APPENDIX J – MERCANTILE EM&V REPORT

Ohio Edison Company
The Cleveland Electric Illuminating Company
The Toledo Edison Company

2019 Mercantile Customer Program Evaluation Report

PREPARED FOR THE FIRSTENERGY OHIO COMPANIES:

Ohio Edison Company
The Cleveland Electric Illuminating Company
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1. Executive Summary

The Ohio operating companies, The Cleveland Electric Illuminating Company (“CEI”), Ohio Edison Company (“OE”), and The Toledo Edison Company (“TE”) (collectively “Companies”), continued the Mercantile Customer Program during 2019. This report presents the results of the impact and process evaluations of the Mercantile Customer Program activity occurring during 2019.

The main features of the approach used for the evaluation are as follows:

Data for the study were collected through a review of program materials, on-site inspections, end-use metering, and interviews with the Companies’ staff members, participating customers, and contractors. Based on data provided by the Companies, a sample design was developed for on-site data collection. Samples were drawn that provide savings estimation with ±10% statistical precision at the 90% confidence level.

Table 1-1 shows the sample size employed for this evaluation.

Site visits were utilized to collect data for savings impact calculations, to verify measure installation, and to determine measure operating parameters. The facility staff was interviewed to determine the operating hours of installed systems and to locate any additional benefits or shortcomings with the installed systems. For some of these sites, energy-efficient equipment was monitored to obtain real-time information on equipment operating characteristics. Verification can be achieved through customer and contractor support, providing the necessary data and information without the need for a physical site visit. This was achieved for 3 dockets in our evaluation. On-site verification occurred for the remaining 24 out of 27 dockets in the ADM sample.

Table 1-1 Sample Sizes for Data Collection Efforts

Type of Data Collected	Sample Size
Evaluation Sample	27
Participant Survey Completed	19
In-Depth Interviews	4

The ADM sample of 27 dockets accounts for approximately 56% of the reported annual energy savings. Ex post gross savings were estimated using proven techniques, including industry-standard engineering calculations and verification of computer simulations developed to determine energy savings.

The realized energy savings of the 2019 Mercantile Customer Program from the three service territories are summarized in Table 1-2. The gross realization rate for program kWh savings is 95%.

Table 1-2 Summary of Annual Energy Savings (kWh)

Operating Company	Rate Code	Ex Ante kWh Savings	Ex Post kWh Savings	Realization Rate
CEI	CE-GP	3,070,704	3,078,495	100%
	CE-GS	9,783,780	8,583,130	88%
	CE-GSU	13,153,272	12,892,762	98%
	CE-GT	6,604,423	5,847,228	89%
Total		**32,612,179**	**30,401,616**	**93%**
OE	OE-GP	4,308,625	4,469,746	104%
	OE-GS	8,126,586	8,039,877	99%
	OE-GT	349,993	242,256	69%
Total		**12,785,204**	**12,751,879**	**100%**
TE	TE-GP	400,471	355,333	89%
	TE-GS	629,460	521,539	83%
	TE-GT	2,147,884	2,123,361	99%
Total		**3,177,815**	**3,000,233**	**94%**
Grand Total		**48,575,198**	**46,153,728**	**95%**

The ex post gross peak demand reduction (kW) of the 2019 Mercantile Customer Program from the three service territories is summarized in Table 1-3. The gross realization rate for program peak kW savings is 123%.

Table 1-3 Summary of Peak Demand Reduction (kW)

Operating Company	Rate Code	Ex Ante kW Savings	Ex Post kW Savings	Realization Rate
CEI	CE-GP	444.00	543.87	122%
	CE-GS	1,662.00	1,456.37	88%
	CE-GSU	2,489.00	2,925.44	118%
	CE-GT	459.00	711.87	155%
Total		**5,054.00**	**5,637.54**	**112%**
OE	OE-GP	235.00	568.06	242%
	OE-GS	479.00	1,067.95	223%
	OE-GT	38.00	36.26	95%
Total		**752.00**	**1,672.27**	**222%**
TE	TE-GP	388.00	388.00	100%
	TE-GS	12.00	19.00	158%
	TE-GT	248.00	244.80	99%
Total		**648.00**	**651.80**	**101%**
Grand Total		**6,454.00**	**7,961.61**	**123%**

2. Introduction and Purpose of Study

This report presents the results of the impact and process evaluations of the Mercantile Customer Program for activity for the program year.

2.1 Overview of Evaluation Approach

The overall objective of the impact evaluation of the Mercantile Customer Program is to verify the gross energy savings (kWh), lifetime energy savings (kWh), and peak demand (kW) reduction resulting from participation in the program.

Per Ohio RC §4928.662, for all measure types listed in the Ohio TRM[1]; all installation rates, deemed savings, and hours of use were calculated per the Ohio TRM ("Deemed"). In addition, ADM calculated gross savings for measures in the program with "as found" baseline conditions, hours of use, and installation rates. The values reported for both ex ante and ex post energy savings (kWh) and peak demand reduction (kW) represent the higher calculated value obtained from both methodologies.

The approach for the impact evaluation had the following main features.

Available documentation (e.g., audit reports, savings calculation work papers, etc.) was reviewed for a sample of dockets, with attention given to the calculation procedures and documentation for savings estimates.

On-site data collection was conducted for a sample of dockets to provide the information needed for estimating savings and demand reductions. Monitoring was also conducted at some sites to obtain more accurate information. When applicable verification was achieved through the virtual collection of data and information.

Gross savings were estimated using industry standard techniques:

- Analysis of lighting savings was accomplished using ADM's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information about operating parameters collected on-site and, if appropriate, industry standards as well as inputs from the OH TRM.

For custom measures or relatively more complex measures, ADM estimated savings using IPMVP[2] Option C: Whole Facility analysis methodology.

[1] Ohio Independent Evaluator 2010 Evaluation Plan, Prepared for Public Utilities Commission of Ohio, December 6, 2010. Revised September 30, 2013.

[2] International Performance, Measurement, and Verification Protocol. "Concepts and Options for Determining Energy and Water Savings", Volume 1. January 2012.

3. Description of Program

Since 2009, the Companies have implemented the Mercantile Customer Program in Ohio. On July 17, 2013, the Public Utilities Commission of Ohio ordered that the Mercantile Pilot Program be permanently adopted, explaining that the Pilot for mercantile customers has fulfilled its goal of developing a simplified application filing and approval process.

To be eligible to participate in the Mercantile Customer Program, a customer had to be a "mercantile customer" as defined in R.C. § 4928.01 (A) (19). According to this definition, a mercantile customer is a commercial or industrial customer who meets either of two criteria:

- Consumes more than 700,000 kWh per year: or
- Is part of a national account involving multiple facilities in one or more states.

The Mercantile Customer Program is targeted at mercantile customers that have implemented projects in the last three calendar years that resulted in energy efficiency and/or peak demand reductions.

Under Rule 4901:1-39-05(G), Ohio Administrative Code (O.A.C.), a mercantile customer is permitted to file with the Public Utilities Commission of Ohio (PUCO), either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs.

For the 2019 program year, mercantile customers who participated in the program chose between two types of incentives: An exemption from the Demand Side Energy efficiency (DSE2) Rider for a specified period, or a cash rebate option.

To be eligible for either of these incentive options, a customer was required to provide enough data to illustrate that the customer installed self-directed energy efficiency and/or demand reduction technologies that produced energy savings and/or peak demand savings.

Calculations for exemption from the DSE2 rider are made on a site-by-site basis, where a site is defined as a location with one or more facilities located on one or more parcels of land, provided that the parcels are contiguous (e.g., a plant, hospital complex, or university located on one or more contiguous parcels of land would qualify as a site).

Although all accounts related to a given site were eligible for an exemption, the exemption was applied only to those accounts identified by a customer on the Joint Application it files with the Company to the PUCO. Aggregate savings from projects on the site were compared to the aggregate baseline of all accounts included in the application to determine if the site met the eligibility requirement.

Several criteria were used to determine energy efficiency project incentive levels under the Mercantile Customer Program.

- Regardless of whether a customer replaces equipment before its end of life or upon equipment failure, efficiency savings were eligible for counting against the FE Ohio Company targets as measured against the as-found equipment. However, in the case of replacement on failure, for the purposes of calculating savings that are eligible for an incentive, the energy savings calculation must use the standard as the baseline, not the as-found condition.
- If a customer replaced equipment at end of life with standard equipment, projects were not eligible for an incentive; however, utilities may count the savings as compared to as-found towards compliance goals, and the customer is eligible for a Commitment Payment.[3]
- Behavioral modifications or operational improvements could have qualified for incentives, but only if an investment was made on the customer's part and if the savings are measurable and verifiable. If there was no investment, the customer was not eligible for an incentive; however, utilities may verify savings towards compliance goals, regardless of customer incentive level. Even though a customer may not receive an incentive for a behavioral modification, they may receive instead a commitment payment so that utilities may commit those savings towards compliance. Additionally, for behavioral modifications, applicants are required to file annual applications.

Ex ante energy savings are calculated using methodologies outlined in the Ohio TRM or using industry-standard engineering calculations. The ex ante gross savings by each utility are shown in Table 3-1.

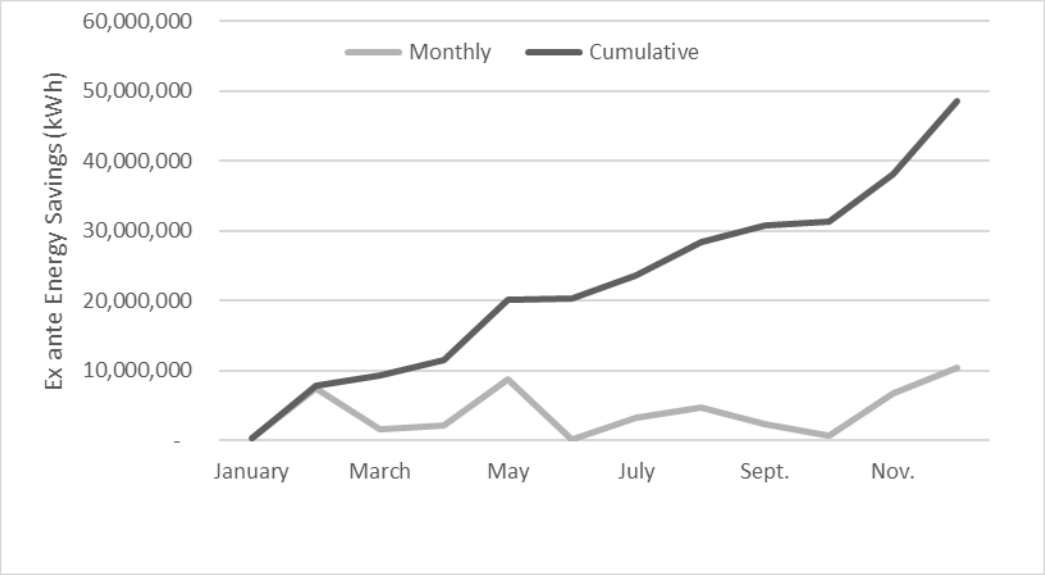
Table 3-1 Ex Ante Annual Energy Savings

Operating Company	Ex Ante kWh Savings
CEI	32,612,179
OE	12,785,204
TE	3,177,815
Total Companies	**48,575,198**

Figure 3-1 shows the program's ex ante kWh savings by date of the application filed. The program progressed consistently throughout the year.

