate of 99%.

Project Description

The participant received incentives for installing (859) LED retrofit kits, (120) LED 4' lamps, and (1) LED 4' strip light.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
high bay to LED retrofit kit	208	208	144	33.7	3,338	1.02	78,113	78,113	100%
4' Strip to LED retrofit kit	651	651	95	78	6,132	1.02	57,604	69,220	120%
4' lamp to LED 4' lamp	76	76	34	10.5	3,338	1.02	6,081	6,081	100%
4' lamp to LED 4' lamp	44	44	32	10.5	3,338	1.02	3,074	3,221	105%
4' Strip to LED Strip	1	1	60	34.2	3,338	1.02	177	88	50%
Permanent Delamping	0	0	0	0	0	0	8,798	0	0%
Permanent Delamping	0	0	0	0	0	0	4,576	0	0%
Total							158,424	156,723	99%

Results

BES2022_001971 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	158,424	156,723	99%	45.22	19,670,450
Total	**158,424**	**156,723**	**99%**	**45.22**	

The realized energy savings are 156,723 kWh, resulting in a gross energy savings realization rate of 99%. The expected savings estimate differed from the realized savings for the following reasons:

- The verified total of 4' lamps replaced (120) is greater than the ex-ante 4' lamps (118).
- The installed 4' strip quantity (1) is fewer than the ex-ante 4' strip (2).
- The permanent delamping was verified as zero. The site confirmed that the 4' lamps were a one-to-one replacement with no quantity as removed.
- The confirmed hours of use for the second measure (6,132) are greater than the ex-ante hours (5,103).

The realized energy savings estimate is equal to 1% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	746	3.2
HDD	26	0.5
Days	9,403	0.7
Post_Flag	(2,349)	(0.1)
Intercept	867,454	2.1

The Post_Flag coefficient suggests an estimated savings of 28,191 kWh. The t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.8. Project Number: BES2022_002003

Executive Summary

Under project BES2022_002003, a program participant received incentives from Appalachian Power for installing LED lighting in the exterior of the facility.

The realized energy savings are 1,060,494 kWh, resulting in a gross energy savings realization rate of 117%.

Project Description

The participant received incentives for installing (567) LED high bay fixtures, (11) LED 2x2 panels, (95) LED 2x4 panels, (11) LED 4' strips, (22) LED 8' strips, and (28) occupancy sensors.

Measurement and Verification Effort

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

Lighting energy savings were 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*

Occupancy sensor energy savings are calculated as:

$$kWh_{savings} = kW_{connected} \text{ x Hours x } SVG_e \text{ x ISR x } WHF_e$$

Where:

$kWh_{connected}$	*= Assumed kW lighting load connected to control*
$Hours$	*= Deemed average hours of use per year*
SVG_e	*= Percentage of annual lighting energy saved by lighting control* *=.28*
ISR	*= In Service Rate* *=1.00*
WHF_e	*= Waste Heat Factor for Energy to account for cooling and heating impacts from efficient lighting*

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					
2L U-tube to LED 2x2 Panel	11	11	60	40	2,080	1.02	644	467	73%
4'4LT8 to LED 2x4 Panel	65	65	128	50	2,080	1.02	14,832	10,757	73%
Permanent Delamping	171	171	324	0	6,240	1.02	288,381	352,635	122%
MH to LED UFO high bay	6	6	458	150	6,240	1.02	16,032	11,762	73%
4'4IT8 to 2x4 Panel	30	30	128	50	2,080	1.02	6,845	4,965	73%
4'6LT5HO to LED high bay	333	333	324	110	6,240	1.02	383,176	453,568	118%
4'6LT5HO to LED high bay	196	196	324	165	6,240	1.02	168,831	198,353	117%
4'6LT5HO to LED high bay	28	28	324	220	6,240	1.02	15,157	18,534	122%
4'2LT8 to LED 4' Strip	11	11	60	45	6,240	1.02	579	1,050	182%
4'2LT5 to LED 8' Strip	22	22	108	90	6,240	1.02	1,389	2,520	182%
Total							895,865	1,054,611	118%

Occupancy Sensor Energy Savings Calculations

Measure	Quantity (Occ Sens)	Controlled Wattage	Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Efficient	Efficient					
Occupancy Sensor	28	131	6240	1.02	8,978	7,883	88%
Total					8,978	7,883	88%

Results

BES2022_002003 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	895,865	1,054,611	118%	210.06	11,970,000
Occupancy Sensor	8,978	7,883	88%	0.08	
Total	**904,842**	**1,062,494**	**117%**	**210.14**	

The realized energy savings are 1,062,494 kWh, resulting in a gross energy savings realization rate of 117%. The main difference between the expected and realized energy savings was primarily due to the hours of operation. The confirmed hours of use at the facility (2,080 and 6,240) differ from the hours (2,868, 3,438, and 5,130) used in the ex ante savings estimate. In addition, the verified installed quantities of the sixth and seventh measures (333 and 196, respectively) are fewer than the quantities (344 and 204, respectively).

The realized energy savings estimate is equal to 12% of the 2022 annual usage.

Ancillary Econometric Analysis

Econometric analysis is not presented for this site due to the implementation of projects at two different times within the year, which hindered the clear identification of a post-implementation period.

2.1.9. Project Number: BES2023_002018

Executive Summary

Under project BES2023_002018, a program participant received incentives from Appalachian Power for replacing fluorescent lamps and fixtures with LED lamps and fixtures.

The realized energy savings are 392,043 kWh, resulting in a gross energy savings realization rate of 212%.

Project Description

The participant received incentives for installing (2,950) LED 4' lamps, (20) LED 2' T-5 lamps, (10) LED strip fixtures, (28) LED 2x2 panel fixtures, and (50) LED 2' lamps.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' T8 to 4' LED lamp	2950	2950	32	15.5	7,300	1.08	180,732	383,754	212%
2' T5 to 2' LED T5 lamp	20	20	14	9	7,300	1.08	743	788	106%
4' strip to LED 4' strip	10	10	60	45.3	7,300	1.08	546	1,159	212%
U-tube fixture to 2x2 LED panel	28	28	60	40.2	7,300	1.08	2,059	4,371	212%
2' T12 to 2' LED lamp	50	50	17	12	7,300	1.08	928	1,971	212%
Total							185,007	392,043	212%

Results

BES2022_002018 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	185,007	392,043	212%	65.64	11,001,600
Total	**185,007**	**392,043**	**212%**	**65.64**	

The realized energy savings are 392,043 kWh, resulting in a gross energy savings realization rate of 212%. The main difference between the expected and realized energy savings is due to the site being a health care facility with hours of use averaging 7 days a week/ 20 hours per day (7,300). The ex-ante savings used much lower hours (3,238). In addition, the second measure above was confirmed with the site contact to be 2' lamps and not 4' lamps as stated in the ex-ante documentation. The lamps were installed within a lab freezer.

The realized energy savings estimate is equal to 4% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	577	7.9
HDD	(222)	(5.7)
Days	35,925	3.6
Post_Flag	(31,733)	(1.0)
Intercept	(151,538)	(0.5)

The *Post_Flag* coefficient corresponds to an estimated savings of 380,793 kWh, aligning with the results of the ex post savings analysis. However, the small t-statistic and the fact that these savings represent a minor portion of the total energy usage of the building both signal uncertainty in this estimate.

2.1.10. Project Number: BES2023_002176

Executive Summary

Under project BES2023_002176, a program participant received incentives from Appalachian Power for installing LED lighting in their facility.

The realized energy savings are 25,629 kWh, resulting in a gross energy savings realization rate of 71%.

Project Description

The participant received incentives for installing (343) 4' LED Lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, a phone interview with the site contact was conducted to verify installation of the measures and the lighting hours of operation, and to collect data on heating and cooling equipment for use in applying heating and cooling interactive factors. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' Linear to 4' LED lamp	168	168	32	13.5	3,659	1.06	16,643	12,054	72%
4' Linear to 4' LED lamp	175	175	32	12	3,659	1.06	19,262	13,575	70%
Total							35,905	25,629	71%

Results

BES2023_002176 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2023 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	35,905	25,629	71%	8.33	4,027,000
Total	**35,905**	**25,629**	**71%**	**8.33**	

The realized energy savings are 25,629 kWh, resulting in a gross energy savings realization rate of 71%. The main difference between expected and realized savings is due to the verified hours of use (3,659) being fewer than the ex-ante hours (5,192). In addition, the verified specification wattage for the first measure (13.5W) is fewer than the ex-ante wattage (14W).

The realized energy savings estimate is less than 1% of the 2022 annual usage.

Ancillary Econometric Analysis

The econometric analysis is not presented. The site completed multiple projects throughout the year, which did not provide a continuous post period for use in modeling the energy savings.

2.1.11. Project Number: BES2023_002390

Executive Summary

Under project BES2023_002390, a program participant received incentives from Appalachian Power for replacing fluorescent high bay fixtures with LED high bay fixtures.

The realized energy savings are 531,495 kWh, resulting in a gross energy savings realization rate of 71%.

Project Description

The participant received incentives for installing (189) LED 212W high bay fixtures and (244) LED 170W high bay fixtures.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*					
High bay to LED high bay	148	148	575	212	3,752	1.02	281,177	205,603	73%
High bay to LED high bay	41	41	575	212	3,752	1.02	77,894	56,958	73%
High bay to LED high bay	244	244	458	170	3,752	1.02	391,171	268,934	69%
Total							750,242	531,495	71%

Results

BES2023_002390 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	750,242	531,495	71%	170.82	882,720
Total	**750,242**	**531,495**	**71%**	**170.82**	

The realized energy savings amount to 531,495 kWh, yielding a gross energy savings realization rate of 71%. The discrepancy between the anticipated and actual energy savings primarily stems from the verified Direct Load Control (DLC) specification wattages (212W and 170W) exceeding the initially estimated wattages (210W and 150W). Furthermore, the actual hours of use, confirmed through communication with the site contact (3,752 hours), were less than the anticipated hours (5,103 hours).

The realized energy savings estimate is equal to 60% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	360	17.1
HDD	(95)	(11.5)
Days	5,097	2.5
Post_Flag	(9,557)	(1.2)
Intercept	(69,903)	(1.1)

The *Post_Flag* coefficient corresponds to an estimated savings of 114,684 kWh. The t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.12. Project Number: BES2023_002402

Executive Summary

Under project BES2023_002402, a program participant received incentives from Appalachian Power for replacing Fluorescent linear lamps and fixtures with LED lamps and fixtures.

The realized energy savings are 447,306 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (85) LED high bay fixtures, (3,070) LED 8' lamps, (1) LED 2x4 panel, and (176) LED 4' lamps.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*					
high bay to LED high bay	85	85	315	210	8,760	1.02	46,455	46,455	100%
T12 lamp to LED 8' lamp	3070	3070	59	42	8,760	1.02	378,492	378,492	100%
2x4 Fixture to LED 2x4 Panel	1	1	118	27	8,760	1.02	660	660	100%
T8 lamp to LED 4' lamp	176	176	32	15	8,760	1.02	21,699	21,699	100%
Total							447,306	447,306	100%

Results

BES2022_002402 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	447,306	447,306	100%	78.96	3,226,000
Total	447,306	447,306	**100%**	**78.96**	

The realized energy savings are 447,306 kWh, resulting in a gross energy savings realization rate of 100%. All the factors used to estimate the savings were collected, with the same values as found in the application.

The realized energy savings estimate is equal to 18% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	56	5.8
HDD	(21)	(4.5)
Days	12,830	10.7
Post_Flag	(24,776)	(5.7)
Intercept	(122,338)	(3.3)

The *Post_Flag* coefficient is associated with an estimate of 297,310 kWh savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.13. Project Number: BES2023_002425

Executive Summary

Under project BES2023_002425, a program participant received incentives from Appalachian Power for upgrading their interior and exterior lighting.

The realized energy savings are 5,269 kWh, resulting in a gross energy savings realization rate of 115%.

Project Description

The participant received incentives for replacing T8 fluorescent high bay fixtures and metal halide fixtures with (12) LED UFO high bay fixtures and (2) LED wall pack fixtures.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify installation and lighting hours of use. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*					
T8 2x4 fixture to LED UFO	12	12	240	204.9	6,000	1	2,449	2,527	103%
MH to LED Wall Pack	1	1	275	39.22	4,609	1	847	1,087	128%
MH to LED Wall Pack	1	1	458	98.9	4,609	1	1,290	1,655	128%
Total							4,587	5,269	115%

Results

BES2023_002425 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	4,587	5,269	115%	1.02	1,399,900
Total	**4,587**	**5,269**	**115%**	**1.02**	

The realized energy savings are 5,269 kWh, resulting in a gross energy savings realization rate of 115%. The expected savings estimate differed from the realized savings for the following reasons:

- The ex post savings analysis confirmed the interior hours as 5 days a week/ 24 hours per day with 10 yearly holidays (6,000) which are greater than the ex-ante hours (5,103).
- The confirmed exterior measures operate on dusk to dawn hours (4,609) which are greater than the TRM hours (3,604) used in the ex-ante savings estimate.
- The specifications for the invoiced measures had slightly different wattages. The ex post used verified wattages (204.9W, 39.22W, and 98.9W, respectively) that differed from the ex-ante wattages (200W, 40W, and 100W, respectively).

The realized energy savings estimate is less than 1% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	23	2.5
HDD	(12)	(2.6)
Days	354	0.3
Post_Flag	(5,397)	(1.3)
Intercept	104,559	2.9

The *Post_Flag* coefficient indicates an estimated savings of 64,764 kWh, significantly exceeding the savings determined through engineering analysis. The t-statistic is too small to reliably estimate the saving using the billing analysis. Moreover, since the energy savings from the measure account for less than 1% of the facility's total usage, accurately modeling the energy savings using consumption data is difficult.

2.1.14. Project Number: BES2023_002499

Executive Summary

Under project BES2023_002499, a program participant received incentives from Appalachian Power for installing LED lighting to the interior of their facility.

The realized energy savings are 27,872 kWh, resulting in a gross energy savings realization rate of 70%.

Project Description

The participant received incentives for replacing linear fluorescent fixtures with (260) 8' LED lamps and (144) 4' LED lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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' lamp to LED 8' lamp	260	260	59	42	3,712	1.06	24,887	17,390	70%
4' lamp to LED 4' lamp	104	104	32	13.5	3,712	1.06	10,589	7,570	71%
4' lamp to LED 4' lamp	40	40	32	13.5	3,712	1.06	4,073	2,912	71%
Total							39,548	27,872	70%

Results

BES2023_002499 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	39,548	27,872	70%	8.93	289,400
Total	**39,548**	**27,872**	**70%**	**8.93**	

The realized energy savings are 27,872 kWh, resulting in a gross energy savings realization rate of 70%. The expected savings estimate differed from the realized savings for the following reasons:

- The ex post savings analysis confirmed annual hours of use (3,712) which are fewer than the ex-ante hours (5,192).
- The confirmed installed quantity of the first measure (260) is fewer than the ex-ante quantity (266).
- The specification for the invoiced first measure states a wattage of (42W) which is greater than the wattage in the ex-ante (32W).

The realized energy savings estimate is equal to 10% of the 2022 annual usage for the usage totaled from the metered accounts on the site.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(50)	(4.8)
HDD	14	3.9
Days	393	0.4
Post_Flag	(4,701)	(1.4)
Intercept	14,480	0.5

The *Post_Flag* coefficient is associated with an estimate of 56,412 kWh savings, approximately double that of the engineering estimate. The t-statistic is too small to reliably estimate the saving using the billing analysis and the discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.15. Project Number: BES2023_002500

Executive Summary

Under project BES2023_002500, a program participant received incentives from Appalachian Power for replacing fluorescent lamps and fixtures with LED lamps and fixtures.

