2017 Customer Action Program
Measurement and Verification Report

Prepared for the FirstEnergy Ohio Companies:

Ohio Edison Company

The Cleveland Electric Illuminating Company

The Toledo Edison Company

Prepared by:

ADM Associates, Inc.

3239 Ramos Circle

Sacramento, CA 95827

916-363-8383

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1 Executive Summary

For 2017, the Ohio Operating Companies, The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (OE), and The Toledo Edison Company (TE) (collectively "Companies") offered the Customer Action Program ("CAP"). The CAP captures energy savings and peak demand reductions achieved through actions taken by customers outside of utility-administered programs pursuant to R.C. 4928.662. Under this Revised Code section, the operating companies are authorized to count toward the benchmarks energy efficiency savings and peak demand reductions that are: (1) achieved through customer actions that comply with federal standards, including resources recognized as capacity resources by PJM Interconnection, L.L.C.; (2) achieved since 2006, measured on the higher of an as found or deemed basis; and (3) for new construction, counted based on 2008 federal standards.

Under contract with the Companies, ADM Associates, Inc. (ADM) performed evaluation, measurement, and verification (EM&V) activities for the CAP. The procedures used to perform the EM&V activities described in this report were informed by the approved State of Ohio Energy Efficiency Technical Reference Manual ("TRM")[1] and ADM's previous experience performing EM&V activities for the Companies' DSM programs. In addition, the procedures chosen built on information collected during a project initiation meeting and succeeding discussions with the Companies' staff.

The evaluation effort was accomplished by employing a variety of approaches to capture customer and market information, which included surveying efforts; market research; reports from retailers, administrators and trade allies; site verification visits; removal of potential cross participation from 2017 EE programs; and other evaluation, measurement and verification activities.

1.1 Residential

ADM employed varying evaluation strategies in performing an impact evaluation of the residential measures of the CAP. There were three residential measure categories investigated in the evaluation: Lighting, Appliances, and HVAC.

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

For each measure, ADM employed two strategies:

- A bottom-up approach utilizing primary data collected from the Companies' service territories via a Random Digit Dialing (RDD) telephone survey.
  - Used for ex-post savings calculations for Lighting and Refrigeration measures.
  - Used to corroborate savings for HVAC measures.
- A top-down approach utilizing macro-level data.
  - Used for ex-post savings calculations for HVAC measures.
  - Used to corroborate savings for Lighting and Refrigeration measures.

To ascertain information for the *bottom-up* approach about the energy efficient measures the Companies' residential customers purchased during 2017, ADM conducted a telephone survey. The survey asked a plethora of questions about the customer's energy efficient equipment purchases and resulted in a rich data set of information from 3,600 customers. Statistical tests were conducted to ensure there wasn't a statistically significant difference between the RDD survey sample and the Companies' service territories with respect to demographic characteristics that may influence energy efficient purchasing behavior. The percent of installations for each measure type was then extrapolated to the Companies residential household population for each operating company while removing potential cross-participation with the EE Programs.

The top-down approach utilized 2017 market data from U.S. Energy Information Administration, the Association of Home Appliance Manufacturers, Air Conditioning Heating and Refrigeration Institute, and EnergyStar with supported allocations to residential households in the Companies' service territories who purchased energy efficient equipment during 2017.

Both approaches were integrated to achieve and corroborate the ex post savings. By employing the bottom-up strategy, ADM estimated energy savings and demand reduction for each lighting and refrigeration measure. For CFLs, LEDs, and halogen bulbs, the top-down approach employed a lighting consumption model as an independent check on the ex-post savings. For refrigeration, the top-down approach utilized market data as an independent check on ex post savings and in 2017 freezers were added into the measure mix. Because of the low incidence of survey respondents with HVAC purchases, savings were calculated using the top-down approach. The RDD survey results for HVAC were used as an independent check on ex post savings.

The energy saving calculations were conducted using Ohio TRM Deemed Savings and engineering algorithms. Savings from measures rebated through the Companies' 2017 program offerings were removed from the CAP savings estimates. A summary of the measure-level energy savings results is shown in Table 1-1.