[3] The commitment payment is not an incentive but rather intended to offset the administrative costs of filing an application. Case No. 10-834-EL-POR, September 15, 2010 Entry.

Figure 3-1 Reported Savings by Regulatory Reporting Date



4. Methodology

ADM's evaluation of the Mercantile Customer Program consisted of an impact evaluation and a process evaluation. The impact methodology is described in section 4.1 and the process evaluation is described in section 4.2 of this chapter.

4.1 Impact Evaluation Methodology

The methodology used for estimating gross savings is described in this section.

Sampling Plan

Data used to estimate the gross savings achieved through the Mercantile Customer Program were collected for samples of applications filed during the program year. Data provided by the Companies program staff showed that during the year, there were 84 filed dockets associated with the program, which were expected to provide savings of 48,575,198 kWh annually.

The completed dockets represented a wide range of measures and energy savings values. Of the 84 dockets, 8 have ex ante annual savings of less than 50,000 kWh, and 15 have ex ante savings over 1,000,000 kWh. Most dockets fell within 100,000 and 700,000 ex ante annual energy savings. To represent the population of dockets, ADM selected a stratified sample (known as ratio estimation) with enough dockets to estimate the total achieved savings with 10% precision at a 90% confidence. Dockets were categorized by measure (lighting and non-lighting) as well as ex ante annual energy savings kWh. The boundaries of each stratum were developed to ensure precision is met. Realization rates (the ratio of ex post to ex ante savings) for dockets sampled in each stratum are only extrapolated to other dockets within that stratum.

Occasionally the energy savings for a given docket are impacted by circumstances that are not consistent with similar dockets. In these situations, the verified energy savings are held for the docket but are not extrapolated to any other dockets ("certainty dockets"). The statistical reason for including a certainty stratum is to capture and isolate the largest outliers so that their extremely large values do not influence sampling variability. Two dockets in this program were determined to be certainty dockets, 19-0072 and 19-1112. Docket 19-0072 was held from extrapolating to a population due the magnitude and nature of the measures installed. Docket 19-0072 included a variety of custom measures such as infiltration reduction, HVAC equipment, and HVAC controls. Docket 19-1112 was not extrapolated to a population as some of the details required for an accurate estimation of energy savings was not available; therefore, the realization rate applied to this docket is not representative of similar dockets.

The resulting sample of 27 dockets consisted of 4 categories, or strata, for non-lighting dockets, 4 strata for lighting dockets, and two certainty dockets. The ex post gross annual energy savings (kWh) precision is ±8.36%.

Sampling for the collection of program M&V data accounted for the M&V effort occurring in real-time during program implementation. Completed dockets accumulate over time as the program is implemented, and sample selection was thus spread over the entire program year. ADM used a near real-time process whereby a portion of the sample was selected periodically as docket applications in the program were completed. The timing of sample selection was contingent upon the timing of the completion of dockets during the program year.

Table 4-1 presents the number of dockets and ex ante energy savings of the sampled dockets by stratum.

Table 4-1 Population Statistics Used for Sample Design

Stratum Name	Ex Ante kWh Savings	Strata Boundaries (kWh)	Population of Dockets	Design Sample Size
Certainty	6,298,229	Certainty Strata	2	2
Lighting 1	1,060,108	<100,000	16	3
Lighting 2	4,959,883	100,000-500,000	18	3
Lighting 3	3,396,882	500,000-1,062,863	5	2
Lighting 4	11,595,685	>1,062,863	6	4
Non-Lighting 1	409,225	<100,000	6	2
Non-Lighting 2	3,834,935	100,000-500,000	19	2
Non-Lighting 3	9,007,763	500,000-1,742,184	9	7
Non-Lighting 4	8,012,488	>1,742,184	3	2
Total	**48,575,198**		**84**	**27**

As shown in Table 4-2, the 27 evaluation sample dockets account for approximately 56% of the ex ante annual energy savings.

Table 4-2 Ex Ante Annual Energy Savings for Sampled Dockets by Stratum

Stratum Name	Ex Ante kWh Savings (population)	Ex Ante kWh Savings (Sample)	Percent of Ex Ante kWh in Sample
Certainty	6,298,229	6,298,229	100%
Lighting 1	1,060,108	202,052	19%
Lighting 2	4,959,883	895,664	18%
Lighting 3	3,396,882	1,150,792	34%
Lighting 4	11,595,685	6,598,635	57%
Non-Lighting 1	409,225	179,724	44%
Non-Lighting 2	3,834,935	536,626	14%
Non-Lighting 3	9,007,763	6,285,859	70%
Non-Lighting 4	8,012,488	5,207,710	65%
Total	**48,575,198**	**27,355,291**	**56%**

As shown in Table 4-3, the sample dockets account for approximately 41% of the ex ante peak demand reduction (kW).

Table 4-3 Ex ante Peak Demand kW Savings for Sampled Dockets by Stratum

Stratum Name	Ex Ante Peak kW (population)	Ex Ante Peak kW (Sample)	Percent of Ex Ante kWh in Sample
Certainty	365.00	365.00	100%
Lighting 1	198.00	28.00	14%
Lighting 2	819.00	165.00	20%
Lighting 3	811.00	337.00	42%
Lighting 4	2,342.00	1,418.00	61%
Non-Lighting 1	53.00	22.00	42%
Non-Lighting 2	428.00	0.00	-
Non-Lighting 3	931.00	63.00	7%
Non-Lighting 4	507.00	221.00	44%
Total	**6,454.00**	**2,619.00**	**41%**

Review of Documentation

After the sample of dockets was selected, the Companies' program staff provided documentation pertaining to those dockets. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort.

For each docket, the available documentation (e.g., audit reports, savings calculation work papers, etc.) for each rebated measure was reviewed, with attention given to the calculation procedures and documentation for savings estimates. Documentation that was reviewed for the sample included program forms, databases, reports, billing system data, weather data, and any other potentially useful data. Each application was reviewed to determine whether the following types of information had been provided:

Documentation for the equipment changed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information

Documentation for the new equipment installed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information

Information about the savings calculation methodology, including (1) what methodology was used, (2) specifications of assumptions and sources for these specifications, and (3) correctness of calculations

If there was uncertainty regarding a docket or incomplete project documentation, ADM staff contacted the Company program staff to seek further information to ensure the development of an appropriate docket-specific M&V plan.

On-Site Data Collection Procedures

On-site visits were completed to collect data that were used in calculating savings impacts. The visits to the sites of the sampled dockets collected primary data on the facilities participating in the program.

When dockets were selected for the M&V sample, ADM notified the Companies by providing the Companies' EM&V staff with a list of dockets for which ADM planned to schedule M&V activities. This list includes the company name, the PUCO docket, the site address or other premise identification, and the respective contact information for the customer representative ADM intended to contact to schedule an appointment. Typically, notification was provided at least two weeks prior to ADM contacting customers to provide ample time to schedule M&V visits.

During the on-site visits, the ADM field staff accomplished three major tasks:

- Verified the implementation status of all measures for which customers received incentives. ADM verified that the energy efficiency measures were indeed installed, that they were installed correctly and that they still function properly.

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

At some sites, monitoring was conducted to gather more information on the operating hours/power of the installed measures. Monitoring was conducted at sites where it was judged that the monitored data would be useful for further refinement and higher accuracy of savings calculations. Monitoring was not considered necessary for sites where project documentation allowed for sufficiently detailed calculations.

Procedures for Estimating Savings from Measures Installed through the Mercantile Customer Program

ADM used a specific set of methods to determine gross savings for dockets that depend on the type of measure being analyzed. These measure types and the typical methods are summarized in Table 4-4.

Table 4-4 Typical Methods to Determine Savings for Custom Measures

Type of Measure	Method to Determine Savings
Compressed Air Systems	Engineering analysis, with monitored data on load factor and schedule of operation
Lighting	Custom-designed lighting evaluation model, which uses data on wattages before and after installation of measures and hours-of-use data from field monitoring.
HVAC (including packaged units, chillers, cooling towers, controls/EMS)	eQuest (or Trane Trace®) model using DOE-2 as its analytical engine for estimating HVAC loads and calibrated with site-level billing data to establish a benchmark.
Motors and VFDs	Measurements of power and run-time obtained through monitoring
Refrigeration	Simulations with eQuest engineering analysis model, with monitored data
Process Improvements	Engineering analysis, with monitored data on load factor and schedule of operation
Data Centers	Analysis based on most current ASHRAE Standard 90.4
Agricultural Grow Facilities Lighting	Lighting analysis based on Photosynthetic Photon Flux (PPF)

The activities specified produced two estimates of gross savings for each sample docket: an ex ante gross savings estimate (as provided by the customer) and the ex post gross

savings estimates developed through the M&V procedures employed by ADM. ADM developed estimates of program-level gross savings by applying the ratio estimation procedure in which achieved savings rates estimated for the sample dockets were applied to the program-level ex ante savings.

Throughout 2019, ADM reviewed the ex ante savings calculations of dockets that exceed 1,000,000 kWh. These reviews led to changes in some docket savings values which helped mitigate evaluation risk. ADM completed 12 reviews in 2019.

Energy and demand savings realization rates[4] were calculated for each docket for which on-site data collection and engineering analysis/building simulations were conducted. Sites with relatively high or low realization rates were further analyzed to determine the reasons for the discrepancy between ex ante and ex post energy savings.

The basic procedures used for estimating savings from various measure types can be reviewed in Appendix B.

4.2 Process Evaluation Methodology

The following section provides a brief description of the Mercantile Customer Program, as well as the process evaluation objectives and ADM's evaluation methods.

Process Evaluation Objectives

ADM designed the process evaluation to research and document the program delivery mechanisms, and collective experiences of program participants, partners, and staff. ADM uses such information to assess whether implementation strategies and/or program design could better serve business customers. Table 4-5 provides a summary of the research questions and corresponding data collection activities

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

Table 4-5 Research Questions

Researchable Questions	Activity to Support the Question
Were there any significant program design changes? If so, what influenced the change(s) how did the change(s) impact the program?	■ Program staff interviews ■ Administrator interviews
Is the program being administered effectively in terms of program oversight, communication, staffing, training and/or reporting?	■ Program staff interviews ■ Administrator interviews
Is the program being implemented effectively in terms of the participation processes, application tools, and marketing and outreach? Could improvements be made to better reach the intended market?	■ Program staff interviews ■ Administrator interviews ■ Participant Survey
What influenced participants to enroll in the Program over other qualifying Programs offered by the Companies?	■ Participant survey ■ Administrator interviews
Were the program participants and administrators satisfied with their experiences?	■ Administrator interviews ■ Participant survey

Process Evaluation Methods

ADM reviewed program documentation, administered participant surveys, and completed in-depth interviews with program staff and administrators.