The realized energy savings are 60,528 kWh, resulting in a gross energy savings realization rate of 119%.

Project Description

The participant received incentives for installing (152) LED 8' high bay fixtures, (2) LED 4' high bay fixtures, (19) LED 2x2 panels, (20) LED 2x4 panels, and (75) LED 8' strips.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the installation site installation was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*					
high bay to LED 8' high bay	90	90	119	84	4,320	1.06	17,336	17,336	100%
high bay to LED 8' high bay	62	62	118	84	4,320	1.06	11,601	11,601	100%
high bay to LED 4' high bay	2	2	59	43	4,320	1.06	176	176	100%
Troffer to LED 2x2 Recessed	19	19	60	31	4,320	1.06	2,405	3,032	126%
Troffer to LED 2x4 Recessed	20	20	118	36.4	4,320	1.06	8,255	8,982	109%
high bay to LED 8' Strip	75	75	120	73	4,320	1.06	11,145	19,400	174%
Total							50,919	60,528	119%

Results

BES2023_002500 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	42,367	50,359	119%	13.86	13,344,000
Total	**42,367**	**50,359**	**119%**	**13.86**	

The realized energy savings are 60,528kWh, resulting in a gross energy savings realization rate of 119%. The main difference between the expected and realized energy savings is due to the DLC specification wattages in the fourth through sixth measures (31W, 36.4W, and 73W, respectively) being fewer than the ex-ante savings wattages (37W, 43W, and 93W, respectively).

The realized energy savings estimate is less than 1% of 2022 annual usage.

Ancillary Econometric Analysis

The econometric analysis is not presented. The site completed multiple projects throughout the year, which did not provide a continuous post period for use in modeling the energy savings.

2.1.16. Project Number: BES2023_002509

Executive Summary

Under project BES2023_002509, a program participant received incentives from Appalachian Power for upgrading their exterior lighting to LED fixtures.

The realized energy savings are 16,159 kWh, resulting in a gross energy savings realization rate of 120%.

Project Description

The participant received incentives for (25) LED wall pack fixtures.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the Evaluation Team contacted the site 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 were 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*					
Exterior Lighting to LED Wall Pack Fixtures	25	25	195	45	4,309	1	13,515	16,159	120%
Total							13,515	16,159	120%

Results

BES2023_002509 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	13,515	16,159	120%	3.75	99,120
Total	**13,515**	**16,159**	**120%**	**3.75**	

The realized annual energy savings are 16,159 kWh, resulting in a gross energy savings realization rate of 120%. The ex post savings analysis confirmed that the base lighting as well as the efficient measures were/ are controlled by photocells. The use of photocells provides an annual hour of use (4,309) greater than the ex-ante hours (3,604).

The ex post savings analysis determined that photocells controlled both the replaced and new efficient lighting. With the controls in place, the actual annual energy usage is 4,309 hours, which exceeds the 3,604 hours used in the ex ante savings analysis.

The realized energy savings estimate is equal to 16% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(11)	(3.3)
HDD	3	3.4
Days	207	0.8
Post_Flag	(2,318)	(2.2)
Intercept	1,263	0.2

The *Post_Flag* coefficient is associated with an estimate of 27,816 kWh savings. The econometric analysis was greater than the savings estimated using the engineering analysis. The discrepancy between the estimated impact of the project on energy use from the regression model and the

engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.17. Project Number: BES2023_002510

Executive Summary

Under project BES2023_002510, a program participant received incentives from Appalachian Power for installing LED lighting in the interior of the facility.

The realized energy savings are 45,873 kWh, resulting in a gross energy savings realization rate of 91%.

Project Description

The participant received incentives for installing (20) LED high bay fixtures.

Measurement and Verification Effort

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

Lighting energy savings were 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*

Occupancy Sensor energy savings are calculated as:

$$kWh_{savings} = kW_{connected} \text{ x Hours x } SVG_e \text{ x } WHF_e$$

Where:

$kWh_{connected}$	= *Assumed kW lighting load connected to control*
Hours	= *Deemed average hours of use per year*
SVG_e	= *Percentage of annual lighting energy saved by lighting control*
WHF_e	= *Waste Heat Factor for Energy to account for cooling and heating impacts from efficient lighting*

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 high bay	20	20	1080	552	4,344	1	39,210	45,873	117%
Total							39,210	45,873	117%

Occupancy Sensor Energy Savings Calculations

Measure	Quantity (Occ Sens)	Controlled Wattage	Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Efficient	Efficient					
Occupancy Sensor	0	552	4344	1	11,478	0	0%
Total					11,478	0	0%

Results

BES2023_002510 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	39,210	45,873	117%	10.56	50,320
Occupancy Sensor	11,478	0	0%	0.00	
Total	**50,687**	**45,873**	**91%**	**10.56**	

The realized energy savings are 45,873 kWh, resulting in a gross energy savings realization rate of 91%. The main difference between the expected and realized energy savings was primarily due to the failure to verify that occupancy sensors were installed at the location. The site contact confirmed that there were no occupancy sensors installed on the high bays and they are operated by switch. Offsetting the missing measure would be the confirmed hours of use at the facility (4,344) are greater than the ex-ante hours (3,438).

The primary factor contributing to the discrepancy between the anticipated and actual energy savings was the inability to confirm the installation of occupancy sensors at the site. It was verified through the site contact that the high bays do not have occupancy sensors installed and are instead operated by switches. However, this was partially mitigated by the fact that the confirmed hours of use at the facility (4,344 hours) exceeded the initially estimated hours (3,438 hours).

The realized energy savings estimate is equal to 91% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing

data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	1.1
HDD	(0)	(0.9)
Days	106	2.0
Post_Flag	(803)	(4.3)
Intercept	902	0.5

The *Post_Flag* coefficient is associated with an estimate of 9,636 kWh savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.18. Project Number: BES2023_002545

Executive Summary

Under project BES2023_002545, a program participant received incentives from Appalachian Power for replacing the existing lighting fixtures in their barn with LED lamps.

The realized energy savings are 19,763 kWh and the realization rate is 14%.

Project Description

The participant received incentives for installing (55) LED high bay fixtures.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
high bay to LED high bay	55	55	458	98.67	1,000	1	142,796	19,763	14%
Total							142,796	19,763	14%

Results

BES203_002545 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	142,796	19,763	14%	19.76	24,120
Total	**142,796**	**19,763**	**14%**	**19.76**	

The realized energy savings are 19,763 kWh, resulting in a gross energy savings realization rate of 32%. The difference between the expected and realized savings estimates is due to the following factors:

- The ex post savings analysis confirmed that the installed location is unconditioned. The ex-ante savings estimate had the site conditioned with AC and non-electric heat.
- The site contact confirmed that the annual hours of use would be between 800-1000 hours. The ex post savings analysis used 1,000 hours while the ex-ante hours of use were 7,110.
- The efficient fixture wattage was 98.67W instead of the 100W in the ex-ante documentation.

The realized energy savings estimate is equal to 80% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(7)	(2.3)
HDD	(4)	(2.6)
Days	(64)	(1.2)
Post_Flag	(500)	(0.8)
Intercept	5,627	3.4

The *Post_Flag* coefficient is associated with an estimate of 6,000 kWh savings. The t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.19. Project Number: BES2023_002546

Executive Summary

Under project BES2023_002546, a program participant received incentives from Appalachian Power for installing LED Lighting in their barn facility.

The realized energy savings are 19,120 kWh and the realization rate is 29%.

Project Description

The participant received incentives for the installation of (62) LED high bay fixtures.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
high bay Fixture to LED high bay	62	62	458	149.62	1,000	1	66,965	19,120	29%
Total							66,965	19,120	29%

Results

BES2023_002546 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	66,965	19,120	29%	19.12	24,120
Total	**66,965**	**19,120**	**29%**	**19.12**	

The realized energy savings are 19,120 kWh, resulting in a gross energy savings realization rate of 29%. The expected savings estimate differed from the realized savings for the following reasons:

- The ex post savings analysis confirmed that the installed location is unconditioned. The ex-ante savings estimate had the site conditioned with AC and non-electric heat.
- The site contact confirmed that the annual hours of use would be between 800-1000 hours. The ex post savings analysis used 1,000 hours while the ex-ante hours of use were 3,438.
- The efficient fixture wattage was 149.62W instead of the 150W shown in the project documentation.

The realized energy savings estimate is equal to 79% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(1)	(0.3)
HDD	(0)	(0.9)
Days	148	1.1
Post_Flag	(448)	(1.0)
Intercept	(3,203)	(0.8)

The *Post_Flag* coefficient is associated with an estimate of 5,376 kWh savings. The t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.20. Project Number: BES2023_002957

Executive Summary

Under project BES2023_002957, a program participant received incentives from Appalachian Power for replacing fluorescent lamps and fixtures with LED lamps and fixtures.

The realized energy savings are 620,417 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (24) LED 2x4 fixtures, (27) LED 8' lamps, (138) LED 240W high bay fixtures, (11) LED 102W high bay fixtures, and (86) lamps removed.

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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					
T12 lamp to Delamping	24	24	32	0	5,103	1.02	3,997	3,997	100%
MH to Delamping	2	2	1000	0	5,103	1.02	10,410	10,410	100%
T12 lamp to Delamping	28	28	32	0	5,103	1.02	4,664	4,664	100%
4L T8 to LED 2x4 fixture	24	24	118	50	5,103	1.02	8,495	8,495	100%
T12 lamp to Delamping	32	32	32	0	5,103	1.02	5,330	5,330	100%
Fluorescent to LED Linear	9	9	175	90	5,103	1.02	3,982	3,982	100%
Fluorescent to LED Linear	18	18	400	90	5,103	0	29,044	29,044	100%
MH to LED high bay	40	40	1000	240	5,103	1.02	158,234	158,234	100%

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 high bay	28	28	1000	240	5,103	1.02	110,764	110,764	100%
MH to LED high bay	11	11	250	102	5,103	1.02	8,588	8,474	99%
MH to LED high bay	46	46	1000	240	5,103	1.02	181,969	181,969	100%
MH to LED high bay	24	24	1000	240	5,103	1.02	94,940	94,940	100%
Total							620,417	620,303	100%

Results

BES2022_002957 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	620,417	620,303	100%	146.58	2,203,000
Total	620,417	620,303	100%	**146.58**	

The realized energy savings are 620,417 kWh, resulting in a gross energy savings realization rate of 100%. All the factors used to estimate the savings were collected, with the same values as found in the application.

The realized energy savings estimate is equal to 28% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(17)	(2.1)
HDD	9	2.3
Days	5,918	5.9
Post_Flag	3,966	1.1
Intercept	2,512	0.1

The *Post_Flag* coefficient is associated with an increase in energy usage, but the t-statistic is too small to reliably estimate the saving using the billing analysis. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.21. Project Number: BES2023_003753

Executive Summary

Under project BES2023_003753 a program participant received incentives from Appalachian Power for replacing fluorescent lamps and fixtures with LED fixtures and occupancy sensors.

The realized energy savings are 322,282 kWh, resulting in a gross energy savings realization rate of 69%.

Project Description

The participant received incentives for installing (18) LED 109.47W high bay fixtures, (379) LED 156.61W high bay fixtures, (9) LED 8' strips, (189) occupancy sensors, and removal of (12) lamps).

Measurement and Verification Effort

To verify project savings, the Evaluation Team reviewed project documentation, the baseline lighting wattage, and the post-retrofit connected load. In addition, an interview with the site installation contact was conducted to review the operating hours in the various usage areas. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*

Occupancy Sensor energy savings are calculated as:

$$kWh_{savings} = kW_{connected} \text{ x Hours x } SVG_e \text{ x ISR x } WHF_e$$

Where:

$kWh_{connected}$	*= Assumed kW lighting load connected to control*
$Hours$	*= Deemed average hours of use per year*
SVG_e	*= Percentage of annual lighting energy saved by lighting control*
	=.28
ISR	*= In Service Rate*
	=1.00
WHF_e	*= Waste Heat Factor for Energy to account for cooling and heating impacts from efficient lighting*

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					
high bay to 2' LED high bay	18	18	324	109.47	4,011	1.02	20,060	15,799	79%
high bay to 2' LED high bay	379	379	324	156.61	4,011	1.02	329,720	259,564	79%
Lamps to delamping	12	12	458	0	1,851	1.02	28,607	10,378	36%
8' Strip to 8'LED Strip	9	9	160	90	4,011	1.02	4,569	2,578	56%
high bay to 2' LED high bay	18	18	324	109.47	4,011	1.02	20,060	15,799	79%
Total							382,956	288,319	75%

Occupancy Sensor Energy Savings Calculations

Measure	Quantity (Occ Sens)	Controlled Wattage	Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Efficient	Efficient					
Occupancy Sensor	189	156.61	4,011	1.02	86,492	33,963	39%
Total					86,492	33,963	39%

Results

BES2023_003753 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	382,956	288,319	75%	90.32	7,500,000
Occupancy Sensor	86,492	33,963	39%	2.92	
Total	**469,448**	**322,282**	**69%**	**93.24**	

The realized energy savings are 322,282 kWh, resulting in a gross energy savings realization rate of 69%. The expected savings estimate differed from the realized savings for the following reasons:

- The occupancy sensor savings were overestimated. The TRM savings are based on a 28% reduction in energy use for occupancy sensors. In addition, the savings analysis found that a higher connected load was used in the ex ante savings calculation than the connected load confirmed by the site contact.
- The efficient DLC fixture wattages for the first, second, and fifth measures (109.47W, 156.61W, and 156.61W, respectively) are less than wattages used in the ex ante analysis (110W, 165W. and 165W, respectively).

The realized energy savings estimate is equal to 4% of 2022 annual usage.

Ancillary Econometric Analysis

The econometric analysis is not presented. The site completed multiple projects throughout the year, which did not provide a continuous post period for use in modeling the energy savings.

2.1.22. Project Number: BES2023_003853

Executive Summary

Under project BES2023_003853, a program participant received incentives from Appalachian Power for installing LED lighting in the interior and exterior of their facility.

The realized energy savings are 772,533 kWh, resulting in a gross energy savings realization rate of 164%.