Table 1.1: Residential Energy Savings

EDC	Measure	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)	Lifetime Savings (kWh)
CEI	HVAC	5,734,301	5,859.72	103,027,734
OE	HVAC	8,005,471	8,180.56	143,833,662
TE	HVAC	2,367,815	2,419.60	42,542,351
Total		16,107,587	16,459.88	289,403,747
CEI	Refrigeration	12,160,119	2074.40	188,563,740
OE	Refrigeration	16,976,345	2896.01	263,247,694
TE	Refrigeration	5,021,173	856.57	77,861,994
Total		34,157,636	5,826.97	529,673,428
CEI	Lighting	23,982,745	3,036.53	296,554,038
OE	Lighting	33,309,368	4,217.41	411,880,609
TE	Lighting	9,326,623	1,180.87	115,326,571
Total		66,618,736	8,434.82	823,761,218
Res Total		**116,883,959**	**30,721.67**	**1,642,838,393**

1.2 Commercial & Industrial

The commercial and industrial (C&I) component of the CAP was evaluated by selecting a random sample of the Companies' C&I customers to evaluate energy savings associated with program-associated measures. The population of customers for which the sample was taken, excluded opt-out customers[2], and customers who participated in the 2017 Mercantile, Large Commercial, and Small Commercial Programs. The sample was generated by stratifying the population of businesses within the Companies' service territories based on average annual energy usage (kWh). For program year 2017, a total of 162,483 businesses comprised the population of entities that may have implemented CAP-associated energy efficiency measures.

Customers were surveyed by phone to collect information pertaining to CAP-associated energy efficiency measures. After a brief introduction, survey respondents were requested to indicate whether they installed any energy efficient equipment during 2017. Respondents who indicated installing equipment during 2017 were then asked detailed

[2] Beginning January 1, 2017, a customer (as defined in R.C. § 4928.6610) of an electric distribution utility may opt out of the opportunity and ability to obtain direct benefits from the utility's portfolio plan as described in R.C. § 4928.6611.

questions regarding the installed equipment. ADM completed decision maker surveys for 2,549 out of 32,347 chosen program-eligible entities. Of those respondents, 267 claimed to have installed energy efficient equipment during 2017. ADM performed a site visit to verify measure implementation for 110 of these respondents, of which 85 sites provided all the required documentation to verify installation. Out of those 85 sites, 58 of them implemented energy efficient equipment resulting in energy savings.

For each business location indicating implementation of energy efficiency equipment, ADM completed a process including decision maker interview (survey), documentation collection, and a site visit to obtain data to enable ADM to calculate energy savings, summer coincident peak savings, and lifetime energy savings.

Energy efficient equipment installed during 2017 reported by the sampled survey respondents was associated with 1,124,178kWh of annual energy savings. The summer coincident peak savings for this sample of businesses was 232.67 kW. A summary of the sample-level energy savings results is shown in Table 1-2.

Table 1.2: C&I Sample Energy Savings

Operating Company	Energy Savings (kWh)	Summer coincidence peak savings (kW)
CEI	228,984	44.68
OE	794,704	162.76
TE	100,490	25.23
2017 Total	**1,124,178**	**232.67**

Energy savings measures considered for CAP include lighting, HVAC, motors, refrigeration, appliances, water heating, and other equipment. The energy savings calculated for each business was a summation of all the energy efficiency measures observed within the businesses premise.

Savings from the sample were extrapolated to the population based on the sample stratification and are presented by rate class for each operating company. No savings from customers participating in the Companies programs were extrapolated to other customers, nor were savings extrapolated to customers that participated in the Companies' programs or customers that are on the list to opt-out. The extrapolated annual energy savings for all operating companies are 51,877,711 kWh. The extrapolated summer coincident peak savings for all operating companies was 11,114.16 kW. A summary of the savings by rate class is shown in Table 1-3.