- **Program Documentation Review:** ADM requested all available documentation from the program staff. This list included any operating or process manuals, marketing materials, and current versions of the applications. We reviewed all program documents that were made available to us after our requests.
- **Program Staff In-Depth Interviews:** ADM researchers conducted in-depth interviews with four key program staff at the Companies', one was a corporate program manager and three were regional account representatives. The objective of these interviews was to gather information about program design and implementation strategies to elicit feedback regarding program successes and opportunities for improvements.
- **Administrator In-Depth Interviews:** ADM conducted in-depth interviews with three staff that work with industry organizations that serve as program administrators. Two of the interviews were with contractors for the industry organizations and one was with the staff at the industry organization. The interviews addressed issues related to program design, communication, and opportunities for improvements.

- **Participant Survey:** ADM administered an online survey to program participants. ADM attempted to reach all organizations that participated in the Program. In total, 19 customers that participated in the program in 2019 completed the survey. The survey investigated program awareness, decision making, the participation process, including communication with program staff, and satisfaction.

5. Detailed Evaluation Findings

This chapter reports ADM's impact evaluation findings for the Mercantile Customer Program.

5.1 Impact Evaluation Findings

This section provides the results of ex post gross annual energy savings for the Mercantile Customer Program during the program year.

Ex Post Gross Annual Energy Savings

The ex post annual energy savings are summarized by the sampling stratum in Table 5-1. Overall, the ex post gross savings were equal to 95% of the ex ante savings. Two projects in the sample were not extrapolated to the population due to their uniqueness in energy efficiency measures and information available. These are complex projects that involve a higher level of uncertainty compared to the population. These two projects are categorized as "Certainty" in the table below.

Table 5-1 Ex ante and Gross Ex Post kWh Savings by Sample Stratum

Stratum Name	Ex Ante kWh Savings	Ex Post kWh Savings	Realization Rate
Certainty	6,298,229	5,384,042	85%
Lighting 1	1,060,108	1,118,840	106%
Lighting 2	4,959,883	5,339,479	108%
Lighting 3	3,396,882	3,818,591	112%
Lighting 4	11,595,685	10,393,909	90%
Non-Lighting 1	409,225	361,914	88%
Non-Lighting 2	3,834,935	3,405,116	89%
Non-Lighting 3	9,007,763	8,319,350	92%
Non-Lighting 4	8,012,488	8,012,488	100%
Total	**48,575,198**	**46,153,728**	**95%**

Two trends were identified in the sample: an underestimation of energy savings for lighting projects and an overestimation of energy savings for non-lighting projects. Table 5-2 shows the ex ante and ex post energy savings by docket within the ADM sample. Four dockets resulted in realization rates below 80%, and one docket above 120%.

Table 5-2 Ex Ante and Ex Post Realized kWh Savings for Sample Population

Docket Number	Ex Ante kWh Savings	Ex Post kWh Savings	Realization Rate
19-0075	517,568	32,359	6%
19-1112	144,153	21,627	15%
19-0096	116,479	56,334	48%
19-1111	93,008	72,230	78%
19-0080	2,307,593	1,867,666	81%
19-0082	421,615	365,771	87%
19-0140	1,192,848	1,033,587	87%
19-0072	6,154,076	5,362,415	87%
19-0672	13,055	11,488	88%
19-0614	229,796	205,273	89%
19-0560	1,562,307	1,562,307	95%
19-0079	83,555	81,374	97%
19-0442	738,864	721,108	98%
19-0088	533,235	530,265	99%
19-0136	1,742,184	1,742,184	100%
19-0093	759,144	759,144	100%
19-0114	86,716	86,716	100%
19-0118	1,350,000	1,350,000	100%
19-0915	1,535,886	1,535,886	100%
19-1893	3,289,622	3,289,622	100%
19-1854	1,918,088	1,918,088	100%
19-1171	420,147	420,147	100%
19-0059	644,864	670,406	104%
19-0091	624,500	675,604	108%
19-0092	105,442	120,384	114%
19-0103	526,292	618,054	117%
19-0083	244,253	393,168	161%

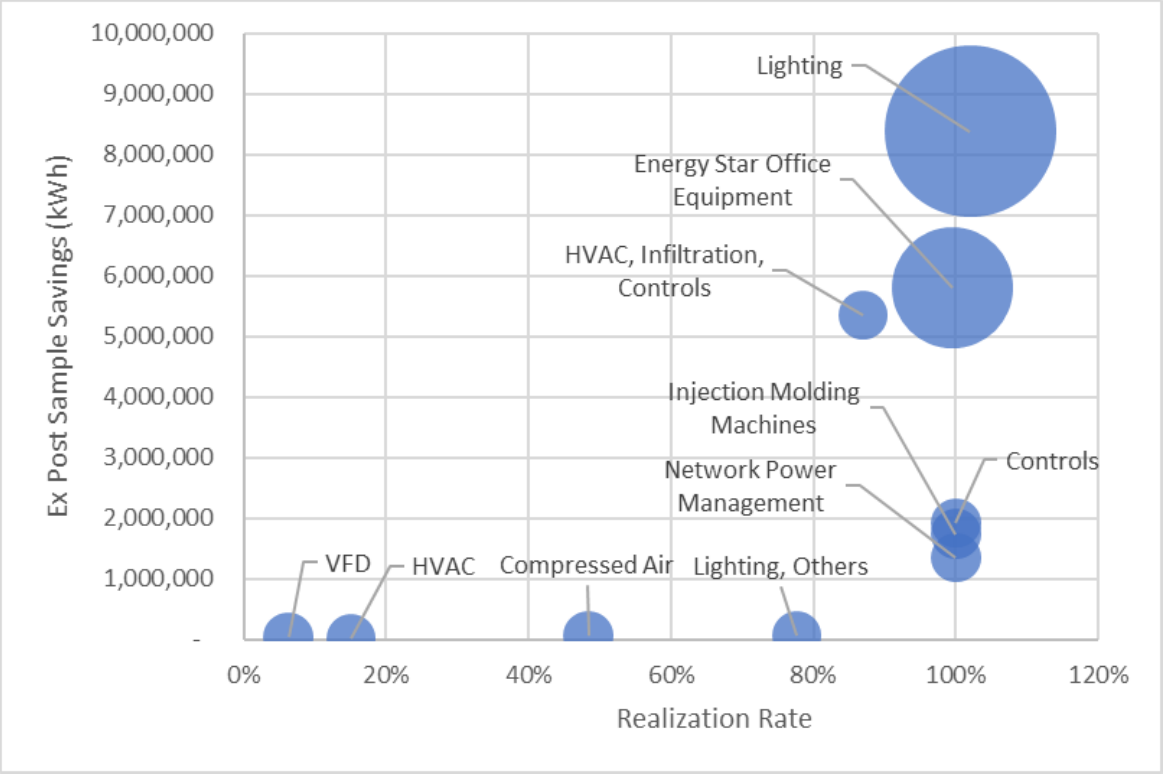
Dockets with the lowest realization rates fell below threshold for an evaluation review before submission to the Public Utility Commission of Ohio (PUCO). Based on evaluation measurement and verification (M&V), reasoning for the lowest realization rate dockets are:

- 19-0075 – Verification of a different baseline system configuration and baseline equipment specifications.

- 19-1112 – Verification of a different mechanical system and operating conditions than claimed as well as different baseline considerations for energy savings calculations.
- 19-0096 – Evaluation power monitoring showed different power consumption compared to what was claimed in ex ante calculations.
- 19-1111 – Evaluation M&V determined differing lighting fixture locations and annual operating hours compared to claimed savings documentation.
- 19-0080 – Evaluation M&V determined some claimed lighting fixtures not to be found on reported invoices. The total of all projects within the docket exceeded the threshold for an evaluation review, however, since they did not meet the requirements individually the docket was not reviewed by ADM before submission to the PUCO.

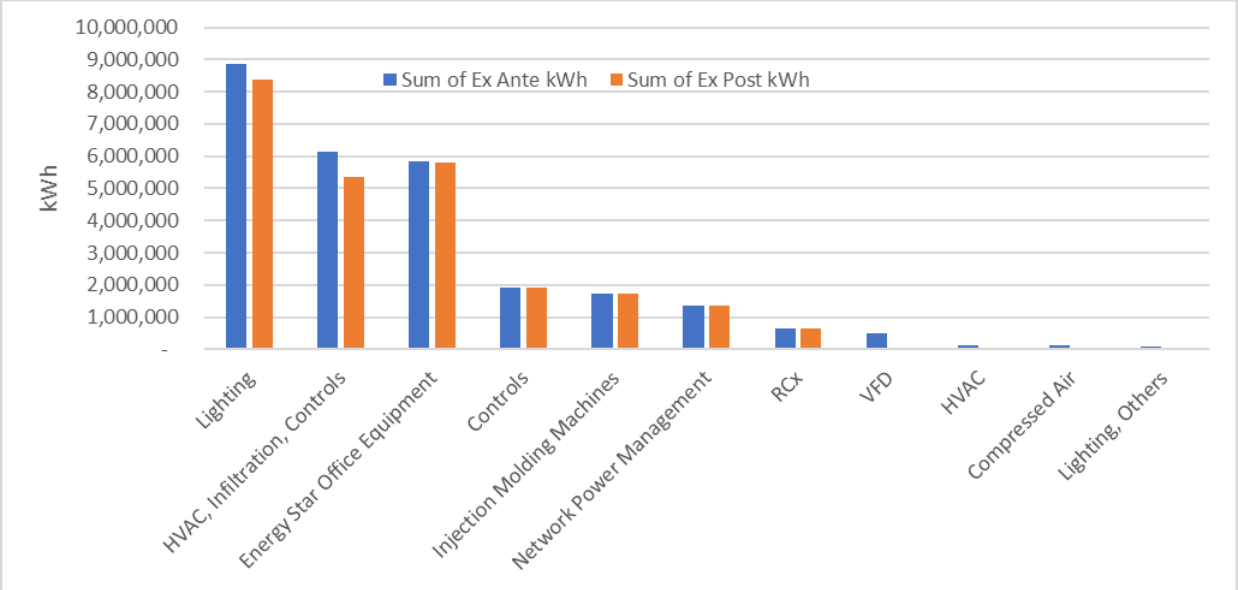
The impact on ex post savings for the sampled dockets is represented graphically in Figure 5-1. This demonstrates the impact that lighting has on overall energy savings. The size of the bubble indicates the number of projects, and the center of the bubble represents sampled annual energy savings. The graphic demonstrates that a small number of Custom projects can bring to the program significant energy savings. In 2019, a single custom project (listed as HVAC, Infiltration, Controls) represents approximately 13% of the ex ante energy savings for the program.

Figure 5-1 Measure Type Ex Post Sample Impact



The magnitude of energy savings by measure type is displayed in Figure 5-2. Lighting projects have continued to provide most energy savings, followed by custom projects and prescriptive office equipment.