Project Description

The participant received incentives for installing (361) LED 4' light bars, (13) LED area lights, (20) LED flood lights, (239) LED high bays, (6) LED UFO high bays, and (8) LED wall packs.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
Exterior to LED Flood	17	17	500	61	4,310	1	32,688	32,163	98%
Exterior to LED Wall Pack	8	8	295	75	4,310	1	7,604	7,585	100%
Exterior to LED Flood	1	1	210	61	4,310	1	653	642	98%
Exterior to LED Flood	2	2	250	61	4,310	1	1,656	1,629	98%
Exterior to LED Area Light	6	6	295	100	4,310	1	5,125	5,042	98%
Exterior to LED Area Light	3	3	1080	200	4,310	1	11,563	11,378	98%
Exterior to LED Area Light	3	3	465	150	4,310	1	4,139	4,073	98%

Exterior to LED Area Light	1	1	465	125	4,310	1	1,489	1,465	98%
Troffer to LED 4' Light Bar	21	21	180	50.3	8,496	0.75	6,782	17,355	256%
Troffer to LED 4' Light Bar	136	136	228	50.3	8,496	1	122,839	205,325	167%
Troffer to LED 4' Light Bar	5	5	192	50.3	8,496	0.75	1,516	4,515	298%
Troffer to LED 4' Light Bar	3	3	288	50.3	2,512	0.75	1,529	1,343	88%
Troffer to LED 4' Light Bar	11	11	192	24.5	8,496	0.75	3,951	11,740	297%
Troffer to LED 4' Light Bar	78	78	96	19.6	8,496	0.75	12,751	37,972	298%
Troffer to LED 4' Light Bar	2	2	82	19.6	8,496	0.75	267	796	298%
Troffer to LED 4' Light Bar	19	19	58	19.6	2,512	0.75	1,553	1,376	89%
Troffer to LED 4' Light Bar	29	29	86	19.6	8,496	0.75	4,117	12,271	298%
Troffer to LED 4' Light Bar	4	4	86	19.6	2,512	0.75	568	500	88%
Troffer to LED 4' Light Bar	13	13	192	19.6	2,512	0.75	4,810	4,222	88%
Troffer to LED 4' Light Bar	13	13	58	19.6	8,496	0.75	1,274	3,181	250%
Troffer to LED 4' Light Bar	13	13	86	19.6	2,512	0.75	1,846	1,626	88%
Troffer to LED 4' Light Bar	1	1	96	19.6	2,512	0.75	163	144	88%
high bay to LED high bay	13	13	465	123	2,512	0.75	9,563	8,376	88%
high bay to LED UFO high bay	6	6	465	146	8,496	0.75	4,920	12,196	248%
high bay to LED high bay	30	30	200	123	8,496	1	11,788	19,626	166%
high bay to LED high bay	45	45	465	123	8,496	1	75,550	130,753	173%
high bay to LED high bay	18	18	465	123	8,496	1	31,414	52,301	166%
high bay to LED high bay	1	1	234	123	8,496	1	566	943	166%
high bay to LED high bay	97	97	200	89	8,496	1	54,449	91,476	168%
high bay to LED high bay	23	23	465	89	8,496	1	43,779	73,473	168%
high bay to LED high bay	2	2	465	108.8	8,496	0.75	1,712	4,539	265%
high bay to LED high bay	23	23	200	136	8,496	1	7,512	12,507	166%
Total							470,136	772,533	164%

Results

BES2023_003853 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	470,136	772,533	164%	115.53	42,960,000
Total	**470,136**	**772,533**	**164%**	**115.53**	

The realized energy savings are 762,559 kWh, resulting in a gross energy savings realization rate of 165%. The expected savings estimate differed from the realized savings for the following reasons:

- The ex post savings analysis confirmed the exterior fixtures are controlled with photocells. The non-daylighting hours of use (4,310) are fewer than the hours (4,380) used in the ex ante savings analysis.

- The confirmed interior office hours were 50 hours per week with 11 holidays (2,512) are fewer than the hours (2,607) used in the ex ante savings analysis.
- The confirmed interior industrial hours as 7 days a week/ 24 hours per day with 11 holidays per year (8,496) which are fewer than the hours (8,760) used in the ex ante savings analysis.
- The confirmed specification wattages for the second, ninth – twelfth, thirteenth, fourteenth - twenty-second, twenty-fourth, twenty-ninth, thirtieth, and thirty-first measures (75W. 50.3W, 24.5W, 19.6W, 146W, 89W, 89W, and 108.8W, respectively) are lower than the wattages used in the ex ante savings analysis (78W, 51W, 25W, 20W, 147W, 90W, 92W, and 123W, respectively).

The realized energy savings estimate is equal to 2% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	(2,603)	(2.2)
HDD	(1,601)	(2.7)
Days	169,934	2.3
Post_Flag	(63,992)	(0.2)
Intercept	(648,193)	(0.3)

The *Post_Flag* coefficient is associated with an estimate of 767,904 kWh savings. While close to the engineering analysis, the t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.23. **Project Number:** CCIP2023_002628

Executive Summary

Under project CCIP2023_002628, a program participant received incentives from Appalachian Power for replacing their primary air compressors with a single compressed air plant.

The realized energy savings are 254,960 kWh, resulting in a gross energy savings realization rate of 99%.

Project Description

The participant replaced two air compressors (50 HP, 40 HP) for one of their processes, and two more air compressors for another process (75 HP, 75 HP) with a palletized air compressor plant.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team initially reviewed pre-installation project documentation, including the baseline air compressor power monitoring trend data. The monitored data captured air flow (CFM) and energy (kWh) for a period of 7 day for the air compressors supporting two different processes in the manufacturing plant. Post installation data was obtained from air compressor control system for the month of April. The data included energy and airflow, from which the average efficiency of 22.2 kW/100 CFM was calculated.

Lighting energy savings were calculated as:

$$kWh_{savings} = \sum_{7\ Days} \left[kWh_{pre-metering} - CFM_{post-metering} \times 22.2 \frac{kW}{100CFM} \right]_{day} \times Days$$

Where:

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

$kWh_{pre\text{-}metering}$ = *Energy metered each with the baseline compressors*

$CFM_{post\text{-}metering}$ = *Air flow per day, metered by new air compressor system*

kW/CFM = *Air compressor efficiency of new system for one month*

Days = *365 days/year, less two holidays*

Air Compressor Weekly Energy Savings Calculations

Day of Week	*Air Flow, CFM*		*Energy, kWh*		
	Baseline	*Installed*	*Baseline*	*Efficiency, kW/100CFM*	*Installed*
Saturday	464,919	431,936	2,318	22.2	1,598
Sunday	424,066	386,544	2,171	22.2	1,430
Monday	482,558	451,875	2,314	22.2	1,672
Tuesday	510,539	526,016	2,379	22.2	1,946
Wednesday	533,112	525,481	2,422	22.2	1,944
Thursday	519,307	525,259	2,439	22.2	1,944

Day of Week	Air Flow, CFM		Energy, kWh		
	Baseline	Installed	Baseline	Efficiency, kW/100CFM	Installed
Friday	646,785	468,838	3,157	22.2	1,735
Total	3,581,287	3,315,947	17,199		12,269

Air Compressor Annual Energy Savings Calculation

Period	Savings per Operating Year		Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
Weekly energy savings	4,930				
Days/year less two holidays	363				
Annual energy savings	257,073		257,073	254,960	99%

Results

CCIP2023_002628 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Annual Energy Usage
	Expected	Realized	Realization Rate		
Compressed Air	257,073	254,960	99%	29.10	1,911,632
Total	**257,073**	**254,960**	**99%**	**29.10**	

The realized energy savings are 254,960 kWh, resulting in a gross energy savings realization rate of 99%. The realized energy savings differ from the expected due to the exclusion of two holidays. The ex post savings analysis used the confirmed hours (3,650) that were greater than hours (3,009) used in the ex ante savings analysis.

The realized energy savings estimate equals 13% of the 2022 annual usage for the project.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	55	1.5
HDD	(35)	(2.0)
Days	3,381	1.9
Post_Flag	(23,728)	(3.9)
Intercept	59,303	1.2

The *Post_Flag* coefficient is associated with an estimate of 284,736 kWh savings, which is comparable to the savings developed from the engineering analysis.

2.1.24. **Project Number:** CCIP2023_003092

Executive Summary

Under project CCIP2023_003092, a program participant received incentives from Appalachian Power for replacing water source heat pumps with efficient units.

The realized energy savings are 42,230 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant replaced 88 water source heat pumps (0.75 to 20 tons) throughout their building with new efficient heat pumps, along with a new heat rejection tower system. The new units are more efficient than the code based efficiency requirement for both heating and cooling.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team initially reviewed the project application and savings estimate with the program implementer. After the project was complete, the documentation for the installed measures, including model specifications and quantities, were collected, and these inputs were used in the TRM savings algorithm for heat pumps.

Heat pump energy savings were calculated as:

$$kWh_{savings} = \sum_{88\,units} \begin{matrix} CAP_{cool} x EFLHcool(\frac{1}{EER_{base}} - \frac{1}{EER_{eff}}) + \\ CAP_{heat} x EFLHheat(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{eff}}) \end{matrix}$$

Where:

$kWh_{savings}$	*= Annual energy savings*
EER_{base}	*= Code efficiency, 12 to 13 EER, by capacity*
EER_{eff}	*= Installed efficiency, 12.8 to 17 EER, by capacity*
$HSPF_{base}$	*= Code efficiency, 14.3 HSPF*
$HSPF_{eff}$	*= Installed efficiency, 12.8 to 22.5 HSPF by capacity*
Capacity	*=Installed heating or cooling capacity, MBH*
$EFLH_{cool}$	*= Effective full load cooling hours, MidAtlantic TRM*
$EFLH_{heat}$	*= Effective full load heating hours, MidAtlantic TRM*

Interval billing data was collected to determine the heating and cooling balance point temperatures, to inform the model to estimate the heating and cooling load for each hour in an 8760 weather model. The optimized model for the balance points of 60F cooling and 60F heating produced the model coefficients in the following table. Although the identified variables are statistically significant, the R^2 value for the regression model was low (0.37). This result suggests that energy use is influenced by other exogenous variables not accounted for in the model. Consequently, the regression approach was not used to estimate the heating and cooling load.

Interval Usage Data Model Variable Coefficients

Coefficients	*Value*	*T-Statistic*
CDD	1.1	5
HDD	0.26	1
Weekend/Weekday	755	11
Occupied, 6AM-7PM	0.6	4
Intercept	1544	144

As an alternative, the EFLH for the nearest city and building type were collected from the MidAtlantic TRM. Those values, along with project specific capacity and efficiency values listed in the following table, estimated the energy savings.

Baseline and New Equipment Specifications

Equipment	*Quantity*	*Cooling Capacity*	*Heating Capacity*	*Cooling Efficiency, EER*		*Heating Efficiency, COP*	
		MBH	*MBH*	*Pre*	*Post*	*Pre*	*Post*
Water source heat pump	15	179.9	114.4	12.2	17.1	4.3	4.81
	4	64.4	43.6	13.0	16.63	4.3	6.60
	17	199.2	152.9	12.2	15.8	4.3	5.30
	5	19.4	15	12.2	14.68	4.3	5.04
	15	128.3	95.1	12.2	14.5	4.3	5.30
	6	103.4	81.3	12.2	13.98	4.3	4.79
	2	9.6	0.3	12.2	13.98	4.3	5.50
	5	61.3	49.3	13.0	13.4	4.3	4.60
	6	27.2	18.6	12.2	13.3	4.3	5.50
	4	261.9	261.6	13.0	13.26	4.3	4.77
	9	346.1	312.3	13.0	13.10	4.3	4.40
Total	**88**	**1,400**	**1,144**				

The application of the savings inputs to the TRM based algorithm, resulted in the following energy and demand savings.

CCIP2023_003092 *Project Realized Gross Savings*

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022Annual Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Water source heat pumps	42,230	42,230	100%	27.2	1,004,200
Total	42,230	42,230	100%	27.2	

The realized energy savings are 42,230 kWh, resulting in a gross energy savings realization rate of 100%. Both the expected and realized savings were estimated using the same approach.

The realized energy savings estimate equals 4% of the annual usage for the project.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	118	8.4
HDD	3.6	4.9
Days	1145	1.5
Post_Flag	(9,380)	(3.0)
Intercept	20,383	0.9

The *Post_Flag* coefficient is associated with an estimate of 112,556 kWh savings. The actual savings is expected to exceed the engineering savings method, as the baseline for the econometric analysis is the existing HVAC units with a lower efficiency value, than the code baseline.

2.1.25. **Project Number:** CCIP2023_003637

Executive Summary

Under project CCIP2023_003637, a program participant received incentives from Appalachian Power for replacing packaged rooftop HVAC with new efficient units.

The realized energy savings are 71,665 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant replaced nineteen rooftop units (7 to 10 tons) providing conditioned air to a retail store. The new units are more efficient (19 to 22 IEER) than code based units (12.2 to 12.7 IEER).

Measurement and Verification Effort

To verify the project savings, the Evaluation Team initially reviewed the project application and savings estimate with the program implementer. After the project was complete, the documentation for the installed produced, model specifications and quantities were collected, with inputs informing the TRM based savings algorithm for heat pumps.

Lighting energy savings were calculated as:

$$kWh_{savings} = \sum_{18\ units} CAP_{cool} x EFLHcool(\frac{1}{IEER_{base}} - \frac{1}{IEER_{install}}) +$$

Where:

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

$IEER_{base}$ = *Code efficiency*

$IEER_{install}$ = *Installed efficiency*

Capacity =*Installed cooling capacity, MBH*

$EFLH_{cool}$ = *Effective full load cooling hours, MidAtlantic TRM*

Baseline and New Equipment Specifications

Equipment	*Quantity*	*Total Cooling Capacity*	*Cooling Efficiency, IEER*	
		MBH	*Base*	*Installed*
Rooftop CAC	4	86	12.4	22
	5	172	12.0	19
	4	114	12.0	21
	4	114	12.2	21
Total	**17**	**486**		

Interval billing data was collected to determine the heating and cooling balance point temperatures, to inform the model to estimate the heating and cooling load for each hour in an 8760-weather model. The optimized model for the balance points of 60F cooling and 50F heating produced the model coefficients in the following table. Although the identified variables are statistically significant, the R^2 value for the regression model was low (0.41). This result suggests that energy use is influenced by other exogenous variables not accounted for in the model. The cooling capacity exceeds the required capacity based on the design degree temperatures, due to backup cooling units. Consequently, the regression approach was not used to estimate the heating and cooling load.

Interval Usage Data Model Variable Coefficients

Coefficients	*Value*	*T-Statistic*
CDD	0.88	109
HDD	0.16	40
Weekend/Weekday	1,296	38
Occupied, 8AM-10PM	4.0	42
Intercept	21	205

As an alternative, the EFLH for the nearest city and building type were collected from the MidAtlantic TRM. Those values, along with project specific capacity and efficiency values are listed in the following table.

Annual heating and cooling energy usage

Results

CCIP2023_003637 *Project Realized Gross Savings*

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022Annual Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Custom-Cooling	71,665	71,665	100%	10.3	933,000
Total	71,665	71,665	100%	10.3	

The realized energy savings are 71,665 kWh, resulting in a gross energy savings realization rate of 100%. Both the expected and realized savings were estimated using the same method.

The realized energy savings estimate equals 8% of the annual usage for the project.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	116	3.5
HDD	11	0.6
Days	1,158	0.7
Post_Flag	(20,873)	(2.5)
Intercept	50,479	1.0

The *Post_Flag* coefficient is associated with an estimate of 250,476 kWh savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.26. Project Number: SBDI2022_001386

Executive Summary

Under project SBDI2022_001386, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 54,317 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (338) LED 4' lamp, (40) LED 8' lamps, (28) LED A-19 15W lamps, (14) LED A-19 9W lamps, (2) LED BR30 lamps, and (2) LED U-bend lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' Linear to LED 4' lamp	338	338	32	12	3,000	1.08	41,396	21,902	53%
8' Linear to LED 8' lap	40	40	75	43	1,500	1.08	4,753	2,074	44%
incandescent to 15W LED A-19	28	28	72	15	1,500	1.08	5,926	2,586	44%
incandescent to 9W LED A-19	14	14	43	9	1,500	1.08	1,767	771	44%
R30 to LED R30	2	2	45	8	1,500	1.08	275	120	44%
U-Lamp to LED U-shape lamp	2	2	40	13	1,500	1.08	201	87	44%
Total							54,317	27,540	51%

Results

SBDI2022_001386 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	54,317	27,540	51%	13.82	57,256
Total	**54,317**	**27,540**	**51%**	**13.82**	

The realized energy savings are 27,540 kWh, resulting in a gross energy savings realization rate of 51%. The main difference between the expected and realized energy savings is the verified hours of use (ranging from 1,500 – 3,000) were less than the hours used in the ex ante saving estimate (ranging from 3,438 – 5,670).

The realized energy savings estimate is equal to 54% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	0.0
HDD	0	1.3
Days	19	0.7
Post_Flag	(30)	(0.4)
Intercept	37	0.0

The *Post_Flag* coefficient is associated with an estimate of 360 kWh savings. The t-statistic is too small to reliably estimate the saving using the billing analysis. The weekend and weekday usage were also utilized for the linear regression model, but this did not improve the result.

2.1.27. Project Number: SBDI2022_001886

Executive Summary

Under project SBDI2022_001886, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 23,835 kWh, resulting in a gross energy savings realization rate of 31%.

Project Description

The participant received incentives for installing (9) LED A-line lamps, (1,022) LED 4' lamps, (51) LED 8' lamps, (32) LED U-shape lamps, (54) LED BR30, and (2) LED candelabra lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' Linear to LED 4' Lamp	400	400	32	18	2,074	1.08	34,292	12,545	37%
4' Linear to LED 4' Lamp	622	622	32	18	778	1.08	32,333	7,315	23%
incandescent to LED A-19	3	3	13	9	774	1.08	45	10	22%
incandescent to LED A-19	6	6	100	14	103	1	1,196	53	4%
U-shape to LED U-shape lamp	32	32	32	16	2,074	1.08	1,971	1,147	58%
BR30 to LED BR30	54	54	15	10	2,074	1.08	1,734	605	35%
Candelabra to LED Candelabra	2	2	40	4	2,074	0	462	161	35%
8' Linear to LED 8' Lamp	51	51	75	40	1,037	1.08	6,060	1,999	33%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Total							78,093	23,835	31%

Results

SBDI2022_001886 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	78,093	23,835	31%	23.41	142,560
Total	**78,093**	**23,835**	**31%**	**23.41**	

The realized energy savings are 23,835 kWh, resulting in a gross energy savings realization rate of 31%. The realized energy savings were fewer than the expected savings because the verified hours of use (103, 774, 778, 1,037, 2,074) were less than the ex-ante hours of use (3,001, 3,438, 5,670, and 5,947). The facility is a church with limited usage. In addition, the verified wattage of the fifth measure (16W) is greater than the ex-ante wattage (13W).

The realized energy savings estimate is equal to 17% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	15	5.7
HDD	6	4.4
Days	457	3.2
Post_Flag	(1,391)	(3.4)
Intercept	(5,713)	(1.4)

The *Post_Flag* coefficient is associated with an estimate of 16,692 kWh savings, which aligns with the ex post savings result.

2.1.28. Project Number: SBDI2022_002010

Executive Summary

Under project SBDI2022_002010, a program participant received incentives from Appalachian Power for upgrading their lighting to LED lamps.

The realized energy savings are 30,363 kWh, resulting in a gross energy savings realization rate of 28%.

Project Description

The participant received incentives for installing (897) LED 4' 18W lamps, (10) LED U-bend lamps, (4) LED 8' lamps, (50) LED A-19 lamps, (5) LED R40 lamps, (3) LED MR16 lamps, (78) LED candelabra lamps, and (13) LED PAR38 lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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*					
U-lamp to LED U-Shape lamp	10	10	32	16	1,248	1.08	1,163	216	19%
4' lamp to LED 4' lamp	897	897	34	17.5	1,248	1.08	87,886	19,949	23%
incandescent to LED A-19 lamp	50	50	23	14	1,248	1.08	1,671	607	36%
8' lamp to LED 8' lamp	4	4	75	40	1,248	1.08	490	189	39%
Candelabra to LED Candelabra	72	72	40	4	1,248	1.08	9,624	3,494	36%
R40 to LED R40 lamp	5	5	100	16.5	1,248	1.08	1,086	563	52%
PAR 38 to LED PAR38 lamp	13	13	100	15	4,380	0	3,982	4,838	122%
MR 16 to LED MR16 lamp	3	3	60	6.5	1,248	1.08	596	216	36%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
Candelabra to LED Candelabra	6	6	40	4	1,248	1.08	802	291	36%
Total							107,301	30,363	28%

Results

SBDI2022_002010 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	107,301	30,363	28%	26.67	142,560
Total	**107,301**	**30,363**	**28%**	**26.67**	

The realized energy savings are 30,363 kWh, resulting in a gross energy savings realization rate of 28%. The realized energy savings were less than the expected savings because the verified hours of use (ranging from 1,248 to 4,380) were less than the hours of use (ranging from 3,438 to 5,670) used for the ex ante savings analysis (the facility is a church with limited lighting hours). In addition, the verified wattages of the first, second, and fourth measures (16W, 17.5W, 40W, respectively) differ from the ex-ante wattages (13W, 18W, 42W, respectively).

The realized energy savings estimate is equal to 21% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	11	6.1
HDD	7	7.0
Days	138	1.3
Post_Flag	(869)	(3.1)
Intercept	(2,279)	(0.8)

The *Post_Flag* coefficient is associated with an estimate of 10,428 kWh savings. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.29. Project Number: SBDI2022_002027

Executive Summary

Under project SBDI2022_002027, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 15,398 kWh, resulting in a gross energy savings realization rate of 121%.

Project Description

The participant received incentives for installing (264) LED 15W 4' Lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
Linear Lamp to LED 4' Lamp	264	264	32	15	3,650	0.94	12,694	15,398	121%
Total							12,694	15,398	121%

Results

SBDI2022_002027 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	12,694	15,398	121%	5.92	77,200
Total	**12,694**	**15,398**	**121%**	**5.92**	

The realized energy savings are 15,398 kWh, resulting in a gross energy savings realization rate of 121%. The realized energy savings differ from the expected due to the hours of use. The confirmed hours (3,650) used in the ex post analysis were greater than the hours (3,009) used in the ex ante analysis.

The realized energy savings estimate equals 20% of the 2022 annual usage for the project.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	4	0.6
HDD	(6)	(1.8)
Days	279	1.6
Post_Flag	(3,307)	(3.1)
Intercept	(1,018)	(0.2)

The *Post_Flag* coefficient is associated with an estimate of 39,700 kWh savings, significantly larger than the ex post savings analysis result. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.30. Project Number: SBDI2022_02059

Executive Summary

Under project SBDI2022_002059, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 9,269 kWh, resulting in a gross energy savings realization rate of 35%.

Project Description

The participant received incentives for installing (56) LED 4' lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
Removal of 4' lamp	56	56	40	0	2,840	0.94	6,336	5,980	94%
4' lamp to 4' LED lamp	56	56	40	18	2,840	0.94	19,958	3,289	16%
Total							26,293	9,269	35%

Results

SBDI2022_002059 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	26,293	9,269	35%	4.58	16,760
Total	**26,293**	**9,269**	**35%**	**4.58**	

The realized energy savings are 9,269 kWh, resulting in a gross energy savings realization rate of 35%. For the second measure, the expected savings estimate used a base wattage (160W), which is greater than the verified actual wattage (40W). The ex ante savings analysis mistakenly used a four lamp fixture for the baseline lighting and a single lamp for the efficient replacement. The analysis should be based on fixture-to-fixture replacements or lamps-to-lamps replacement.

The ex post savings analysis used the base lamp wattage (40W) compared to the efficient lamp wattage (18W).

In addition, the ex post analysis was based on confirmed hours (2,840) that were slightly less than the hours (3,009) used in the ex ante analysis.

The realized energy savings estimate is equal to 2% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	4	5.2
HDD	2	4.0
Days	64	2.3
Post_Flag	(165)	(1.3)
Intercept	(1,802)	(2.2)

The *Post_Flag* coefficient is associated with an estimate of 1,980 kWh savings. The t-statistic is too small to reliably estimate the saving using the billing analysis. Additionally, the discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.31. Project Number: SBDI2022_002101

Executive Summary

Under project SBDI2022_002101, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 58,740 kWh, resulting in a gross energy savings realization rate of 104%.

Project Description

The participant received incentives for installing (280) LED A-19 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
incandescent to LED A-19 lamp	280	280	72	15.5	3,438	1.08	56,720	58,740	104%
Total							56,720	58,740	104%

Results

SBDI2022_002101 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	56,720	58,740	104%	21.36	142,720
Total	**56,720**	**58,740**	**104%**	**21.36**	

The realized energy savings are 58,740 kWh, resulting in a gross energy savings realization rate of 104%. The main reason for the difference between the expected and realized energy savings is the base and efficient wattages used in the ex ante and ex post savings analyses. The confirmed base and efficient wattages (72W and 15.5W, respectively) used in the ex post analysis were larger than the wattages (69.6W and 15W, respectively) used in the ex ante savings analysis.

The realized energy savings estimate is equal to 41% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month.

period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	34	15.8
HDD	3	2.9
Days	219	1.7
Post_Flag	417	1.1
Intercept	(286)	(0.1)

The *Post_Flag* coefficient suggests an increase in energy used after the project was completed, but the t-statistic is too small to reliably estimate the saving using the billing analysis. Factors not accounted for in the regression model may also be increasing energy used during the post period.

2.1.32. Project Number: SBDI2022_002205

Executive Summary

Under project SBDI2022_002205, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 16,862 kWh, resulting in a gross energy savings realization rate of 30%.

Project Description

The participant received incentives for installing (56532) LED 4' lamps, (16) LED 8' lamps, (4) LED U-bend lamps, (33) LED A-19 14W lamps, (32) LED candelabra lamps, (2) LED R40 lamps, (9) LED A-19 15W lamps, (9) LED R30 lamps, and (6) LED PAR38 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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' T12 lamp to LED 4' lamp	532	532	32	18	1,500	1.08	45,609	12,066	26%
incandescent to LED A-19	33	33	23	14	1,100	1.08	1,103	353	32%
2' T12 lamp to LED U-shape	4	4	20	13	1,100	1.08	104	33	32%
8' T12 lamp to LED 8' lamp	16	16	60	40	1,100	1.08	1,069	380	36%
incandescent to LED Candelabra	32	32	40	4	1,100	1.08	4,277	1,369	32%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
incandescent R40 to LED R40	2	2	75	16.5	1,100	1.08	434	139	32%
incandescent to LED A-19	9	9	72	15	1,100	0	1,905	609	32%
Exterior Lighting to LED PAR38	6	6	100	15	3,604	1	1,838	1,838	100%
incandescent R30 to LED R30	9	9	15	8	1,100	1.08	234	75	32%
Total							56,573	16,682	30%

Results

SBDI2022_002205 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	56,573	16,862	30%	13.93	23,700
Total	**56,573**	**16,862**	**30%**	**13.93**	

The realized energy savings are 16,862 kWh, resulting in a gross energy savings realization rate of 30%. Differences in hours of use primarily account for the difference in expected and realized savings. The verified hours for the facility (ranging from 1,100 to 3,604) are less than the hours (ranging from 3,438 to 5,670) used in the ex ante savings analysis. The site is a church with limited hours.

The realized energy savings estimate is equal to 70% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	10	9.1
HDD	1	2.2
Days	5	0.1
Post_Flag	165	0.9
Intercept	2	0.0

The *Post_Flag* coefficient suggests an increase in energy used after the project was completed, but the t-statistic is too small to reliably estimate the saving using the billing analysis. Factors not accounted for in the regression model may also be increasing energy used during the post period.

2.1.33. Project Number: SBDI2023_002479

Executive Summary

Under project SBDI2023_002479, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 27,177 kWh, resulting in a gross energy savings realization rate of 96%.

Project Description

The participant received incentives for installing (710) LED 4' lamps, (21) LED BR30, (10) LED Candelabra lamps, (1) LED A-19 lamp, and (20) LED 2x2 panel.

Measurement and Verification Effort

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

Lighting energy savings were 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' T12 to LED 4' lamp	710	710	40	18	1,584	0.93	24,056	23,010	96%
incandescent to LED A-19 lamp	1	1	60	8	3,425	0.93	111	166	149%
2x2 fixture to LED 2x2 Panel	20	20	64	32.12	3,001	0.93	1,786	1,779	100%
incandescent to LED Candelabra lamp	10	10	60	5	3,425	0.93	1,752	1,752	100%
incandescent BR to LED BR lamp	21	21	15	8	3,438	0.93	470	470	101%
Total							28,176	27,177	96%

Results

SBDI2023_002479 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	28,176	27,177	96%	22.96	138,040
Total	28,176	27,177	96%	**22.96**	

The realized energy savings are 27,177 kWh, resulting in a gross energy savings realization rate of 96%. Differences in the wattages used in the ex ante and ex post savings analyses account for most of the difference between expected and realized savings. The verified efficient wattages for first and third measures (18W and 32.12W, respectively) are greater than the wattage used in the ex-ante savings estimate (17W and 32W, respectively).

The realized energy savings estimate is equal to 20% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	37	7.8
HDD	28	12.3
Days	13	0.2
Post_Flag	453	0.6
Intercept	(2,478)	(1.1)

The *Post_Flag* coefficient suggests an increase in energy used after the project was completed, but the t-statistic is too small to reliably estimate the saving using the billing analysis. Factors not accounted for in the regression model may also be increasing energy used during the post period.

2.1.34. Project Number: SBDI2023_002490

Executive Summary

Under project SBDI2023_002490, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 44,020 kWh, resulting in a gross energy savings realization rate of 85%.

Project Description

The participant received incentives for installing (755) LED 4' lamps, (6) LED 2' lamps, (3) LED A-19 lamps, and (10) LED BR30 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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' Lamp to LED 4' Lamp	755	755	32	17.8	5,052	0.81	51,561	43,873	85%
2' Lamp to LED 2' Lamp	6	6	20	16	1,505	0.81	51	29	57%
incandescent to LED A-19 lamp	3	3	13	9	3,438	0.81	33	33	100%
incandescent to LED BR30 lamp	10	10	15	8	1,505	0.81	85	85	100%
Total							51,731	44,020	85%

Results

SBDI2023_002490 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	51,731	44,020	85%	15.59	310,200
Total	**51,731**	**44,020**	**85%**	**15.59**	

The realized energy savings are 44,020 kWh resulting in a gross energy savings realization rate of 85%. The difference between the expected and realized savings was mainly due to the quantity of the first measure. The documentation states a quantity of 900 4' lamps. However, the trade ally confirmed that only 755 lamps were replaced because lamps were not replaced in some emergency lighting fixtures. In addition, the second measure had a wattage (16W) that was greater than the ex-ante wattage (13W).

The realized energy savings estimate is equal to 14% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12-month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	51	11.0
HDD	19	8.3
Days	20	0.3
Post_Flag	(2,453)	(2.9)
Intercept	12,296	4.9

The *Post_Flag* coefficient indicates an estimated savings of 29,400 kWh, less than the engineering analysis of energy saving impacts. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the

presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.35. Project Number: SBDI2023_002515

Executive Summary

Under project SBDI2023_002515, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 40,451 kWh, resulting in a gross energy savings realization rate of 76%.