Figure 5-2 Measure Type Sample Energy Savings



The most active trade ally in the program yielded 70% of ex ante annual energy savings (with 10% of the program submitted by the Companies). The second most active trade ally yielded 5% of annual energy savings. The top participating trade allies produced generally high and consistent realization rates for both annual energy savings and peak demand reductions.

Ex Post Gross Peak kW Savings

The ex post gross peak demand reduction of the 219 Mercantile Customer Program are shown in Table 5-3 by sampling stratum. Large variation in realization rates for peak demand reduction were found for non-lighting dockets. Peak demand reduction was often not reported.

Table 5-3 Ex ante and Gross Realized Peak Demand Reduction (kW)

Stratum Name	Ex Ante kW Savings	Ex Post kW Savings	Realization Rate
Certainty	365.00	622.35	171%
Lighting 1	198.00	197.29	100%
Lighting 2	819.00	777.80	95%
Lighting 3	811.00	690.43	85%
Lighting 4	2,342.00	2,109.95	90%
Non-Lighting 1	53.00	46.74	88%
Non-Lighting 2	428.00	492.20	115%
Non-Lighting 3	931.00	1,497.20	161%
Non-Lighting 4	507.00	1,527.65	301%
Total	**6,454.00**	**7,961.61**	**123%**

The ex post gross peak kW reductions by docket within the ADM sample are shown in Table 5-4. These dockets represent a peak kW precision of +/- 26.72%. Methodology for the calculation of peak demand reduction can be found in Appendix B. There were projects within in the sample in which ex ante calculations did not include peak reduction calculations, however, these were realized when investigated for ex post calculations.

Table 5-4 Ex Ante and Ex Post Realized kW Savings

Docket Number	Ex Ante kW Savings	Ex Post kW Savings	Realization Rate
19-0079	13.00	9.66	74%
19-0082	98.00	85.03	87%
19-0140	277.00	239.26	86%
19-0083	40.00	47.58	119%
19-0080	537.00	434.18	81%
19-0091	210.00	159.58	76%
19-0096	-	7.34	Indeterminate
19-0088	-	71.76	Indeterminate
19-0136	-	198.88	Indeterminate
19-0093	-	102.74	Indeterminate
19-0114	11.74	11.74	100%
19-0075	-	3.72	Indeterminate
19-0672	-	-	-
19-0614	27.00	24.09	90%
19-0092	15.00	18.22	121%
19-1111	10.00	7.74	77%
19-1112	11.00	10.21	93%
19-0442	-	97.67	Indeterminate
19-0103	127.00	127.25	100%
19-0072	354.00	612.15	173%
19-0118	63.00	62.50	100%
19-0059	-	91.93	Indeterminate
19-0915	357.05	357.05	100%
19-0560	246.88	246.88	100%
19-1893	-	445.21	Indeterminate
19-1854	219.00	220.70	101%
19-1171	-	56.87	Indeterminate
Total	**2,619**	**3,750**	**143%**

Discussion of Ex Post Savings Analysis

Project-specific factors affecting the realization rate include the type of measure implemented, building type, facility operating schedule, and other parameters that may affect energy efficiency measure savings.

Project-specific factors that influenced the realization rate include the following:

- Updated production trend data during the time of evaluation
- Site-specific annual hours of use (HOU) and invoiced quantities
- The difference in the baseline condition (such as HVAC EER and flow modulation) and lighting wattages
- Added variables in billing regression analysis (the use of production data and weather data)

Overall, the major differences in docket level realization rates in lighting projects are due to the claimed vs. invoiced fixture quantities. The difference in docket level realization rates in non-lighting projects was driven by VFD and compressed air baselines. However, by providing reviews of above-threshold dockets, many discrepancies were rectified prior to the filing of dockets. Pre-filing reviews were conducted on dockets that exceeded 1,000,000 kWh of annual energy savings. During PY2019, reviews were conducted on 12 dockets. This practice helps mitigate evaluation risk.

Discussion of Ex Post Peak Demand Reduction

For custom calculations, there were instances where ex ante peak demand reduction (kW) was not provided. Another reason for the difference in peak demand reduction is due to a different method of calculation in the ex post algorithms for as-found lighting projects and custom projects. For as-found lighting calculations, ADM develops an hourly energy reduction based on each hour of the 2019 calendar year (8760 curve). This allows the calculation to pull out the average kW reduction during the peak demand window. Custom ex post calculations which involve simulations also pull hourly values for peak demand reduction.

6. Process Evaluation

The following section provides detailed findings from the process evaluation of the Mercantile Customer Program. ADM conducted surveys and in-depth interviews with program administrators, participants, and program staff. Interviews addressed topics including staff roles and responsibilities, program design and goals, program operations including communication, marketing, and outreach, as well as planned changes for the future.

6.1 Program Staff

Program staff provided feedback on the operation, success, and challenges of the program. Program staff indicated further opportunity in program awareness but that the program year was successful with no significant issues or challenges. Projects in the program range from straightforward energy efficiency measures and calculations to complex analyses and energy simulations.

6.2 Program Administrator Interviews

This section summarizes feedback received from in-depth interviews conducted with representatives at administrator organizations associated with the program. The objective of these interviews was to investigate their perspectives on the program year as well as program strengths, challenges, and the future of the program.

The role of program administrators is to assist customers in submitting applications and acting as a liaison for customers to the Companies. Information from the contacts indicates that the administrator organizations or their contractors are responsible for promoting program participation to business customers. All organizations find projects, help with the applications, submit them to the Companies, track their progress, and then work to make sure the customer gets their rebate.

The interviewees all said they were satisfied with the program year. The administrators expressed general satisfaction with the program design and participation process. There is consensus that the application process is lengthy, but they have been able to explain the program to customers and ensure they understand the timeline for application submission and receipt of rebates. The administrators all reported that program communication was satisfactory and could not be improved.

All interviewees stated that the program's strengths included its continuity, its established design and implementation methods, as well as program staff's level of knowledge and communication.

6.3 Participant Survey Results

The following section presents the results from a telephone and online survey of 19 participants. ADM researchers used both closed- and open-ended questions to investigate participants' program awareness, decision making, program experiences, and satisfaction.

Program participants provided feedback regarding their business characteristics, such as the type of business, number of full-time employees, and total square footage of indoor space. Almost half of the survey respondents reported their organization was a K-12 school (37%) or higher education organization (11%). Other respondents reported that their organization conducted industrial/manufacturing business (11%) followed by colleges/universities and nonprofits or religious services (11%). Other respondents indicated that their business was in public administration, lodging, maintenance, cannabis cultivation, and general office work. Almost half of the respondents reported that the location where the project was completed had 75 or fewer employees (47%). Table 6-1 shows survey responses by facility type.

Table 6-1: Responses by Facility Type

Business Type	CEI		OE		TE		Total	
	N	%	n	%	n	%	n	%
School (K-12)	2	20%	3	75%	2	40%	7	37%
Office	3	30%	0	0%	0	0%	3	16%
Other	3	30%	0	0%	0	0%	3	16%
Industrial/Manufacturing	0	0%	0	0%	2	40%	2	11%
Higher Education	1	10%	0	0%	1	20%	2	11%
Lodging	1	10%	0	0%	0	0%	1	5%
Public administration/Governmental services	0	0%	1	25%	0	0%	1	5%

Program Awareness

About two-thirds of survey respondents reported learning about the program from a contractor or other type of service provider, most commonly from the service provider who completed the project (Table 6-2). About one-fifth of the respondents reported learning about the program from an industry organization.

Table 6-2: Sources for Learning about Incentives

How did you learn about the Mercantile Program?	CEI		OE		TE		Total[1]	
	n	%[2]	n	%	n	%	n	%
The service provider[3] who completed the project	3	33%	2	50%	3	75%	8	42%
Some other service provider	3	33%	1	25%	1	25%	5	26%
An industry association	3	33%	1	25%	0	0%	4	21%
Previously participated in the Mercantile Program	1	11%	1	25%	0	0%	2	11%
Friends or colleagues	1	11%	0	0	1	25%	2	11%
From a utility Customer Representative	0	0%	0	0%	1	25%	1	5%
An event or trade show	1	11%	0	0%	0	0%	1	5%
Don't know	1	11%	0	0	0	0	1	5%

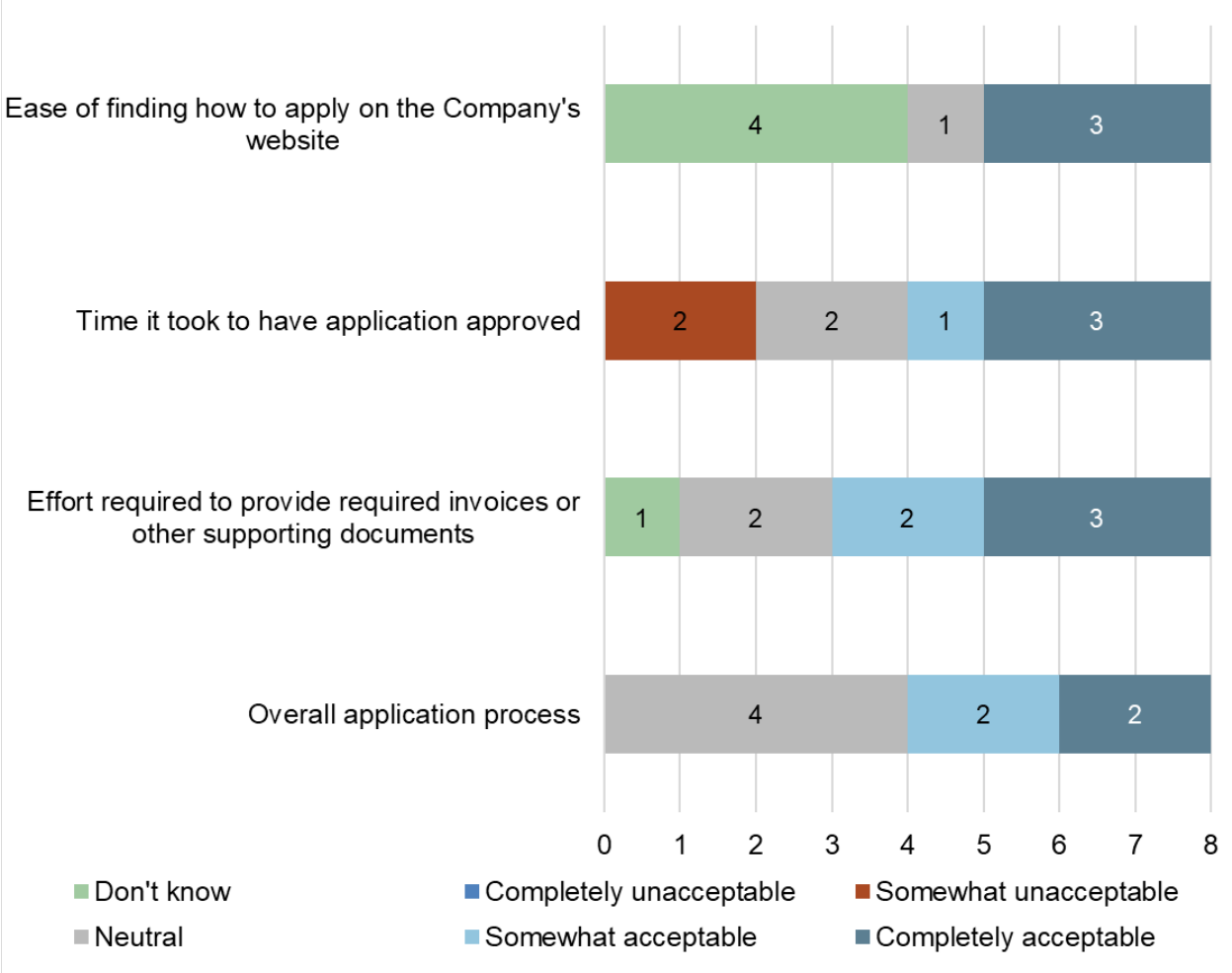
[1] Totals may exceed 100% as respondents could select more than one response.
[2] Percentages have about 12.5% or better precision at 80% confidence.
[3] A contractor, equipment vendor, or energy consultant.

In 2019, two-thirds of the 19 respondents learned about the program from a service provider, and very few mentioned a utility or program source.

Program Participation Process

All respondents who were involved in the application process gave at least a moderately positive rating to the program's overall application process. Those eight respondents were asked about other aspects of their experience applying for the program. Figure 6-1 displays respondents' ratings on the acceptability of the overall application process as well as various aspects of it.

Figure 6-1: How acceptable was the application process?



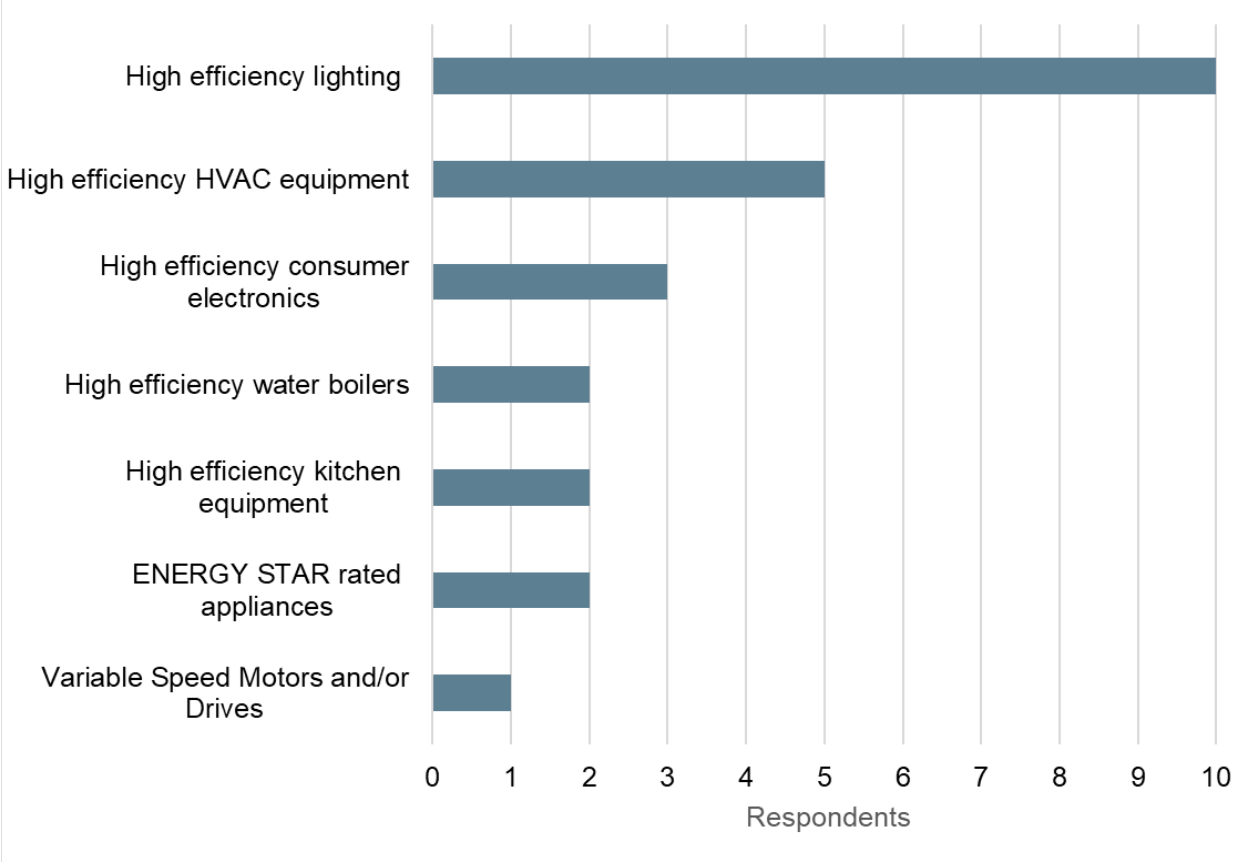
Most respondents did not have any recommendations to improve the application process, though two respondents reported somewhat unacceptable application process and the length of time the process took. Applications for the Mercantile Customer Program must obtain approval from the PUCO, typically auto-approved in 60 days. This regulatory process lengthens the processing time for getting customers their rebate or exemption.

Plans for Future Energy-Efficient Projects

Just over half of the survey respondents indicated they had plans to install high-efficiency equipment in the next two years.

Among the 11 respondents with plans to install high-efficiency equipment in the next two years, lighting equipment was the most identified equipment type, followed by high efficiency HVAC and consumer electronics, including computers or TVs. Figure 6-2 displays which high-efficiency measures respondents plan to install in the next two years.

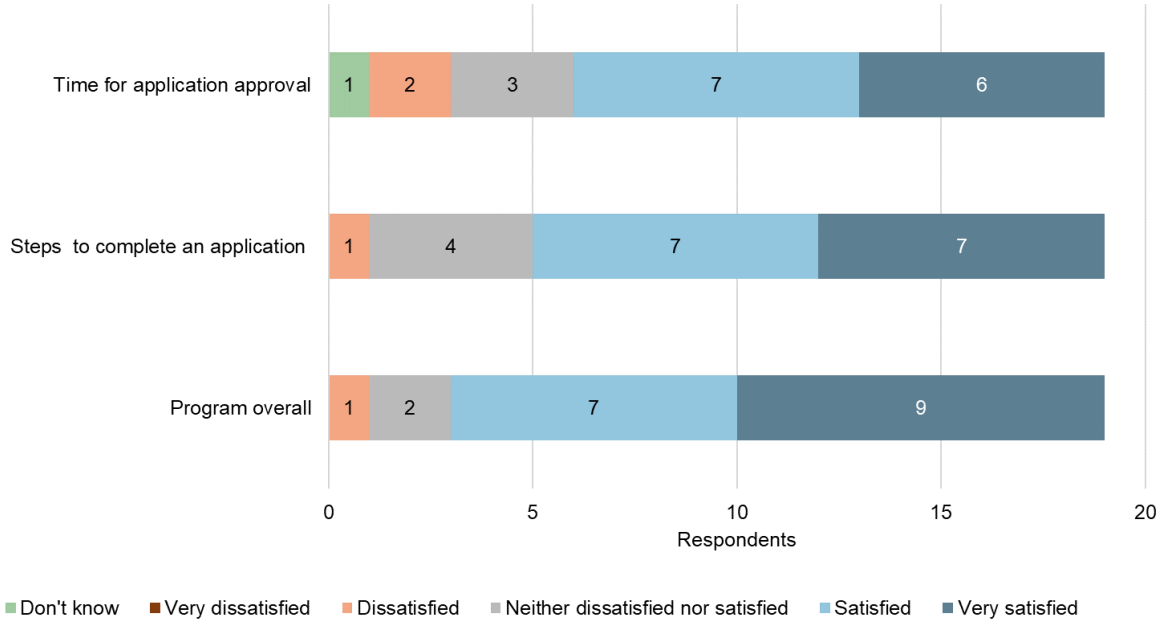
Figure 6-2: If Respondents Plan to Install Equipment, What Will They Install?



Program Communication and Customer Satisfaction

Overall, survey respondents reported being satisfied with the program and indicated that they appreciated the program's design and the available incentives. Figure 6-3 displays survey respondents' satisfaction with the amount of time it took to get their application approved, steps taken to apply, and the program overall.

Figure 6-3: Program Satisfaction



7. Conclusion

Table 7-1 summarizes the ex post gross savings for each operating company. The Mercantile Program achieved an overall annual energy savings realization rate of 95%.

Table 7-1 Summary of Annual Energy Savings (kWh)

Operating Company	Rate Code	Ex Ante kWh Savings	Ex Post kWh Savings	Realization Rate
CEI	CE-GP	3,070,704	3,078,495	100%
	CE-GS	9,783,780	8,583,130	88%
	CE-GSU	13,153,272	12,892,762	98%
	CE-GT	6,604,423	5,847,228	89%
Total		**32,612,179**	**30,401,616**	**93%**
OE	OE-GP	4,308,625	4,469,746	104%
	OE-GS	8,126,586	8,039,877	99%
	OE-GT	349,993	242,256	69%
Total		**12,785,204**	**12,751,879**	**100%**
TE	TE-GP	400,471	355,333	89%
	TE-GS	629,460	521,539	83%
	TE-GT	2,147,884	2,123,361	99%
Total		**3,177,815**	**3,000,233**	**94%**
Grand Total		**48,575,198**	**46,153,728**	**95%**

The following are conclusions determined during the impact and process evaluation.

- Verified energy savings fell slightly below estimates, with a realization rate of 95%
- Verified peak demand reduction exceeded estimates. A combination of detailed reviews, site visits and/or data measurements resulted in ex post demand reduction values (for some projects) which were greater than original estimates.
- The administrators were generally satisfied with the program design and participation process. Although the participation process is necessarily lengthy, the administrators have learned how to explain the program to customers and ensure they understand the timeline for application submission and receipt of rebates.
- Participants were satisfied with the program overall but less so for the application process, including the amount of time it takes for application approval and the steps to submit a complete application.

7.1 Recommendations

ADM offers the following recommendations for continued improvement of the program.

- Ensure that provided documentation includes peak demand reduction (kW), when applicable, as well as verifiable invoices that match claimed quantities.
- Verification that eligibility for evaluation review (exceeding the threshold of 1,000,000 kWh annual energy savings) includes the summation of all projects within a docket.
- Continue communicating clearly and frequently with program administrators and customer service representatives. Program administrators, Company staff, and customer service representatives all noted that there had been strong internal communication during the program year.
- There are multiple factors impacting the timeline for an application. Transparency with participants about the process and time frame is an important aspect of customer satisfaction.
- Consider submitting all VFD, compressed air and chiller dockets for pre-filing reviews regardless of savings value. These measures did not have significant savings at the program level but present evaluation risk.