Project Description

The participant received incentives for installing (981) LED 4' lamps, (66) LED A-19 14W lamps, (166) LED A-19 15W lamps, (14) LED A-19 9W lamps, (5) LED Globe lamps, (21) LED Candelabra lamps, (16) LED PAR38 lamps, (2) LED 2' lamps, and (28) LED R30 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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' T12 to 4' LED lamp	50	50	34	18	3,000	0.82	3,720	1,969	53%
incandescent to LED A-19	166	166	72	15	2,275	0.82	26,675	17,651	66%
4' T12 4' LED lamp	781	781	34	18	1,584	0.82	16,231	16,231	100%
incandescent to LED A-19	14	14	43	9	2,275	0.82	1,342	888	66%
incandescent to LED A-19	66	66	23	14	2,275	0.82	1,489	1,108	74%
incandescent to LED Globe	5	5	40	5	2,275	0.82	362	326	90%

Measure	Quantity (Fixtures)		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Gross Realization Rate
	Baseline	Efficient	Baseline	Efficient					
incandescent to LED Candelabra	19	19	40	4	2,275	0	1,928	1,276	66%
incandescent to LED Candelabra	2	2	40	4	2,275	0.82	203	134	66%
Exterior Lighting to LED PAR38	16	16	23	15	3,604	1	461	461	100%
incandescent R30 to LED R30	28	28	15	8	2,275	0.82	553	366	66%
2' T12 to 2' LED lamp	2	2	20	9	2,275	0.82	45	41	90%
Total							53,008	40,451	76%

Results

SBDI2023_002515 Project Realized Gross Savings

Measure Category	kWh Savings			Realized Peak kW Reduction	2022 Total Energy Usage
	Expected	Realized	Realization Rate		
Lighting	53,008	40,451	76%	33.85	187,000
Total	**53,008**	**40,451**	**76%**	**33.85**	

The realized energy savings are 40,451 kWh, resulting in a gross energy savings realization rate of 76%. The main reason for the difference between the expected and realized energy savings is due to the hours of operation in all but the third and ninth measures. Verified hours for the facility (ranging from 2,275 to 3,000) are less than the hours used in the ex-ante savings estimate (ranging from 2,521 to 5,670).

The realized energy savings estimate is equal to 22% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	31	6.5
HDD	24	9.9
Days	64	0.9
Post_Flag	(2,672)	(3.1)
Intercept	2,065	1.0

The *Post_Flag* coefficient is associated with an estimate of 32,064 kWh savings and is similar to the engineering estimate.

2.1.36. Project Number: SBDI2023_002653

Executive Summary

Under project SBDI2023_002653, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 10,293 kWh, resulting in a gross energy savings realization rate of 100%.

Project Description

The participant received incentives for installing (308) LED A-19 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
Incandescent to LED A-19 lamp	308	308	23	14	3,438	1.08	10,293	10,293	100%
Total							10,293	10,293	100%

Results

SBDI2023_002653 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	10,293	10,293	100%	3.74	282,400
Total	10,293	10,293	**100%**	**3.74**	

The realized energy savings are 10,293 kWh, resulting in a gross energy savings realization rate of 100%. All the factors used to estimate the savings were collected, with the same values as found in the application.

The realized energy savings estimate is equal to 4% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	5	0.2
HDD	3	0.4
Days	(85)	(0.3)
Post_Flag	(2,125)	(0.6)
Intercept	25,051	2.2

The *Post_Flag* coefficient is linked to an estimated savings of 25,500 kWh, considerably larger than the engineering estimate of the energy savings. The t-statistic is too small to reliably estimate the saving using the billing analysis.

2.1.37. Project Number: SBDI2023_002702

Executive Summary

Under project SBDI2023_002702 a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 3,409 kWh, resulting in a gross energy savings realization rate of 79%.

Project Description

The participant received incentives for installing (98) LED 4' lamps and (6) LED BR30 lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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' T12 to LED 4' lamp	98	98	32	17	2,389	0.94	4,158	3,301	79%
BR30 to LED BR30	6	6	17	9	2,389	0.94	153	108	71%
Total							4,311	3,409	79%

Results

SBDI2023_002702 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	4,311	3,409	79%	2.00	22,805
Total	**4,311**	**3,409**	**79%**	**2.00**	

The realized energy savings are 3,409 kWh, resulting in a gross energy savings realization rate of 79%. The difference between the expected and realized savings was mainly due to the hours of use. The ex post savings analysis used confirmed hours of use (2,389) are less than the hours used in the ex ante savings analysis (3,009). In addition, the efficient wattage for the second measure (9W) is greater than the wattage used in the ex ante savings analysis (8W).

The realized energy savings estimate is equal to 14% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	5	13.6
HDD	1	8.1
Days	0	0.1
Post_Flag	258	4.2
Intercept	852	4.9

The *Post_Flag* coefficient suggests an increase in energy used after the project was completed, but the t-statistic is too small to reliably estimate the saving using the billing analysis. Factors not accounted for in the regression model may also be increasing energy used during the post period.

Part 2

2.1.38. Project Number: SBDI2023_002703

Executive Summary

Under project SBDI2023_002703, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 10,204 kWh, resulting in a gross energy savings realization rate of 79%.

Project Description

The participant received incentives for installing (32) LED BR30 lamps, (7) LED A-19 lamps, and (284) LED 4' lamps.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
BR30 to LED BR30	32	32	17	9	2,389	0.94	815	575	71%
4' Linear to LED 4' Lamp	284	284	32	17	2,389	0.94	12,049	9,566	79%
Incandescent to LED A-19 lamp	7	7	12	8	2,389	0.94	79	63	79%
Total							12,943	10,204	79%

Results

SBDI2023_002703 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	12,943	10,204	79%	6.00	40,400
Total	**12,943**	**10,204**	**79%**	**6.00**	

The realized energy savings are 10,204 kWh, resulting in a gross energy savings realization rate of 79%. The difference between the expected and realized savings was mainly due to the hours of use. Fewer hours of use (2,389) were confirmed for the ex post savings analysis than the hours of use used in the ex ante analysis (3,009). In addition, the efficient wattage for the first measure (9W) is greater than the wattage (8W) used in the ex ante analysis.

The realized energy savings estimate is equal to 14% of the 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	2	0.9
HDD	1	1.6
Days	21	0.7
Post_Flag	4,376	13.2
Intercept	2,354	2.8

The *Post_Flag* coefficient suggests an increase in energy used after the project was completed, but the t-statistic is too small to reliably estimate the saving using the billing analysis. Factors not accounted for in the regression model may also be increasing energy used during the post period. In fact, the site has had increasing energy usage each month in 2023 suggesting there was a change in operations.

2.1.39. Project Number: SBDI2023_002912

Executive Summary

Under project SBDI2023_002912, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 32,908 kWh, resulting in a gross energy savings realization rate of 88%.

Project Description

The participant received incentives for installing (572) LED 4' lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' lamp to LED 4' lamp	572	572	40	18	2,782	0.94	37,211	32,908	88%
Total							37,211	32,908	88%

Results

SBDI2023_002912 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	37,211	32,908	88%	16.61	98,600
Total	**37,211**	**32,908**	**88%**	**16.61**	

The realized energy savings are 32,908 kWh, resulting in a gross energy savings realization rate of 88%. The realized energy savings were less than the expected savings because the verified hours of use (2,782) were less than the hours (3,009) used in the ex ante savings analysis. In addition, the verified specification wattage (18W) is higher than the ex ante wattage (17W).

The realized energy savings estimate is equal to 33% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	14	11.2
HDD	10	17.1
Days	(17)	(0.9)
Post_Flag	(1,534)	(7.3)
Intercept	3,379	4.7

The *Post_Flag* coefficient is associated with an estimate of 18,400 kWh savings, which is less than the ex post savings analysis.

2.1.40. Project Number: SBDI2023_002921

Executive Summary

Under project SBDI2023_002921, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 8,702 kWh, resulting in a gross energy savings realization rate of 78%.

Project Description

The participant received incentives for installing (172) LED 4' lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' T12 to LED 4' lamp	172	172	40	17	2,340	0.94	11,189	8,702	78%
Total							11,189	8,702	78%

Results

SBDI2023_002921 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	11,189	8,702	78%	5.22	98,600
Total	**11,189**	**8,702**	**78%**	**5.22**	

The realized energy savings are 8,702 kWh, resulting in a gross energy savings realization rate of 78%. The realized energy savings were less than the expected savings because the verified hours of use (2,340) were fewer than the ex ante hours (3,009).

The realized energy savings estimate is equal to 9% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	4	2.6
HDD	3	3.5
Days	48	2.2
Post_Flag	(1,011)	(3.8)
Intercept	(856)	(1.2)

The *Post_Flag* coefficient is associated with an estimate of 12,132 kWh savings, which is somewhat greater than the ex post savings result.

2.1.41. Project Number: SBDI2023_002922

Executive Summary

Under project SBDI2023_002922, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 9,916 kWh, resulting in a gross energy savings realization rate of 78%.

Project Description

The participant received incentives for installing (196) LED 4' lamps.

Measurement and Verification Effort

To verify the project savings, the Evaluation Team reviewed project documentation, the baseline wattages, and the post-retrofit connected load. In addition, the site was contacted to verify the measure installation and lighting hours of operation. These data sources were referenced to develop estimates of realized energy impacts.

Lighting energy savings were 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' Linear to LED 4' Lamp	196	196	40	17	2,340	0.94	12,751	9,916	78%
Total							12,751	9,916	78%

Results

SBDI2023_002922 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	12,751	9,916	78%	5.95	27,800
Total	**12,751**	**9,916**	**78%**	**5.95**	

The realized energy savings are 9,916 kWh, resulting in a gross energy savings realization rate of 78%. The realized energy savings were less than the expected savings because the verified hours of use (2,340) were less than the ex ante hours of use (3,009).

The realized energy savings estimate is equal to 36% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	6	5.6
HDD	3	6.6
Days	20	1.2
Post_Flag	(168)	(0.8)
Intercept	(136)	(0.3)

The *Post_Flag* coefficient is associated with an estimate of 2,016 kWh savings. The t-statistic is too small to reliably estimate the saving using the billing analysis and the discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

2.1.42. Project Number: SBDI2023_002962

Executive Summary

Under project SBDI2023_002962, a program participant received incentives from Appalachian Power for upgrading their interior lighting to LED lamps.

The realized energy savings are 60,275 kWh, resulting in a gross energy savings realization rate of 105%.

Project Description

The participant received incentives for installing (608) LED 4' lamps and (1) LED 2' lamp.

Measurement and Verification Effort

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

Lighting energy savings were 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*					
2' T12to 2' LED lamp	2	1	17	9	5,280	1.06	89	90	100%
4' T12 to 4' LED lamp	608	608	31	14	5,280	1.06	57,117	57,848	101%
Total							57,207	57,938	101%

Results

SBDI2023_002962 Project Realized Gross Savings

Measure Category	*kWh Savings*			*Realized Peak kW Reduction*	*2022 Total Energy Usage*
	Expected	*Realized*	*Realization Rate*		
Lighting	57,207	57,938	101%	13.04	272,000
Total	**57,207**	**57,938**	**101%**	**13.04**	

The realized energy savings are 57,938 kWh, resulting in a gross energy savings realization rate of 101%. The verified hours of use (5,280) are slightly greater than the hours of use from the ex-ante savings (5,192).

The realized energy savings estimate is equal to 21% of 2022 annual usage.

Ancillary Econometric Analysis

To further assess the energy savings estimate developed using engineering analysis referenced above, the Evaluation Team also conducted an econometric energy usage analysis using the following equation, with the coefficients determined by a linear regression of the monthly billing data, along with variables to predict the energy usage. The pre-period was a 12 month period prior to the project installation, and the post-period, all months since the project installation.

$$kWh_{monthly} = CDD + HDD + Days + Post\_Flag + Intercept$$

Where:

CDD =*Cooling Degree Days for a given month, assumes a base temperature of 65°F*
HDD = *Heating Degree Days for a given month, assumes a base temperature of 65°F*
Days = *Billing days per period*
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	16	2.7
HDD	1	0.5
Days	57	0.9
Post_Flag	(2,271)	(2.4)
Intercept	19,009	7.8

The *Post_Flag* coefficient is associated with an estimate of 27,252 kWh savings, which is less than the engineering analysis result. The discrepancy between the estimated impact of the project on energy use from the regression model and the engineering analysis indicates the presence of external factors not included in the model that are affecting the estimated energy saved.

3. C&I Program Participant Survey Instrument

1. Thank you for taking this survey to tell us about your experience with Appalachian Power's [program_name] Program. Your feedback is very important to us and will help Appalachian Power improve its programs for customers like you.

   Your responses are confidential and will be used for research purposes only. ADM Associates does not share survey data with third parties for marketing purposes. Our full privacy statement is linked here: admenergy.com/privacy

   Once you have entered a response for each question, use the arrow at the bottom right of the screen to get to the next question.

[Add Captcha]

Screening [do not display]

2. Our records indicate that you are the main contact for the [efficient_measure1] project completed at [location].

Were you involved in the decision to complete this project?

1. Yes
2. No **[TERMINATE AFTER Q3]**

[DISPLAY IF Q3 = 1]

3. Can you provide the contact details for the person most involved in the decision to complete this project?

   Name

   Email

   Phone

Awareness [do not display]

4. 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. From an Appalachian Power Account Representative
3. From a program representative
4. Through an internet search
5. At an event or trade show
6. Received an email blast or electronic newsletter from Appalachian Power
7. From social media post (Facebook, Twitter, LinkedIn)

8. From the Appalachian Power program website
9. From friends or colleagues
10. Other (Please specify)
98. Don't know

5. When considering improvements to increase commercial and industrial energy efficiency, what are the most significant challenges that your organization faces? (Please select all that apply)

[RANDOMIZE 2 – 9]

1. No challenges or barriers
2. High initial cost
3. Understanding potential areas for improvement/lack of technical knowledge
4. Funding competition with other investments/improvements
5. Long payback period/return on investment
6. Lack of awareness about available incentives for energy efficient equipment
7. Lack of corporate support for energy efficiency investments
8. Lack of staff time dedicated to energy efficiency upgrades
9. Don't own building
97. Other (Please specify)
98. Not sure

[Display IF Q5=2-9]

6. What could Appalachian Power do to help organizations like yours overcome the challenges faced when investing in energy efficient equipment?

[Multiselect]

1. Nothing
2. Higher incentives
3. More technical/engineering support
4. Improve application process
5. Something else (Please describe)
98. Not sure

Program Delivery [do not display]

SBDI [Do Not Display] [Display Block if SBDI = 1]

7. How did you sign up for the program?
   1.Used the online portal
   2.Contacted the program by email
   3. The contractor or Trade Ally you hired signed you up
   4. Some other way (Please describe)

8. Did the contractor or Trade Ally you worked with complete a Quick Energy Check-Up (QEC) to identify energy and cost saving opportunities?
   1. Yes
   2. No
   98. Don't know

[DISPLAY IF Q8 = 1]

9. Did you feel like you had all of the information you needed to act on the recommendations that came out of your Quick Energy Check-up (QEC)?
   1. Yes
   2. No
   98. Not sure

[DISPLAY IF Q= 2]

10. Why do you say you didn't have all the information you needed?

[DISPLAY IF Q8= 1]

11. Did the contractor or Trade Ally recommend any other energy efficiency improvements that you chose not to make?
   1. Yes
   2. No
   98. Not sure

[DISPLAY IF Q11= 1]

12. What types of recommended improvements did you choose not to make?
   1. Lighting improvements
   2. Refrigeration improvements (e.g., refrigerated cases)
   3. Commercial kitchen improvements
   4. Hot water improvements (such as hot water pipe wrap or low flow devices)

[DISPLAY IF Q11= 1]

13. Why did you not make those recommended improvements? (Please select all that apply)
   1. Did not want to spend the money
   2. Have not had the time
   3. Did not want to disrupt your business
   4. There isn't a program incentive for the recommended improvements
   5. Did not expect it would make much of a difference
   6. For some other reason (Please describe)

Application Process [Do N6ot Display] [Display Block if SBDI = 0]

14. 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
    4. Other (Please specify) [OPEN ENDED]

15. 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 Q15 = 1 "Yourself"]

16. 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 – Not at all clear
    2
    3
    4
    5 – Completely clear
    Not Applicable or Don't Know

[DISPLAY Q17 ONLY IF Q16 < 4]

17. What information, including instructions on forms, needs to be further clarified?

Equipment Selection [DO NOT DISPLAY]

18. 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 Q19 IF Q18= 1]

19. 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 Q20 IF sbdi = 0]

20. 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 Q21 IF Q20= 1]

21. 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 Q22 IF sbdi = 0]

22. 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 Measure 1 [DO NOT DISPLAY]

23. The next questions are about your decision to [install1] the [efficient_measure1] at the facility located at [location].