Appendix A: Evaluation Savings Tables

This appendix contains annualized ex post kWh savings, ex post peak demand reductions, and ex post lifetime savings for the Mercantile Customer Program.

Table A-1: Summary of kWh Savings

Operating Company	Ex Ante kWh Savings	Ex Post kWh Savings	Realization Rate
CEI	32,612,179	30,401,616	93%
OE	12,785,204	12,751,879	100%
TE	3,177,815	3,000,233	94%
Total Companies	**48,575,198**	**46,153,728**	**95%**

Table A-2: Summary of Peak kW Savings

Operating Company	Ex Ante Peak kW Savings	Ex Post Peak kW Savings	Realization Rate
CEI	5,054.00	5,637.54	112%
OE	752.00	1,672.27	222%
TE	648.00	651.80	101%
Total Companies	**6,454.00**	**7,961.61**	**123%**

Table A-3: Summary of ex post Lifetime kWh Savings

Operating Company	Lifetime Ex Post kWh Savings
CEI	321,284,156
OE	91,452,077
TE	45,053,893
Total Companies	**457,790,127**

Appendix B: Savings Calculation Methodologies

Plan for Analyzing Savings from Lighting Measures: 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 are examined that might include the addition of energy-conserving control technologies such as motion sensors or daylighting controls. These measures typically involve a reduction in hours of operation and/or lower current passing through the fixtures.

Analyzing the savings from such lighting measures requires data for retrofitted fixtures on (1) wattages before and after retrofit and (2) hours of operation before and after the retrofit. Fixture wattages are taken from a table of standard wattages, with corrections made for non-operating fixtures. Hours of operation are determined from metered data collected after measure installation for a sample of fixtures.

To determine baseline and post-retrofit demand values for the lighting efficiency measures, ADM uses in-house data on standard wattages of lighting fixtures and ballasts to determine demand values for lighting fixtures. These data provide information on wattages for the common lamp and ballast combinations.

As noted, ADM collects data with which to determine average operating hours for retrofitted fixtures by using Time-of-Use (TOU) data loggers to monitor a sample of "last points of control" for unique usage areas in the sites where lighting efficiency measures have been installed. Usage areas are defined to be those areas within a facility that are expected to have comparable average operating hours. For industrial customers, expected usage areas include fabrication areas, clean rooms, office space, hallways/stairways, and storage areas. Typical usage areas are designated in the forms used for data collection.

ADM uses per-fixture baseline demand, retrofit demand, and appropriate post-retrofit operating hours to calculate peak demand savings and annual energy savings for sampled fixtures of each usage type.

The on-off profile and the fixture wattages are used to calculate post-retrofit kWh usage. Peak fixture demand is calculated by dividing the total fixture kWh usage during the Companies' peak period by the number of hours in the peak period.

Peak period demand savings are calculated as the difference between peak period baseline demand and post-installation peak period demand of the affected lighting equipment, per the following formula:

$$Peak\ Demand\ Savings\ =\ kW\ Before - kW\ After$$

The baseline and post-installation average demands are calculated by dividing the total kWh usage during the Peak Period by the number of hours in the Peak Period.

ADM calculates annual energy savings for each sampled fixture per the following formula:

$$Annual\ Energy\ Savings\ =\ kWh\ Before\ -\ kWh\ After$$

The values for insertion in this formula are determined through the following steps:

1. Results from the monitored sample are used to calculate the average operating hours of the metered lights in each costing period for every unique building type/usage area.
2. These average operating hours are then applied to the baseline and post-installation average demand for each usage area to calculate the respective energy usage and peak period demand for each usage area.
3. The annual baseline energy usage is the sum of the baseline kWh consumption in all the usage areas. Post-retrofit energy usage is calculated similarly. The energy savings are calculated as the difference between baseline and post-installation energy usage.
4. Savings from lighting measures in conditioned spaces are factored by region-specific and building type-specific heating cooling interaction factors, allowing for the calculation of total savings attributable to lighting measures, inclusive of impacts on HVAC operation.

Plan for Analyzing Savings from HVAC Measures: Savings estimates for HVAC measures installed at a facility are derived by using the energy use estimates developed through DOE-2 simulations and engineering calculations. Each simulation produces estimates of HVAC energy and demand usage to be expected under different assumptions about equipment and/or construction conditions. There may be cases in which DOE-2 simulation is inappropriate because data are not available to properly calibrate a simulation model, and engineering analysis provides more accurate M&V results.

For the analysis of HVAC measures, the data collected through on-site visits and monitoring are utilized. Using these data, ADM prepares estimates of the energy savings for the energy-efficient equipment and measures installed in each of the participant facilities. Engineering staff develops independent estimates of the savings through engineering calculations or through simulations with energy analysis models. By using energy simulations for the analysis, the energy use associated with the end-use affected by the measure(s) being analyzed can be quantified. With these quantities in hand, it is a simple matter to determine what the energy use would have been without the measure(s).

Before making the analytical runs for each site with sampled project HVAC measures, engineering staff prepares a model calibration run. This is a base case simulation to

ensure that the energy use estimates from the simulations have been reconciled against actual data on the building's energy use. This run is based on the information collected in an on-site visit pertaining to types of equipment, their efficiencies and capacities, and their operating profiles. Current operating schedules are used for this simulation, as are local (TMY) weather data covering the study period. The model calibration run is made using actual weather data for a time corresponding to the available billing data for the site.

The goal of the model calibration effort is to have the results of the DOE-2 simulation come within approximately 10% of the patterns and magnitude of the energy use observed in the billing data history. In some cases, it may not be possible to achieve this calibration goal because of the idiosyncrasies of facilities (e.g., multiple buildings, discontinuous occupancy patterns, etc.).

Once the analysis model has been calibrated for a facility, ADM performs three steps in calculating estimates of energy savings for HVAC measures installed or to be installed at the facility.

1. An analysis of energy use at a facility under the assumption that the energy efficiency measures are not installed is performed.
2. Energy use at the facility with all conditions the same but with the energy efficiency measures now installed is analyzed.
3. The results of the analyses from the preceding steps are compared to determine the energy savings attributable to the energy efficiency measure.

Plan for Analyzing Savings from Motors: Estimates of the energy savings from use of high-efficiency motors on HVAC and non-HVAC applications are derived through an "after-only" analysis. With this method, energy use is measured only for the high-efficiency motor and only after it has been installed. The data thus collected is then used in estimating what energy use would have been for the motor application if the high-efficiency motor had not been installed. In effect, the after-only analysis is a reversal of the usual design calculation used to estimate the savings that would result from installing a high-efficiency motor. That is, at the design stage, the question addressed is how energy use change for an application would if a high-efficiency motor is installed, whereas the after-only analysis addresses what the level of energy use would have been had the high-efficiency motor not been installed.

For the “after only” analysis, it is not possible to use a comparison of direct measurements to determine savings, since measured data are collected only for the high-efficiency motor. However, savings attributable to the installation of the high-efficiency motor can be estimated using the information on the efficiencies of the high-efficiency motor and on the motor, it replaced. Demand and energy savings can be calculated as follows:

$$Peak\ Demand\ Savings = \mathrm{kW_{peak}}\ \mathrm{x}\ \left(\frac{1}{\mathrm{Eff_{old}}} - \frac{1}{\mathrm{Eff_{new}}}\right)$$

Where:

kW_{peak} = Volts x $Amps_{peak}$ x Power Factor, and $Amps_{peak}$ is the interval with the maximum recorded Amps during the monitoring period.

$$Energy\ Savings = \mathrm{kW_{ave}}\ \mathrm{x}\ \left(\frac{1}{\mathrm{Eff_{old}}} - \frac{1}{\mathrm{Eff_{new}}}\right)\ \mathrm{x\ Hours\ of\ use}$$

Where:

kW_{ave} = Volts x $Amps_{ave}$ x Power Factor and $Amps_{ave}$ is the average measured Amps for the duration of the monitored period.

$$Annual\ Energy\ Savings = \mathrm{kW_{ave}}\ \mathrm{x}\ \left(\frac{1}{\mathrm{Eff_{old}}} - 1/\mathrm{Eff_{new}}\right)\ \mathrm{x\ (days\ of\ operation\ per\ year/\ days\ metered)\ x\ Annual\ Adjustment\ Factor}$$

Where:

kW_{ave} = Volts x $Amps_{ave}$ x Power Factor for the monitoring period

$Amps_{ave}$ is the average measured Amps for the duration of the monitored period

use factor is determined from interviews with site personnel.

Annual Adjustment Factor is 1 if the monitoring period is typical for the yearly operation, less than 1 if the monitoring period is expected to be higher use than typical for the rest of the year, and more than 1 if the monitoring period is expected to be lower than typical for the rest of the year.[5]

The information on motor efficiencies needed for the calculation of savings is obtained from different sources.

Data on the efficiencies of high-efficiency motors installed under the program should be available from program records.

Care must be taken using nameplate efficiency ratings of replaced motors unless the company maintains good documentation of their equipment. If a motor has been rewound it may not operate as originally rated. However, if the efficiencies of the old motors are not directly available, the efficiency values can be imputed by using published data on average efficiency values for motors of given horsepower. Based on rules established under the Commission's Mercantile Pilot Program, Docket No. 10-834-EL-EEC, utilities may count equipment of failure to as-found conditions.

[5] Current year weather data were compared with the *Typical Meteorological Year* from the National Oceanic & Atmospheric Administration (NOAA)

Because most motors monitored run only under full load conditions, some adjustments must be made from the "industry averages" of full load efficiencies. Motor efficiency curves of typical real motors that have the same full load efficiencies are used for determining part load efficiencies.

Like motor efficiency, the power factor varies with motor loading. Motor power factor curves of typical real motors that have the same full load power factor are used for determining part load power factor.

Another factor to consider in demand and energy savings comparisons of motor change-out programs is the rotor slip. Full load RPM ratings of motors vary. For centrifugal loads, such as fans and pumps, the power supplied is dependent on the speed of the driven equipment. The power is theoretically proportional to the cube of the speed, but in practice acts more like the square of the speed. In general, high-efficiency motors have slightly higher full load RPM ratings (lower slip) than standard motors. Where nameplate ratings of full load RPM are available for replaced motors, a derating factor can be applied.[6]

The data needed to carry out these plans for determining savings are collected from several sources.

1. The first source of data is the information from each project's documentation. This information is expected to include aggregate energy used at a site, disaggregated energy usage data for certain targeted processes (if available), before (actual) and after (projected) data on production, scrap, and other key performance indicators, and final reports (which include process improvement recommendations, analyses, conclusions, performance targets, etc.).
2. The second source of data is the energy use data that the Companies collect for these customers.
3. The third source is information collected through on-site inspections of the facilities. ADM staff collects the data during on-site visits using a form that is comprehensive in addressing a facility's characteristics, its modes and schedules of operation, and it's electrical and mechanical systems. The form also addresses various energy efficiency measures, including high-efficiency lighting (both lamps and ballasts), lighting occupancy sensors, lighting dimmers and controls, air conditioning, high-efficiency motors, etc.
4. The fourth source of data, selected end-use equipment, is monitored to develop information on operating schedules and power draws.