Before PARTICIPATING in the program, had you completed a project similar to the [efficient_measure1] [installed1] at the [location] location? Please consider projects completed at this facility or at another facility operated by your organization.

1. Yes
2. No
98. Don't know

[Display if Q23 = 1]

24. Did you complete any of those projects without receiving a program incentive?
    1. Yes
    2. No
    98. Don't know

25. 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

26. Did you have plans to [install1] the [efficient_measure1] at the [location] location before participating in the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q27 IF Q26= 1]

27. Prior to hearing about the program incentive, was the purchase of the [efficient_measure1] included in your organization's capital budget?
    1. Yes
    2. No
    98. Don't know / Not applicable

[DISPLAY Q28 IF Q26 = 1]

28. Had your organization ALREADY ordered or purchased the [efficient_measure1] BEFORE you heard about the program?
    1. Yes
    2. No
    98. Don't know

29. Did the incentive help the [efficient_measure1] project receive implementation approval from your organization?
    1. Yes
    2. No
    98. Don't know / Not applicable

30. Would you have completed the [efficient_measure1] project even if you had not participated in the program?
    1. Yes
    2. No
    98. Don't know

31. Prior to completing this project, did you have previous experience with the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q32 IF Q31 = 1]

32. How important was previous experience with the Appalachian Power-offered program in making your decision to [install1] the [efficient_measure1] 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]

33. Did a program representative or other Appalachian Power representative recommend that you [install1] the [efficient_measure1] at the [location] location?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q34 IF Q33 = 1]

34. If the program representative had not recommended [installing1] the [efficient_measure1], 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]

35. If the contractor or Trade Ally that installed your equipment had not recommended [installing1] the [efficient_measure1], 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

36. Would your organization been financially able to [install1] the [efficient_measure1] at the [location] location without the financial incentive from the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY q37 IF Q36 = 2]

37. 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

38. If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [installed1] the [efficient_measure1] 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 q39 IF q26= 1 AND Q30 = 1 AND Q36 = 2 and q37 = 1]

39. 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 Q40 IF measure_quantity1 > 1]

40. Did you purchase and install more [efficient_measure1] 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 Q41 = IF energy_equipment1= 1]

41. 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 Q42 IF Q41 = 1]

42. What kind of equipment, if any, would you have installed if the information and incentives were not available from the program?
    [OPEN ENDED]

43. Did you [install1] the [efficient_measure1] 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 Q44 IF Q43= 1]

44. 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

Free Ridership Major Measure 2 [DO NOT DISPLAY] [display page if Count_of_measure_types > 1]

45. Before PARTICIPATING in the program, had you completed a project similar to the [efficient_measure2] [installed2] at the [location] location?
    1. Yes
    2. No
    98. Don't know

46. Why did you decide to [install2] the [efficient_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

47. 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

48. Did you have plans to [install2] the [efficient_measure2] at the [location] location before participating in the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q49 IF Q48= 1]

49. Prior to hearing about the program incentive, was the purchase of the [efficient_measure1] included in your organization's capital budget?
    1. Yes
    2. No
    98. Don't know / Not applicable

[DISPLAY Q50IF Q49 = 1]

50. Had your organization ALREADY ordered or purchased the [efficient_measure1] BEFORE you heard about the program?

1. Yes
2. No
98. Don't know

51. Did the incentive help the [efficient_measure1] project receive implementation approval from your organization?
    1. Yes
    2. No
    98. Don't know / Not applicable

52. Would you have completed the [efficient_measure2] project even if you had not participated in the program?
    1. Yes
    2. No
    98. Don't know

53. Prior to completing this project, did you have previous experience with the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q54 IF Q53 = 1]

54. How important was previous experience with the Appalachian Power-offered program in making your decision to [install2] the [efficient_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]

55. Did a program representative or other Appalachian Power representative recommend that you [install2] the [efficient_measure2] at the [location] location?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q56 IF Q55 = 1]

56. If the program representative had not recommended [installing2] the [efficient_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]

57. If the program energy advisor or Trade Ally that installed your equipment had not recommended [installing2] the [efficient_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

58. Would your organization be financially able to [install2] the [efficient_measure2] at the [location] location without the financial incentive from the program?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q59 IF Q58 = 2]

59. 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

60. If the financial incentive from the Appalachian Power-offered program had not been available, how likely is it that you would have [installed2] the [efficient_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 q61 IF q48= 1 AND Q52 =1 AND Q58 = 2 and q59 = 1]

61. 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 Q62 IF MEASURE_QUANT2 > 1]

62. Did you purchase and install more [efficient_measure2] than you otherwise would have without the program?
    1. Yes
    2. No, the program did not affect quantity purchased and installed.
    98. Don't know

[DISPLAY Q63 = IF ENERGY_EQUIP2 = 1]

63. Did you choose equipment that was more energy efficient than you would have chosen because of the program?
    1. Yes
    2. No, the program did not affect level of efficiency chosen for equipment.
    98. Don't know

[DISPLAY Q64 IF Q63= 1]

64. What kind of equipment, if any, would you have installed if the information and incentives were not available from the program?
    [OPEN ENDED]

65. Did you [install2] the [efficient_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 Q66 IF Q65= 1]

66. 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]

[NOTE: THESE QUESTIONS SERVE TO COLLECT DATA TO QUANTIFY SPILLOVER EFFECTS]

67. 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 **[SKIP TO FIRMOGRAPHICS]**

[DISPLAY Q68 if Q67 = 1]

68. 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 (Please describe)
    96. Didn't implement any measures [SKIP TO FIRMOGRAPHICS]

[DISPLAY Q69 if Q67= 1]

69. 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]

[DISPLAY Q70 if Q67= 1]

70. 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 Q71 IF Q68 = 1]

71. 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 Q72 IF Q71 = 20]

72. What other type of lighting equipment did you install?
[TEXT BOX]

[REPEAT Q73 - Q76 FOR EACH TYPE SELECTED IN Q71]

73. How many [Q71 RESPONSE] did you install?
[TEXT BOX] Watts

74. What was the average wattage of the [Q71 RESPONSE]?

75. Were the [Q71 RESPONSE] installed inside, outside, or in a parking garage?
1. Inside
2. Outside
3. Parking garage
98. Don't know

[DISPLAY Q76 IF Q75 = 1]

76. What type of building did you install the [Q71 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 Q77 IF Q75 = 1]

77. Is the inside space heated, cooled, or both?
    1. Heated
    2. Cooled
    3. Both
    98. Don't know

78. What type of lighting did the [Q71 RESPONSE] replace?
    1. T12s (linear fluorescents)
    2. T8s (linear fluorescents)
    3. Metal-halide / High-intensity discharge
    4. incandescent
    5.[DISPLAY IF Q71 = 9, 11, OR 12] Compact fluorescent (CFL)
    6. Something else [OPEN]
    98. Don't know

79. What was the average wattage of the old lamps or bulbs?

80. How many of the old lamps or bulbs did you remove?

[DISPLAY Q81 IF Q71 = 20]

81. 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 Q82 IF Q81 = 1 OR Q81 = 3]

82. How many single-sided LED exit signs did you install?

[DISPLAY Q83 IF Q81 = 1 OR Q81 = 3]

83. How many double-sided LED exit signs did you install?

[DISPLAY Q84 IF Q81 = 98]

84. How many LED exit signs did you install?

[DISPLAY Q85 if Q68 =1]

85. 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 Q86 if Q68 =1]

86. 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 Q87 if [Q85=0,1,2,3 AND Q86=0,1,2,3]

OR IF [Q85=8,9,10 AND Q86=8,9,10]

87. You scored the importance of your program experience to your decision to implement additional lighting measures with [Q85 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 [Q86 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 Q88 IF Q68 = 2]

88. How many fixtures are being controlled by the lighting controls?
    [TEXT BOX]

[DISPLAY Q89 IF Q68 = 2]

89. On average, how many lamps or bulbs does each fixture contain?
    [TEXT BOX]

[DISPLAY Q90 IF Q68 = 2]

90. What is the average wattage of these lamps?

[TEXT BOX]

[DISPLAY Q91 IF Q68 = 2]

91. Are any of the lighting controls that you installed central time clock controls?
    1. Yes
    2. No
    98. Don't know

[DISPLAY Q92 IF Q91 = 1]

92. How many of the fixtures are controlled by the central time clock?
    [TEXT BOX]

[DISPLAY Q93 IF Q68 = 2]

93. 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 Q94 IF Q68 = 2]

94. 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 Q95 if Q68 = 2]

95. 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 Q96 if [Q94=0,1,2,3 AND Q95=0,1,2,3]

OR [Q94=8,9,10 AND Q95=8,9,10]]

96. You scored the importance of your program experience to your decision to implement lighting controls with [Q94 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 [Q95 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 Q97 IF Q68 = 3]

97. 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 Q98 IF Q97 = 6]

98. What other type of HVAC equipment did you install?
[TEXT BOX]

[REPEAT Q99 – Q101 for each selected in Q97]

99. We would like to know more about the rated efficiency and number of units of the [Q97 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.

100. 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

101. What city is the building where you installed the heating/cooling equipment located in?

[TEXT BOX]

[DISPLAY Q102 IF Q97 = 1-7]

102. 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 Q103 IF Q97 = 1-7]

103. 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 Q104 if [Q102=0,1,2,3 AND Q103=0,1,2,3] OR [Q102=8,9,10 AND Q103=8,9,10]]

104. You scored the importance of your program experience to your decision to implement energy efficient HVAC equipment with [Q102 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 [Q103 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 Q105 IF Q68 = 4]

105. How many ENERGY STAR room air conditioners did you install?

[TEXT BOX]

[DISPLAY Q106 IF Q68 = 4]

106. 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 Q107 IF Q68 = 4]

107. What city is the building where you installed the room air conditioners located in?

[TEXT BOX]

[DISPLAY Q108 IF Q68 = 4]

108. 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 Q109 IF Q68 = 4]

109. 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 Q110 if [Q108=0,1,2,3 AND Q109=0,1,2,3] OR [Q108=8,9,10 AND Q109=8,9,10]]

110. You scored the importance of your program experience to your decision to install the energy efficient air conditioners with [Q108 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 [Q109 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 Q111 IF Q68 = 5]

111. How many efficient motors did you install?
[TEXT BOX]

[DISPLAY Q112 IF Q68 = 5]

112. 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 Q113 IF Q68 = 5]

113. 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 Q114 IF Q68 = 5]

114. On average, how many hours per day do the motors operate? That is, what is the average number of hours the motors you installed operate?
[TEXT BOX] hours per day

[DISPLAY Q115 IF Q68 = 5]

115. 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 Q116 IF Q68 = 5]

116. 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 Q117 if [Q115=0,1,2,3 AND Q116=0,1,2,3] OR [Q115=8,9,10 AND Q116=8,9,10]]

117. You scored the importance of your program experience to your decision to implement efficient motors with [Q115 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 [Q116 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 Q118 IF Q68 = 6]

118. 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 Q119 IF Q118 = 6]

119. What other type of energy efficient refrigeration equipment did you install?
[TEXT BOX]

[DISPLAY Q120 IF Q118 = 1]

120. How many ENERGY STAR commercial freezers did you install?
[TEXT BOX]

[DISPLAY Q121 IF Q120 = 1, REPEAT FOR EACH UP TO THREE TIMES]

121. What is the volume in cubic feet of the first freezer?
[TEXT BOX]

[DISPLAY Q122 IF Q120 = 1, REPEAT FOR EACH UP TO THREE TIMES]

122. Does this freezer have a solid door or a glass door?
1. Solid door
2. Glass door
98. Don't know

[DISPLAY Q123 IF Q120 = 1, REPEAT FOR EACH UP TO THREE TIMES]

123. Is this a vertical freezer or a chest type freezer?
1. Vertical
2. Chest
98. Don't know

[DISPLAY Q124 IF Q118 = 2]

124. How many ENERGY STAR commercial refrigerators did you install?
[TEXT BOX] refrigerators

[DISPLAY Q125 IF Q124 = 2, REPEAT FOR EACH UP TO THREE TIMES]

125. What is the volume in cubic feet of the first refrigerator?
[TEXT BOX] cubic feet

[DISPLAY Q126 IF Q124 = 2, REPEAT FOR EACH UP TO THREE TIMES]

126. Does this refrigerator have a solid door or a glass door?
1. Solid door
2. Glass door
98. Don't know

[DISPLAY Q127 IF Q124 = 2, REPEAT FOR EACH UP TO THREE TIMES]

127. Is this a vertical refrigerator or a chest type refrigerator?
1. Vertical
2. Chest
98. Don't know

[DISPLAY Q128 IF Q118 = 3]

128. 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 Q129 IF Q128= 1 OR 3]

129. How many humidity-based controls did you install?
[TEXT BOX]

[DISPLAY Q130 IF Q128= 1 OR 3]

130. What is the total number of freezer or refrigerator doors controlled by the humidity-based controls?
[TEXT BOX]

[DISPLAY Q131 IF Q128= 2 OR 3]

131. How many conductivity-based controls did you install?
[TEXT BOX]

[DISPLAY Q132 IF Q128= 2 OR 3]

132. What is the total number of freezer or refrigerator doors controlled by the conductivity-based controls?
[TEXT BOX]

[DISPLAY Q133 IF Q128 = 98]

133. How many anti-sweat heater controls did you install?
[TEXT BOX]

[DISPLAY Q134 IF Q128 = 98]

134. What is the total number of freezer or refrigerator doors controlled by the anti-sweat heater controls?
[TEXT BOX]

[DISPLAY Q135 IF Q118 = 4]

135. How many linear feet in total of LED case lighting did you install?
[TEXT BOX]

[DISPLAY Q136 IF Q118 = 5]

136. How many linear feet of refrigerated case covers did you install?
[TEXT BOX]

[DISPLAY Q137 if Q68=6]

137. 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 Q138 if Q68=6]

138. 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 Q139 if [Q137=0,1,2,3 AND Q138=0,1,2,3] AND [Q137=8,9,10 AND Q138=8,9,10]]

139. You scored the importance of your program experience to your decision to implement energy efficient refrigeration equipment with [Q137 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 [Q138 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 Q140 IF Q68 = 7]

140. 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 Q141 IF Q140 = 8]

141. What other type of kitchen equipment did you install?
[TEXT BOX]

[DISPLAY Q142 IF Q140 = 1]

142. 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 Q143 IF Q140 = 1]

143. 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 Q144 IF Q140 = 1]

144. Did you install the pre-rinse spray valves that the [location] location?
1. Yes
2. No
98. Don't know

[DISPLAY Q145 IF Q144= 2]

145. In what city is the building where you installed the pre-rinse spray valves located in?
[TEXT BOX]

[DISPLAY Q146 IF Q140 = 2]

146. How many ENERGY STAR commercial fryers did you install?
[TEXT BOX]

[DISPLAY Q147 IF Q140 = 3]

147. 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 Q148 IF Q140 = 4]

148. How many ENERGY STAR hot food holding cabinets did you install?
[TEXT BOX]

[DISPLAY Q149 IF Q140 = 5]

149. How many ENERGY STAR commercial griddles did you install?
[TEXT BOX]

[DISPLAY Q150 IF Q140 = 6]

150. How many ENERGY STAR commercial convection ovens did you install?
[TEXT BOX]

[DISPLAY Q151 IF Q140 = 7]

151. How many ENERGY STAR commercial combination ovens did you install?
[TEXT BOX]

[DISPLAY Q152 if Q68= 7 and Q140=1-8]

152. 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 Q153 if Q68= 7 and Q140=1-8]

153. 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 Q139 if [Q152=0,1,2,3 AND Q153=0,1,2,3] OR [Q152=8,9,10 AND Q153=8,9,10]]

154. You scored the importance of your program experience to your decision to implement energy efficient kitchen equipment with [Q152 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 [Q153 RESPONSE] out of 10 possible points.

Can you please explain the role the program made in your decision to implement this measure?
[TEXT BOX]

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.

155. 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

156. Using a scale where 1 means completely dissatisfied and 5 means very satisfied, how satisfied are you with:
[FOR EACH, 1 = 1 – Very dissatisfied, 2 = 2, 3 = 3, 4 = 4, 5 = 5 – Very satisfied, 98 = Not Applicable or Don't know]

a) **[DISPLAY IF Q155 = 1]** how long it took program staff to address your questions or concerns
b) **[DISPLAY IF Q155 = 1]** how thoroughly they addressed your question or concern
c) the equipment that was installed
d) **[DISPLAY IF Q22 = 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 Q156 <3]

157. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above.

[DISPLAY IF Q156g <3]

158. 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 Q158 = 1 - 7]

159. What is the specific type(s) of equipment that you are interested in?

160. Do you have any suggestions for improving the program or on energy efficiency in commercial and industrial facilities?

Firmographics [DO NOT DISPLAY]

161. 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)
99. Prefer not to state

162. 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 describe)
98. Don't know

163. 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)

164. 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

4. C&I Program Participant Survey Results

4.1. BES

Q5 - 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	41.7%	5
2	From an Appalachian Power Account Representative	16.7%	2
3	From a program representative	0.0%	0
4	Through an internet search	16.7%	2
5	At an event or trade show	0.0%	0
6	Received an email blast or electronic newsletter from Appalachian Power	0.0%	0
7	From social media post (Facebook, Twitter, LinkedIn)	0.0%	0
8	From the Appalachian Power program website	8.3%	1
9	From friends or colleagues	16.7%	2
10	Other	0.0%	0
	Total	100%	12

Q6 - When considering improvements to increase commercial and industrial energy efficiency, what are the most significant challenges that your organization faces? (Please select all that apply)

#	Answer	%	Count
1	No challenges or barriers	7.7%	1
2	High initial cost	38.5%	5

3	Understanding potential areas for improvement/lack of technical knowledge	23.1%	3
4	Funding competition with other investments/improvements	0.0%	0
5	Long payback period/return on investment	38.5%	5
6	Lack of awareness about available incentives for energy efficient equipment	15.4%	2
7	Lack of corporate support for energy efficiency investments	0.0%	0
8	Lack of staff time dedicated to energy efficiency upgrades	23.1%	3
9	Don't own building	0.0%	0
10	Other (Please specify)	23.1%	3
98	Not sure	0.0%	0
	Total	100%	13

Q7 - What could Appalachian Power do to help organizations like yours overcome the challenges faced when investing in energy efficient equipment?

#	Answer	%	Count
1	Nothing	0.0%	0
2	Higher incentives	66.7%	8
3	More technical/engineering support	16.7%	2
4	Improve application process	16.7%	2
5	Something else (Please describe)	16.7%	2
98	Not sure	0.0%	0
	Total	100%	12

Q8 - How did you sign up for the program?

#	Answer	%	Count
1	Used the online portal	0.0%	0
3	The contractor or Trade Ally you hired signed you up	0.0%	0
4	Some other way (Please describe)	0.0%	0
2	Contacted the program by email	0.0%	0
	Total		0

Q9 - Did the contractor or Trade Ally you worked with complete a Quick Energy Check-Up (QEC) to identify energy and cost saving opportunities?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q10 - Did you feel like you had all of the information you needed to act on the recommendations that came out of your Quick Energy Check-up (QEC)?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q12 - Did the contractor or Trade Ally recommend any other energy efficiency improvements that you chose not to make?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q13 - What types of recommended improvements did you choose not to make?

#	Answer	%	Count
1	Lighting improvements	0.0%	0
2	Refrigeration improvements (e.g., refrigerated cases)	0.0%	0
3	Commercial kitchen improvements	0.0%	0
4	Hot water improvements (such as hot water pipe wrap or low flow devices)	0.0%	0
	Total		0

Q14 - Why did you not make those recommended improvements? (Please select all that apply)

#	Answer	%	Count
1	Did not want to spend the money	0.0%	0
2	Have not had the time	0.0%	0
3	Did not want to disrupt your business	0.0%	0
4	There isn't a program incentive for the recommended improvements	0.0%	0
5	Did not expect it would make much of a difference	0.0%	0
6	For some other reason (Please describe)	0.0%	0
	Total		0

Q15 - 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	61.5%	8
2	Your vendor or contractor initiated it	23.1%	3
3	The idea arose in discussion between your organization and your vendor or contractor	7.7%	1
4	Other (Please specify)	7.7%	1
98	Don't Know	0.0%	0
	Total	100%	13

Q16 - 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	75.0%	9
2	Another member of your company	16.7%	2
3	A contractor	16.7%	2
4	An equipment vendor	8.3%	1
5	A designer or architect	0.0%	0
6	Program Representative	25.0%	3
	Total	100%	12

Q17 - 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	33.3%	3
4	4	33.3%	3
5	5 – Completely clear	33.3%	3
6	Not Applicable or Don't Know	0.0%	0
	Total	100%	9

Q19 - 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	53.8%	7
2	No	46.2%	6
	Total	100%	13

Q20 - Did you install any of that equipment WITHOUT applying for a financial incentive through an energy efficiency program?

#	Answer	%	Count
1	Yes	66.7%	4
2	No	33.3%	2
	Total	100%	6

Q21 - Did a program representative provide on-site assistance in planning and specifying equipment for your project completed at [Field-location]?

#	Answer	%	Count
1	Yes	8.3%	1
2	No	91.7%	11
	Total	100%	12

Q22 - 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	100.0%	1
2	Moderate to large effect on decision	0.0%	0
3	Small effect on decision	0.0%	0
4	Input did not affect decision	0.0%	0
	Total	100%	1

Q23 - Who installed your program-qualified equipment or efficiency upgrades? Was it...

#	Answer	%	Count
1	Your own staff	30.8%	4
2	A contractor you've worked with before	61.5%	8
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

Q24 - The next questions are about your decision to [Field-install1] the [Field-efficient_measure1] at the facility located at [Field-location]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-efficient_measure1] [Field-installed1] at the [Field-location]? Please consider projects completed at this facility or at another facility operated by your organization.

#	Answer	%	Count
1	Yes	61.5%	8
2	No	38.5%	5
98	Don't know	0.0%	0
	Total	100%	13

Q25 - Did you complete any of those projects without receiving a program incentive?

#	Answer	%	Count
1	Yes	50.0%	4
2	No	37.5%	3
98	Don't know	12.5%	1
	Total	100%	8

Q26 - 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	53.8%	7
2	After	38.5%	5
98	Don't know	7.7%	1
	Total	100%	13

Q27 - Did you have plans to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location before participating in the program?

#	Answer	%	Count
1	Yes	69.2%	9
2	No	30.8%	4
98	Don't know	0.0%	0
	Total	100%	13

Q28 - Prior to hearing about the program incentive, was the purchase of the [Field-efficient_measure1] included in your organization's capital budget?

#	Answer	%	Count
1	Yes	66.7%	6
2	No	33.3%	3
98	Don't know / Not applicable	0.0%	0
	Total	100%	9

Q29 - Had your organization ALREADY ordered or purchased the [Field-efficient_measure1] BEFORE you heard about the program?

#	Answer	%	Count
1	Yes	22.2%	2
2	No	77.8%	7
98	Don't know	0.0%	0
	Total	100%	9

Q30 - Did the incentive help the [Field-efficient_measure1] project receive implementation approval from your organization?

#	Answer	%	Count
1	Yes	69.2%	9
2	No	30.8%	4
98	Don't know / Not applicable	0.0%	0
	Total	100%	13

Q31 - Would you have completed the [Field-efficient_measure1] project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	46.2%	6
2	No	30.8%	4
98	Don't know	23.1%	3
	Total	100%	13

Q32 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	30.8%	4
2	No	69.2%	9
	Total	100%	13

Q33 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location? Would you say that it was...

#	Answer	%	Count
1	Very important	75.0%	3
2	Somewhat important	25.0%	1
3	Only slightly important	0.0%	0
4	Not at all important	0.0%	0
98	Don't know	0.0%	0
	Total	100%	4

Q34 - Did a program representative or other Appalachian Power representative recommend that you [Field-install1] the [Field-efficient_measure1] at the [Field-location] location?

#	Answer	%	Count
1	Yes	15.4%	2
2	No	84.6%	11
	Total	100%	13

Q35 - If the program representative had not recommended [Field-installing1] the [Field-efficient_measure1], 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}	100.0%	2
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	0.0%	0
	Total	100%	2

Q36 - If the contractor or Trade Ally that installed your equipment had not recommended [Field-installing1] the [Field-efficient_measure1], 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

Q37 - Would your organization been financially able to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	76.9%	10
2	No	15.4%	2
98	Don't know	7.7%	1
	Total	100%	13

Q38 - 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	100.0%	2
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	2

Q39 - 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-efficient_measure1] at the [Field-location] location anyway?

#	Answer	%	Count
1	Definitely would have ${e://Field/installed1}	23.1%	3
2	Probably would have ${e://Field/installed1}	23.1%	3
3	Probably would not have ${e://Field/installed1}	30.8%	4
4	Definitely would not have ${e://Field/installed1}	7.7%	1
98	Don't know	15.4%	2
	Total	100%	13

Q41 - Did you purchase and install more [Field-efficient_measure1] 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.	46.2%	6
98	Don't know	0.0%	0
	Total	100%	13

Q42 - 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.	76.9%	10
98	Don't know	0.0%	0
	Total	100%	13

Q44 - Did you [Field-install1] the [Field-efficient_measure1] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	46.2%	6
2	No, program did not affect did not affect timing of project.	46.2%	6
98	Don't know	7.7%	1
	Total	100%	13

Q45 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	0.0%	0
2	6-12 months later	33.3%	2
3	1-2 years later	16.7%	1
4	3-5 years later	16.7%	1
5	More than 5 years later	33.3%	2
98	Don't know	0.0%	0
	Total	100%	6

Q46 - The next questions are about your decision to [Field-install2] the [Field-efficient_measure2] at the facility located at [Field-location]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-efficient_measure2] [Field-installed2] at the [Field-location] location?

#	Answer	%	Count
1	Yes	100.0%	2
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	2

Q47 - Did you complete any of those projects without receiving a program incentive?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q48 - 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	100.0%	2
98	Don't know	0.0%	0
	Total	100%	2

Q49 - Did you have plans to [Field-install2] the [Field-efficient_measure2] at the [Field-location] location before participating in the program?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	50.0%	1
	Total	100%	2

Q50 - Prior to hearing about the program incentive, was the purchase of the [Field-efficient_measure2] included in your organization's capital budget?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don't know / Not applicable	0.0%	0
	Total	100%	1

Q51 - Had your organization ALREADY ordered or purchased the [Field-efficient_measure2] BEFORE you heard about the program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

Q52 - Did the incentive help the [Field-efficient_measure2] project receive implementation approval from your organization?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	50.0%	1
98	Don't know / Not applicable	0.0%	0
	Total	100%	2

Q53 - Would you have completed the [Field-efficient_measure2] project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q54 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	2
98	Don't know	0.0%	0
	Total	100%	2

Q55 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-install2] the [Field-efficient_measure2] 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

Q56 - Did a program representative or other Appalachian Power representative recommend that you [Field-install2] the [Field-efficient_measure2] at the [Field-location] location?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q57 - If the program representative had not recommended [Field-installing2] the [Field-efficient_measure2], 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}	100.0%	1
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	100%	1

Q58 - If the contractor or Trade Ally that installed your equipment had not recommended [Field-installing2] the [Field-efficient_measure2], 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

Q59 - Would your organization been financially able to [Field-install2] the [Field-efficient_measure2] at the [Field-location] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	50.0%	1
2	No	0.0%	0
98	Don't know	50.0%	1
	Total	100%	2

Q60 - 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
98	Don't know	0.0%	0
	Total		0

Q61 - 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-efficient_measure2] 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}	50.0%	1
3	Probably would not have ${e://Field/installed2}	0.0%	0
4	Definitely would not have ${e://Field/installed2}	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q63 - Did you purchase and install more [Field-efficient_measure2] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	50.0%	1
2	No, program did not affect quantity purchased and installed.	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q64 - 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.	100.0%	2
98	Don't know	0.0%	0
	Total	100%	2

Q66 - Did you [Field-install2] the [Field-efficient_measure2] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	50.0%	1
2	No, program did not affect did not affect timing of project.	50.0%	1
98	Don't know	0.0%	0
	Total	100%	2

Q67 - 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	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q68 - 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	23.1%	3
2	No, not that you are aware of	76.9%	10
	Total	100%	13

Q69 - What additional energy efficient equipment have you installed?

#	Answer	%	Count
1	Lighting	66.7%	2
2	Lighting controls or occupancy sensors	0.0%	0
3	LED exit signs	66.7%	2
4	Unitary or split air conditioning system or chiller	33.3%	1
5	ENERGY STAR Room air conditioners	0.0%	0
6	Efficient motors	66.7%	2
7	Refrigeration equipment (including LED case lighting)	33.3%	1
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

Q117_8_TEXT - Something else

Something else (Please describe) - Text

Q70 - Why didn't you receive incentives for those items?

#	Answer	%	Count
1	Didn't know whether equipment qualified for financial incentives	33.3%	1
2	Equipment did not qualify for financial incentives	33.3%	1
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)	33.3%	1
	Total	100%	3

Q118_9_TEXT - Other (Please specify)

Other (Please specify) - Text

All this is done in Roanoke through our Sustainability Group

Q162 - 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	11.1%	1	88.9%	8	9
2	how thoroughly they addressed your question or concern	0.0%	0	0.0%	0	0.0%	0	22.2%	2	77.8%	7	9
3	the equipment that was installed	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	12	12
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	8.3%	1	25.0%	3	66.7%	8	12
6	the amount of time it took to get your rebate or incentive	0.0%	0	0.0%	0	9.1%	1	9.1%	1	81.8%	9	11
7	the range of equipment that qualifies for incentives	8.3%	1	0.0%	0	8.3%	1	8.3%	1	75.0%	9	12
8	the program, overall	0.0%	0	8.3%	1	0.0%	0	16.7%	2	75.0%	9	12

Q164 - 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

Q167 - What is your job title or role?

#	Answer	%	Count
1	Facilities Manager	25.0%	3
2	Energy Manager	0.0%	0
3	Other facilities management/maintenance position	8.3%	1
4	Chief Financial Officer	25.0%	3
5	Other financial/administrative position	0.0%	0
6	Proprietor/Owner	8.3%	1
7	President/CEO	8.3%	1
8	Manager	8.3%	1
9	Other (Please describe)	16.7%	2
	Total	100%	12

Q168 - What is the type of work that your firm or organization does at [Field-location]?