[6]As an example, take the case where a new motor has a full load RPM rating of 1770 and the old motor had a full load RPM rating of 1760. The derating factor would be:

Derating factor = $(RPM_{old})^2 / (RPM_{new})^2 = 1760^2 / 1770^2 = 0.989$

Plan for Analyzing Savings from VFDs: A variable-frequency drive (VFD) is an electronic device that controls the speed of a motor by varying the magnitude of the voltage, current, or frequency of the electric power supplied to the motor. The factors that make a motor load a suitable application for a VFD are (1) variable speed requirements and (2) high annual operating hours. The interplay of these two factors can be summarized by information on the motor's duty cycle, which essentially shows the percentage of time during the year that the motor operates at different speeds. The duty cycle should show good variability in speed requirements, with the motor operating at reduced speed a high percentage of the time.

Potential energy savings from the use of VFDs are usually most significant with variable-torque loads, which have been estimated to account for 50% to 60% of total motor energy use in the non-residential sectors. Energy-saving VFDs may be found on fans, centrifugal pumps, centrifugal blowers, and other centrifugal loads, most usually where the duty cycle of the process provided a wide range of speeds of operation.

ADM's approach to determining savings from the installation of VFDs involves (1) making one-time measurements of voltage, current, and power factor of the VFD/motor and (2) conducting continuous measurements of amperage over a period to obtain the data needed to develop VFD load profiles and calculate demand and energy savings. VFDs are generally used in applications where motor loading changes as motor speed changes. Consequently, the true power drawn by a VFD is recorded to develop VFD load shapes. One-time measurements of power are made for different percent speed settings. Power and percent speed or frequency (depending on VFD display options) are recorded for as wide a range of speeds as the customer allows the process to be controlled; field staff attempt to obtain readings from 40 to 100% speed in 10 to 15% increments.

Plan for Analyzing Savings from Compressed Air Measures: Measures to improve the efficiency of a compressed air system include the reduction of air leaks, resizing of compressors, installing more efficient compressors, improved controls, or a complete system redesign. Savings from such measures are evaluated through engineering analysis of compressor performance curves, supported by data collected through short-term metering.

ADM field staff obtains nameplate information for the pre-retrofit equipment either from the project file or during the on-site survey. Performance curve data are obtained from manufacturers. Engineering staff then conduct an engineering analysis of the performance characteristics of the pre-retrofit equipment. During the on-site survey, field staff inspects the as-built system equipment, takes pressure and load readings, and interview the system operator to identify seasonal variations in load. Potential interactions with other compressors are assessed and it is verified that the rebated compressor is being operated as intended.

When appropriate, short-term measurements are performed to reduce the uncertainty in defining the load on the as-built system. These measurements may be taken either with a multi-channel logger, which can record true power for several compressors, with current loggers, which can provide average amperage values, or with motor loggers to record operating hours. The appropriate metering equipment is selected by considering variability in load and the cost of conducting the monitoring.

Plan for Analyzing Savings from Refrigeration and Process Improvements: Analysis of savings from refrigeration and process improvements is inherently project specific. Because of the specificity of processes, analyzing the processes through simulations is generally not feasible. Rather, reliance is made on engineering analysis of the process affected by the improvements. Major factors in ADM's engineering analysis of process savings are operating schedules and load factors. Information on these factors is developed through short-term monitoring of the affected equipment, be it pumps, heaters, compressors, etc. The monitoring is done after the process change, and the data gathered on operating hours and load factors are used in the engineering analysis to define "before" conditions for the analysis of savings.

Plan for Analyzing Savings from Whole Facility Energy and Water Process Improvements: In cases where a measure's impact may be "visible in the bills", ADM investigates using an IPMVP7 Option C: Whole Facility analysis methodology. The general format used is a monthly pre/post-implementation billing data regression, which compares site-specific weather data and/or other impactful variables (e.g. production data) against monthly billing data to determine how the energy consumption of the facility varies with these variables and the implemented measure. To perform the billing regression, several pieces of information are usually ascertained:

- Details about the electric metering arrangement at a facility, to determine which meter(s) are impacted by the measure, and other loads involved.
- Time affected by measure implementation.
- Whether or not any other energy projects or changes to facility operation affecting energy usage were implemented in or around the timeframe of the rebated measure. If so, adjustments may be made, or in some cases, the regression is not feasible.

[7] International Performance, Measurement, and Verification Protocol. "Concepts and Options for Determining Energy and Water Savings", Volume 1. January 2012.

Plan for analyzing savings from Indoor Horticultural Lighting: Analysis of savings for this measure in a new construction setting is determined based on matching a baseline condition with the total amount of energy required within the light spectrum for plant growth in the efficient condition. This measure of energy is known as Photosynthetic Photon Flux (PPF). PPF is a value that is provided in manufacturer specifications and can be verified through independent third-party testing. PPF can be calculated by either:

- Using energy measurements in a laboratory setting and calculations based on standards such as the American Society of Agricultural and Biological Engineers (ASABE) s640; or
- Direct measurements from a Photosynthetically Active Radiation (PAR) meter.

Plan for analyzing savings from Retro-Commissioning (RCx): Specific savings calculations vary by measure, and RCx can include many measures. Therefore, measurement and verification techniques may vary but will follow the protocol of the Uniform Methods Project (UMP). When many measures are considered, a billing regression analysis is often the first choice.

Appendix C: Participant Survey

FirstEnergy Ohio

Mercantile Customer Program

2019 Participant Survey

Variables	Definition
CUSTOMER CONTACT NAME	First and last name
CUSTOMER ORGANIZATION	Company
LOCATION	Address
CUSTOMER CONTACT EMAIL	Email address
CUSTOMER CONTACT PHONE	Phone number
PROJECT	Equipment, RCx, NC
PROJECT DESCRIPTION	Insert text description of project
INCENTIVE TYPE	Incentive type chosen = Rebate, Exemption
NULL INCENTIVE TYPE	Incentive type not chosen = Rebate, Exemption
KWH GROSS	Project level kWh savings total
UTILITY	EDC
LIGHTING ENDUSE	If project is lighting = 1, else = 0
HVAC ENDUSE	If project is HVAC = 1, else = 0
CUSTOM ENDUSE	If project is CUSTOM = 1, else = 0

Mode of Administration

Online (Primary) and Telephone (Secondary Follow-up as needed)

Respondent Characteristics [Do Not Display]

1. **Program records indicate you were the main contact for the [PROJECT DESCRIPTION] project completed at the [LOCATION] location.**

   The following questions are about your experience with the program and various factors that influence your organization when making decisions about energy efficiency projects.

   Were you involved in the decision to complete this project(s)?

   1. Yes, I was involved in the decision to complete the project
   2. No, I was not involved in the project
   3. No, I do not work for the company that completed the energy efficiency project; I provided services for the project

   98. Don't know

[SHOW Q2 IF Q1 = 2, 3, 98]

2. **Could you please provide the name and contact information of the person most knowledgeable about the decision to complete the [PROJECT DESCRIPTION] project at the [LOCATION]?**

1. **Open Ended: _____ [name and email]**
98. **Don't know [SKIP TO END]**
99. **Refused [SKIP TO END]**

3. **What is your job title or role?**

1. Facilities Manager
2. Engineer/Energy Manger
3. Director
4. Other facilities management/maintenance position
5. Chief Financial Officer
6. Other financial/administrative position
7. Proprietor/Owner
8. President/CEO
9. Manager
97. Other (Specify)

Decision Making [Do Not Display]

4. Which of the following, if any, does your company have in place at [LOCATION] location? **[Select all that apply] [RANDOMIZE]**

1. A person or persons responsible for monitoring or managing energy usage
2. Defined energy savings goals
3. A specific policy requiring that energy efficiency be considered when purchasing equipment
4. Carbon reduction goals
5. None of the above
97. Other policies or procedures regarding energy efficiency or use (please describe)
98. Don't know

5. How does your organization typically decide to make energy efficiency improvements for this facility?

1. Made by a group or committee
2. One-person decision
3. Based on staff recommendations to a decision-maker
4. Depends on the amount of the investment
97. Other (Specify)
98. Don't know

Awareness [Do Not Display]

6. How did you learn about [UTILITY]'s Mercantile Program? [Select all that apply] [RANDOMIZE]

1. Previously participated in the Mercantile Program
2. From the contractor, equipment vendor, or energy consultant who completed the project at the [LOCATION] location.

3. From some other contractor, equipment vendor, or energy consultant
4. From a [UTILITY] Customer Representative
5. From a program representative
6. From [UTILITY]'s website, (EnergySaveOhio.com)
7. From a search engine (Google, Yahoo, Bing)
8. An event or trade show
9. Received an email blast or electronic newsletter
10. Received an informational brochure
11. TV/radio ads sponsored by [UTILITY]
12. Friends or colleagues
13. An industry association
97. Other (Specify)
98. Don't know

[DISPLAY Q7 IF Q6 = 1 AND NOTHING ELSE SELECTED]

7. Do you recall how you originally learned about [UTILITY]'s Mercantile Program? [Select all that apply] [RANDOMIZE]

1. From the contractor, equipment vendor, or energy consultant who completed the project at the [LOCATION] location.
2. From some other contractor, equipment vendor, or energy consultant
3. From a [UTILITY] Customer Representative
4. From a program representative
5. From [UTILITY]'s website, (EnergySaveOhio.com)
6. From a search engine (Google, Yahoo, Bing)
7. An event or trade show
8. Received an email blast or electronic newsletter
9. Received an informational brochure
10. TV/radio ads sponsored by [UTILITY]
11. Friends or colleagues
12. An industry association
97. Other (Specify)
98. Don't know

[DISPLAY Q8 IF Q6 = 13 OR Q7 = 12]

8. From which of the following industry associations did you learn about [UTILITY]'s Mercantile Program? [Select all that apply] [RANDOMIZE]

1. Association of Independent Colleges & Universities (AICUO)
2. Council of Smaller Enterprises (COSE)
3. County Commissioners' Association of Ohio (CCAO)
4. Industrial Energy Users (IEU)
5. Ohio Manufacturer's Association (OMA)
97. Other (Specify)
98. Don't know

9. In addition to the Mercantile Customer Program, did you know that in 2019, [UTILITY] offered incentive programs for energy efficiency projects?

1. Yes
2. No
98. Don't know

[SHOW Q10 IF Q9 = 1]

10. Have you applied for incentives through these programs?

1. Yes
2. No
98. Don't know

[SHOW Q11 IF Q10 = 2]

11. Why didn't you choose to receive incentives through these programs for the [PROJECT DESCRIPTION] completed at the [LOCATION] location? [Select all that apply] [RANDOMIZE]

1. The equipment was implemented before I learned of the incentive programs
2. I was concerned that applying for an incentive would delay the project
3. The financial payoff I received through Mercantile Customer Program was better
4. The incentive programs were unavailable when the project was planned
97. Other (Please explain)
98. Don't know

Program Delivery Efficiency [Do Not Display]

The following questions are about your organization's experience with the Mercantile Program, for the [PROJECT DESCRIPTION] project completed at [LOCATION], rather than any other projects you may have done that received an incentive through a [UTILITY] program. Please keep this project in mind when answering the questions.

12. Regarding your organization's decision to participate in the Mercantile Customer Program, who initiated the discussion about the financial assistance opportunity? Would you say…?

1. Your organization initiated it
2. Your vendor or contractor initiated it
3. The idea arose in a discussion between your organization and your vendor or contractor
97. Some other way (Specify)
98. Don't Know

13. Which of the following people or groups helped complete your application for the [INCENTIVE TYPE] (including gathering required documentation)? [Select all that apply] [RANDOMIZE]

1. Yourself
2. Another member of your company
3. A contractor
4. An equipment vendor
5. A designer or architect
6. A [UTILITY] Customer Service Representative
7. An industry association

97. Someone else (Specify)
98. Don't know

[SHOW Q14 IF Q13 = 7]

14. Which industry association helped with your application for the Mercantile Customer Program?

1. Association of Independent Colleges & Universities (AICUO)
2. Council of Smaller Enterprises (COSE)
3. County Commissioners' Association of Ohio (CCAO)
4. Industrial Energy Users (IEU)
5. Ohio Manufacturer's Association (OMA)

97. Other (Please specify)
98. Don't know

15. Why did you choose the [INCENTIVE TYPE] instead of the [NULL INCENTIVE TYPE]? [Select all that apply] [RANDOMIZE]

1. The paperwork was easier
2. The process was quicker
3. Financial benefit was better
4. **[SHOW IF INCENTIVE TYPE = Rebate]** Preferred getting a single payment

97. Other (Specify)
98. Don't know

[SHOW Q16 IF Q13 = 1]

16. Thinking back to the application process, please rate the clarity of information on how to complete the…

	Not at all clear	Somewhat clear	Neutral	Mostly clear	Completely clear	Don't know
Mercantile Customer Program Application	1	2	3	4	5	98
[INCENTIVE TYPE] Forms	1	2	3	4	5	98

PUCO Application to Commit	1	2	3	4	5	98
Mercantile Customer Project Commitment Agreement	1	2	3	4	5	98
[SHOW IF LIGHTING END USE = 1] Lighting Project Calculator	1	2	3	4	5	98

[SHOW Q17 IF Q160-0 = 1 OR 2]

17. What information, including instructions on forms, needs to be further clarified?

1. Open Ended: _____

[SHOW Q18 IF Q13 = 1]

18. Using the scale provided, how would you rate the following…

	Completely unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Completely acceptable	Don't Know
the ease of finding how to apply for the Mercantile Customer Program on [UTILITY]'s website	1	2	3	5	5	98
the ease of using the application forms	1	2	3	5	5	98
the time it took to have the application approved	1	2	3	5	5	98
the effort required to provide required invoices or other supporting documentation	1	2	3	4	5	98
the ease of the application submission process	1	2	3	4	5	98
the overall application process	1	2	3	4	5	98

[SHOW Q19 AND Q20 IF Q180-0 = 1 OR 2]

19. In your own words, please describe what was unacceptable about the application process? Please be as specific as possible.

2. Open Ended: _____

20. Do you have any suggestions for how the application process could be improved?

1. Open Ended: _____

[SHOW Q21 IF Q13 = 1]

21. Did you have a clear sense of whom you could go to for assistance with the application process?

1. Yes
2. No

98. Don't know

[SHOW Q22 IF INCENTIVE TYPE = Rebate]

22. How did the rebate amount compare to what you expected?

1. **It was much less**
2. **It was somewhat less**
3. **It was about the amount expected**
4. **It was somewhat more**
5. **It was much more**
98. **Don't know**

Equipment Selection and Influence factors [Do Not Display]

[SHOW Q23 IF PROJECT = Equipment]

23. How much effect did each of the following types of people have on your decision to implement the efficient equipment? [Select all that apply]

	Provided no input	Input did not affect the decision	Small effect on the decision	Moderate to large effect on the decision	Critical effect – could not have made the decision without it	Don't know
Vendor (retailer)	1	2	3	4	5	98
Contractor (installer)	1	2	3	4	5	98
Designer or architect	1	2	3	4	5	98
[UTILITY] staff member, such as a customer representative	1	2	3	4	5	98
Staff from an industry organization	1	2	3	4	5	98

24. Was there anyone else who affected your decision to implement the energy-efficient equipment?

1. Yes
2. No
98. Don't know

[SHOW Q25 IF Q24 = 1]

25. Who was it that affected your decision?

1. Open ended: _____

[SHOW Q26 IF Q230-e = 4 OR 5 OR Q24 = 1]

26. What did they do that affected your decision?

1. Open ended: _____

27. Who implemented your program-qualified equipment or efficiency upgrades?

1. **Your own staff**
2. **A contractor you've worked with before**
3. **A contractor recommended by [UTILITY]**
4. **A new contractor that someone else recommended**

97. Other (Specify)
98. Don't know

28. Is the equipment that you implemented under the Mercantile Customer Program still in place and operating?

1. **Yes**
2. **No**

98. Don't know

[SHOW Q29 IF Q28 = 2]

29. Why is the equipment no longer implemented or operating?

1. Open ended: _____

Plans for Future EE Projects [Do Not Display]

30. Does your organization have plans to install any high-efficiency equipment in the next two years?

1. Yes
2. No

98. Don't know

[SHOW Q31 IF Q30 = 1]

31. What equipment types does your organization plan to install/complete? [Select all that apply]

1. High-Efficiency Lighting
2. The high-Efficiency HVAC equipment
3. Variable Speed Motors and/or Drives
4. ENERGY STAR® certified Appliances
5. High-efficiency Commercial Kitchen Equipment
6. Agriculture Equipment
7. High-Efficiency Consumer Electronics (high-efficiency TVs, computer, data centers, and/or imagining devices)

97. Something else (Specify)
98. Don't know

[SHOW Q32 IF Q30 = 1]

32. To the best of your knowledge, which of the following [UTILITY] incentives, if any, do you plan to apply for when you install that equipment?

1. A Mercantile Program rebate or exemption
2. Another [UTILITY] incentive program
3. We do not plan to apply for incentives
98. Don't know

[SHOW Q33 IF Q32 = 2]

33. Why would you choose another program over the Mercantile Program?

1. Open ended: _____

[SHOW Q34 IF Q32 = 3]

34. Why would you choose not to apply for an incentive?

1. Open ended: _____

[SHOW Q35 IF Q32 = 1]

35. Which incentive option will you choose?

1. Rebate
2. Rider exemption
98. Don't know

[SHOW Q36 IF Q35 = 1]

36. Why will you apply for a rebate instead of an exemption?

1. Open ended: _____

[SHOW Q37 IF Q35 = 2]

37. Why will you apply for an exemption instead of a rebate?

1. Open ended: _____

Program Communication and Customer Satisfaction [Do Not Display]

38. In the course of doing this project did you request any assistance from [UTILITY] Customer Service Representatives?

1. Yes
2. No
98. Don't know

[SHOW Q39 IF Q38 = 1]

39. What types of things did you seek assistance with?

1. The application processes
2. Participation requirements
3. Energy savings calculations
4. Determining whether our project qualified
5. Completing other necessary forms

97. Other (Specify)

98. Don't know

[SHOW Q40 AND Q41 If Q38 = 1]

40. On the scale provided, please indicate how knowledgeable [UTILITY] Customer Service Representatives were about the issues you discussed with them?

Not at all knowledgeable	Slightly knowledgeable	Somewhat knowledgeable	Fairly knowledgeable	Very knowledgeable	Not sure
1	2	3	4	5	98

41. On the scale provided, please indicate how satisfied or dissatisfied you are with:

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	Not sure
How long it took your customer service representative to address your questions or concerns	1	2	3	4	5	98
How thoroughly your customer service representative addressed your question or concern	1	2	3	4	5	98
Your experience working with your customer service representative	1	2	3	4	5	98

[SHOW Q42 IF Q13 = 7]

42. You previously indicated that [RESPONSE Q14] helped you with the application to the Mercantile Program. What type of help did they provide you with? [Select all that apply] [RANDOMIZE]

1. Information on the application process
2. Information on participation requirements
3. Energy savings calculations
4. Determining whether our project qualified
5. Completing other necessary forms

97. Other (Specify)

98. Don't know

43. On the scale provided, please indicate how knowledgeable staff at [RESPONSE Q14] were about the issues you discussed with them?

Not at all knowledgeable	Slightly knowledgeable	Somewhat knowledgeable	Fairly knowledgeable	Very knowledgeable	Not sure
1	2	3	4	5	98

44. On the scale provided, please indicate how satisfied or dissatisfied you are with:

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	Not sure
How long it took [Response Q14] staff members to address your questions or concerns	1	2	3	4	5	98
How thoroughly [Response Q14] staff members addressed your question or concern	1	2	3	4	5	98
Your experience working with the [Response Q14]	1	2	3	4	5	98

45. On the scale provided, please indicate how satisfied or dissatisfied you are with:

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	Not sure
[SHOW IF PROJECT= Equipment] The equipment that was installed	1	2	3	4	5	98
[SHOW IF PROJECT= Equipment] The quality of the installation	1	2	3	4	5	98
The steps you had to take to submit a complete application	1	2	3	4	5	98
The amount of time it took to get your application approved	1	2	3	4	5	98
[SHOW IF INCENTIVE TYPE = Rebate] the amount of time it took to get your rebate	1	2	3	4	5	98
The program, overall	1	2	3	4	5	98

[SHOW Q46 IF Q45 or Q44 0-f = 1 OR 2 OR 3]

46. Please describe the ways in which you were not satisfied with the aspects of the program mentioned above.

1. Open ended: _____

Firmographic [Do Not Display]

47. Which of the following best describes the type of work that your firm or organization does at the [LOCATION] location?

1. Industrial/Manufacturing
2. Restaurant
3. Retail
4. Office
5. Grocery and convenience
6. School (K-12)
7. Higher Education
8. Lodging
9. Warehouse
10. Health Care
11. Arts/Entertainment/Recreation
12. Nonprofit or religious services
13. Transportation services
14. Public administration/Governmental Services

97. Other (Specify)

98. Don't know

48. Including all the properties, how many separate work locations does your organization own or lease space in, in [UTILITY]'s service area? (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.)

1. One
2. Two to three
3. More than three
98. Don't know

49. About how many full-time equivalent employees work at the facility at the [LOCATION] location?

1. Fewer than 10
2. 11 to 25
3. 26 to 40
4. 41 to 75
5. 76 to 100
6. 100 to 500
7. More than 500

98. Don't know

[SHOW Q50 IF Q49 <> 1]

50. And do your company's other facilities in [UTILITY]'s service area employ fewer, about the same, or more employees?

1. Fewer
2. About the same number
3. More
98. Don't know

51. 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

We have finished with the questions we have for this survey. Thank you for your time in answering questions regarding the [UTILITY]'s Mercantile Customer Program. Have a great day!