#	Answer	%	Count
1	Industrial	16.7%	2
2	Restaurant - not fast food	0.0%	0
3	Fast food restaurant	0.0%	0
4	Retail	8.3%	1
5	Office	0.0%	0
6	Grocery and convenience	8.3%	1
7	School	8.3%	1
8	Lodging	0.0%	0
9	Warehouse	8.3%	1
10	Other (Please describe)	50.0%	6
	Total	100%	12

Q170 - 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	18.2%	2
2	5,001 to 10,000	9.1%	1
3	10,001 to 20,000	0.0%	0
4	20,001 to 50,000	9.1%	1
5	50,001 to 75,000	9.1%	1
6	75,001 to 100,000	18.2%	2
7	100,001 to 250,000	9.1%	1
8	250,001 to 500,000	27.3%	3
9	500,001 to 1,000,000	0.0%	0
10	More than 1,000,000	0.0%	0
	Total	100%	11

4.2. SBDI

Q5 - 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	70.6%	12
2	From an Appalachian Power Account Representative	5.9%	1
3	From a program representative	0.0%	0
4	Through an internet search	0.0%	0
5	At an event or trade show	0.0%	0
6	Received an email blast or electronic newsletter from Appalachian Power	0.0%	0
7	From social media post (Facebook, Twitter, LinkedIn)	0.0%	0
8	From the Appalachian Power program website	0.0%	0
9	From friends or colleagues	23.5%	4
10	Other	0.0%	0
	Total	100%	17

Q6 - When considering improvements to increase commercial and industrial energy efficiency, what are the most significant challenges that your organization faces? (Please select all that apply)

#	Answer	%	Count
1	No challenges or barriers	11.8%	2
2	High initial cost	64.7%	11
3	Understanding potential areas for improvement/lack of technical knowledge	11.8%	2
4	Funding competition with other investments/improvements	5.9%	1
5	Long payback period/return on investment	5.9%	1
6	Lack of awareness about available incentives for energy efficient equipment	17.6%	3
7	Lack of corporate support for energy efficiency investments	0.0%	0
8	Lack of staff time dedicated to energy efficiency upgrades	0.0%	0
9	Don't own building	5.9%	1
10	Other (Please specify)	5.9%	1
98	Not sure	11.8%	2
	Total	100%	17

Q7 - What could Appalachian Power do to help organizations like yours overcome the challenges faced when investing in energy efficient equipment?

#	Answer	%	Count
1	Nothing	7.7%	1
2	Higher incentives	61.5%	8
3	More technical/engineering support	23.1%	3
4	Improve application process	7.7%	1
5	Something else (Please describe)	7.7%	1
98	Not sure	0.0%	0
	Total	100%	13

Q8 - How did you sign up for the program?

#	Answer	%	Count
1	Used the online portal	17.6%	3
3	The contractor or Trade Ally you hired signed you up	76.5%	13
4	Some other way (Please describe)	0.0%	0
2	Contacted the program by email	5.9%	1
	Total	100%	17

Q9 - Did the contractor or Trade Ally you worked with complete a Quick Energy Check-Up (QEC) to identify energy and cost saving opportunities?

#	Answer	%	Count
1	Yes	76.5%	13
2	No	5.9%	1
98	Don't know	17.6%	3
	Total	100%	17

Q10 - Did you feel like you had all of the information you needed to act on the recommendations that came out of your Quick Energy Check-up (QEC)?

#	Answer	%	Count
1	Yes	100.0%	13
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	13

Q12 - Did the contractor or Trade Ally recommend any other energy efficiency improvements that you chose not to make?

#	Answer	%	Count
1	Yes	7.7%	1
2	No	69.2%	9
98	Don't know	23.1%	3
	Total	100%	13

Q13 - What types of recommended improvements did you choose not to make?

#	Answer	%	Count
1	Lighting improvements	0.0%	0
2	Refrigeration improvements (e.g., refrigerated cases)	100.0%	1
3	Commercial kitchen improvements	0.0%	0
4	Hot water improvements (such as hot water pipe wrap or low flow devices)	0.0%	0
	Total	100%	1

Q14 - Why did you not make those recommended improvements? (Please select all that apply)

#	Answer	%	Count
1	Did not want to spend the money	0.0%	0
2	Have not had the time	0.0%	0
3	Did not want to disrupt your business	0.0%	0
4	There isn't a program incentive for the recommended improvements	0.0%	0
5	Did not expect it would make much of a difference	100.0%	1
6	For some other reason (Please describe)	0.0%	0
	Total	100%	1

Q15 - 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	0.0%	0
2	Your vendor or contractor initiated it	0.0%	0
3	The idea arose in discussion between your organization and your vendor or contractor	0.0%	0
4	Other (Please specify)	0.0%	0
98	Don't Know	0.0%	0
	Total		0

Q16 - 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	0.0%	0
2	Another member of your company	0.0%	0
3	A contractor	0.0%	0
4	An equipment vendor	0.0%	0
5	A designer or architect	0.0%	0
6	Program Representative	0.0%	0
	Total		0

Q17 - 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	0.0%	0
5	5 – Completely clear	0.0%	0
6	Not Applicable or Don't Know	0.0%	0
	Total		0

Q19 - 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	43.8%	7
2	No	56.3%	9
	Total	100%	16

Q20 - Did you install any of that equipment WITHOUT applying for a financial incentive through an energy efficiency program?

#	Answer	%	Count
1	Yes	100.0%	5
2	No	0.0%	0
	Total	100%	5

Q21 - Did a program representative provide on-site assistance in planning and specifying equipment for your project completed at [Field-location]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

Q22 - 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	0.0%	0
4	Input did not affect decision	0.0%	0
	Total		0

Q23 - 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	0.0%	0
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		0

Q24 - The next questions are about your decision to [Field-install1] the [Field-efficient_measure1] at the facility located at [Field-location]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-efficient_measure1] [Field-installed1] at the [Field-location]? Please consider projects completed at this facility or at another facility operated by your organization.

#	Answer	%	Count
1	Yes	23.5%	4
2	No	76.5%	13
98	Don't know	0.0%	0
	Total	100%	17

Q25 - Did you complete any of those projects without receiving a program incentive?

#	Answer	%	Count
1	Yes	50.0%	2
2	No	50.0%	2
98	Don't know	0.0%	0
	Total	100%	4

Q26 - 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	64.7%	11
2	After	23.5%	4
98	Don't know	11.8%	2
	Total	100%	17

Q27 - Did you have plans to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location before participating in the program?

#	Answer	%	Count
1	Yes	35.3%	6
2	No	64.7%	11
98	Don't know	0.0%	0
	Total	100%	17

Q28 - Prior to hearing about the program incentive, was the purchase of the [Field-efficient_measure1] included in your organization's capital budget?

#	Answer	%	Count
1	Yes	66.7%	4
2	No	33.3%	2
98	Don't know / Not applicable	0.0%	0
	Total	100%	6

Q29 - Had your organization ALREADY ordered or purchased the [Field-efficient_measure1] BEFORE you heard about the program?

#	Answer	%	Count
1	Yes	50.0%	3
2	No	50.0%	3
98	Don't know	0.0%	0
	Total	100%	6

Q30 - Did the incentive help the [Field-efficient_measure1] project receive implementation approval from your organization?

#	Answer	%	Count
1	Yes	94.1%	16
2	No	5.9%	1
98	Don't know / Not applicable	0.0%	0
	Total	100%	17

Q31 - Would you have completed the [Field-efficient_measure1] project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	29.4%	5
2	No	64.7%	11
98	Don't know	5.9%	1
	Total	100%	17

Q32 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	5.9%	1
2	No	94.1%	16
	Total	100%	17

Q33 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location? Would you say that it was...

#	Answer	%	Count
1	Very important	100.0%	1
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	100%	1

Q34 - Did a program representative or other Appalachian Power representative recommend that you [Field-install1] the [Field-efficient_measure1] at the [Field-location] location?

#	Answer	%	Count
1	Yes	43.8%	7
2	No	56.3%	9
	Total	100%	16

Q35 - If the program representative had not recommended [Field-installing1] the [Field-efficient_measure1], how likely is it that you would have [Field-installed1] it anyway?

#	Answer	%	Count
1	Definitely would have ${e://Field/installed1}	14.3%	1
2	Probably would have ${e://Field/installed1}	28.6%	2
3	Probably would not have ${e://Field/installed1}	14.3%	1
4	Definitely would not have ${e://Field/installed1}	42.9%	3
98	Don't know	0.0%	0
	Total	100%	7

Q36 - If the contractor or Trade Ally that installed your equipment had not recommended [Field-installing1] the [Field-efficient_measure1], how likely is it that you would have [Field-installed1] it anyway?

#	Answer	%	Count
1	Definitely would have	18.8%	3
2	Probably would have	25.0%	4
3	Probably would not have	31.3%	5
4	Definitely would not have	25.0%	4
98	Don't know	0.0%	0
	Total	100%	16

Q37 - Would your organization been financially able to [Field-install1] the [Field-efficient_measure1] at the [Field-location] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	58.8%	10
2	No	41.2%	7
98	Don't know	0.0%	0
	Total	100%	17

Q38 - 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	85.7%	6
2	No	0.0%	0
98	Don't know	14.3%	1
	Total	100%	7

Q39 - 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-efficient_measure1] at the [Field-location] location anyway?

#	Answer	%	Count
1	Definitely would have ${e://Field/installed1}	23.5%	4
2	Probably would have ${e://Field/installed1}	11.8%	2
3	Probably would not have ${e://Field/installed1}	41.2%	7
4	Definitely would not have ${e://Field/installed1}	23.5%	4
98	Don't know	0.0%	0
	Total	100%	17

Q41 - Did you purchase and install more [Field-efficient_measure1] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	76.5%	13
2	No, program did not affect quantity purchased and installed.	17.6%	3
98	Don't know	5.9%	1
	Total	100%	17

Q42 - Did you choose equipment that was more energy efficient than you would have chosen because of the program?

#	Answer	%	Count
1	Yes	26.7%	4
2	No, program did not affect level of efficiency chosen for equipment.	60.0%	9
98	Don't know	13.3%	2
	Total	100%	15

Q44 - Did you [Field-install1] the [Field-efficient_measure1] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	70.6%	12
2	No, program did not affect did not affect timing of project.	17.6%	3
98	Don't know	11.8%	2
	Total	100%	17

Q45 - When would you otherwise have completed the project?

#	Answer	%	Count
1	Less than 6 months later	8.3%	1
2	6-12 months later	16.7%	2
3	1-2 years later	8.3%	1
4	3-5 years later	8.3%	1
5	More than 5 years later	33.3%	4
98	Don't know	25.0%	3
	Total	100%	12

Q46 - The next questions are about your decision to [Field-install2] the [Field-efficient_measure2] at the facility located at [Field-location]. Before PARTICIPATING in the program, had you completed a project similar to the [Field-efficient_measure2] [Field-installed2] at the [Field-location] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q47 - Did you complete any of those projects without receiving a program incentive?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q48 - 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	100.0%	1
2	After	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

Q49 - Did you have plans to [Field-install2] the [Field-efficient_measure2] at the [Field-location] location before participating in the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
	Total	100%	1

Q50 - Prior to hearing about the program incentive, was the purchase of the [Field-efficient_measure2] included in your organization's capital budget?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know / Not applicable	0.0%	0
	Total		0

Q51 - Had your organization ALREADY ordered or purchased the [Field-efficient_measure2] BEFORE you heard about the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

Q52 - Did the incentive help the [Field-efficient_measure2] project receive implementation approval from your organization?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don't know / Not applicable	0.0%	0
	Total	100%	1

Q53 - Would you have completed the [Field-efficient_measure2] project even if you had not participated in the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q54 - Prior to completing this project, did you have previous experience with the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q55 - How important was previous experience with the Appalachian Power-offered program in making your decision to [Field-install2] the [Field-efficient_measure2] 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

Q56 - Did a program representative or other Appalachian Power representative recommend that you [Field-install2] the [Field-efficient_measure2] at the [Field-location] location?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q57 - If the program representative had not recommended [Field-installing2] the [Field-efficient_measure2], 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

Q58 - If the contractor or Trade Ally that installed your equipment had not recommended [Field-installing2] the [Field-efficient_measure2], 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	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q59 - Would your organization been financially able to [Field-install2] the [Field-efficient_measure2] at the [Field-location] location without the financial incentive from the program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

Q60 - 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
98	Don't know	0.0%	0
	Total		0

Q61 - 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-efficient_measure2] 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}	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q63 - Did you purchase and install more [Field-efficient_measure2] than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No, program did not affect quantity purchased and installed.	0.0%	0
98	Don’t know	0.0%	0
	Total	100%	1

Q64 - 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

Q66 - Did you [Field-install2] the [Field-efficient_measure2] earlier than you otherwise would have without the program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No, program did not affect did not affect timing of project.	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

Q67 - 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	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

Q68 - 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	11.8%	2
2	No, not that you are aware of	88.2%	15
	Total	100%	17

Q69 - What additional energy efficient equipment have you installed?

#	Answer	%	Count
1	Lighting	100.0%	2
2	Lighting controls or occupancy sensors	50.0%	1
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%	2

Q70 - Why didn't you receive incentives for those items?

#	Answer	%	Count
1	Didn't know whether equipment qualified for financial incentives	50.0%	1
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)	50.0%	1
	Total	100%	2

Q162 - 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%	6	6
2	how thoroughly they addressed your question or concern	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	6	6
3	the equipment that was installed	0.0%	0	5.9%	1	0.0%	0	0.0%	0	94.1%	16	17
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	11.8%	2	88.2%	15	17
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%	15	15
7	the range of equipment that qualifies for incentives	0.0%	0	0.0%	0	0.0%	0	31.3%	5	68.8%	11	16
8	the program, overall	0.0%	0	0.0%	0	6.3%	1	12.5%	2	81.3%	13	16

Q164 - 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

Q167 - What is your job title or role?

#	Answer	%	Count
1	Facilities Manager	26.7%	4
2	Energy Manager	0.0%	0
3	Other facilities management/maintenance position	0.0%	0
4	Chief Financial Officer	0.0%	0
5	Other financial/administrative position	0.0%	0
6	Proprietor/Owner	13.3%	2
7	President/CEO	13.3%	2
8	Manager	13.3%	2
9	Other (Please describe)	33.3%	5
	Total	100%	15

Q168 - What is the type of work that your firm or organization does at [Field-location]?

#	Answer	%	Count
1	Industrial	0.0%	0
2	Restaurant - not fast food	12.5%	2
3	Fast food restaurant	0.0%	0
4	Retail	6.3%	1
5	Office	0.0%	0
6	Grocery and convenience	12.5%	2
7	School	0.0%	0
8	Lodging	6.3%	1
9	Warehouse	0.0%	0
10	Other (Please describe)	62.5%	10
	Total	100%	16

Q170 - 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	14.3%	2
2	5,001 to 10,000	21.4%	3
3	10,001 to 20,000	28.6%	4
4	20,001 to 50,000	21.4%	3
5	50,001 to 75,000	14.3%	2
6	75,001 to 100,000	0.0%	0
7	100,001 to 250,000	0.0%	0
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%	14

5. Confidential: EM&V Costs

Information relating to PY2023 EM&V costs is presented in Table 5-1.

Table 5-1 PY2023 EM&V Costs

Program	*EM&V Cost*
Business Energy Solutions	[redacted]
Custom Pilot	[redacted]
Small Business Direct Install Program	[redacted]
C&I Portfolio Total	[redacted]