Table 1.3: C&I Extrapolated Energy Savings

Strata	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)	Lifetime Savings (kWh)
CE-GP	69,983	31.62	888,530
CE-GS	11,989,910	2,724.38	129,374,466
CE-GSU	288,096	120.11	3,586,293
CE-GT	0	0.00	0
CEI Total	**12,347,989**	**2,876.11**	**133,849,288**
OE-GP	6,333,277	980.17	89,604,061
OE-GS	28,630,471	6,207.47	393,036,748
OE-GSU	746,295	95.08	10,641,876
OE-GT	840,871	108.28	11,983,738
OE Total	**36,550,914**	**7,390.99**	**505,266,423**
TE-GP	6,523	1.88	95,168
TE-GS	2,972,261	845.18	41,601,622
TE-GSU	0	0.00	0
TE-GT	25	0.01	370
TE Total	**2,978,808**	**847.06**	**41,697,159**
Total	**51,877,711**	**11,114.16**	**680,812,871**

2 Introduction and Purpose of Study

The purpose of this report is to present the results of the impact evaluation effort undertaken by ADM to quantify the energy savings and peak demand reductions that were achieved through actions taken by customers outside of the utility-administered programs. This was accomplished by employing a variety of approaches to capture customer and market information; including surveying efforts, market research, analyzing reports from industry groups, and site verification visits.

2.1 Residential

The residential section of this report presents the results of the impact evaluation of the CAP residential customer during 2017. The overall objective of the impact evaluation of the CAP residential program was to verify the gross energy savings (kWh) and peak demand (kW) reduction resulting from energy efficiency measures installed during 2017 by residential customers within the Companies' service territories, that are not counted in other utility-administered efficiency programs.

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

- An RDD survey effort of customers to determine energy efficiency measures installed during the calendar year 2017.
- On-site data collection was conducted for a subsample of survey respondents to gather verification information facilitating determination of CAP energy savings and peak demand reductions.
- Residential energy savings were estimated using the Ohio TRM.

The research questions for the evaluation of the residential component of CAP include the following:

- Are the Companies' residential customers purchasing energy efficient equipment outside of utility-administered efficiency programs?
- What information will residential customers provide regarding energy efficient equipment installed during 2017?

2.1.1 Residential Market Data Acquisition

The sample frame for measurement and verification of residential CAP energy savings includes all 2,175,914 of the Companies' residential customers in single and multifamily dwellings. During the initial stages of the measurement and verification effort, the Companies provided a list detailing the number of residential customers in their service territories by zip code.

ADM purchased contact data for households in each zip code of each service territory to develop a residential customer sample representative of each EDC's demographics. Households in this customer sample were randomly contacted by telephone through RDD and interviewed about lighting, appliance, and other equipment purchases made during 2017.

The sample size of the RDD effort facilitated estimation of residential CAP energy savings at +/-10% statistical precision at a 95% confidence level. The target RDD sample size was further augmented to account for a certain number of respondent refusals of on-site visits. In 2017, there were 3,600 completes during the single wave of the survey. A survey was considered to be complete if the respondent agreed to the survey and indicated whether or not energy efficient equipment was installed during 2017. For cases for which equipment was installed, detailed information about the equipment was acquired. Evaluated energy efficiency equipment included the following categories:

- Lighting
- HVAC
- Refrigeration

Following survey completion, ADM attempted to contact all the survey respondents who purchased the equipment to request participation in a site verification visit. If the respondent agreed, a site visit was scheduled to gather the information on the claimed efficiencies measures. During site visits, ADM staff verified installation of each energy efficiency measure.

A summary of statistics for residential market data acquisition is shown in Table 2.1.

Table 2.1: Residential Market Data Collection Effort Statistics

Unit	Quantity
Population Size (Residential Households)	2,175,914
Customers Completing Survey	3,600
Residential Site Visits	100

2.2 Commercial & Industrial

The overall objective for the impact evaluation of the CAP C&I Program was to verify the gross energy savings (kWh) and peak demand (kW) reduction resulting from energy efficiency measures installed during 2017 by businesses within the Companies' service territories, that are not counted in other utility-administered efficiency programs.

The approach for the impact evaluation included the following main activities and approaches:

- Customers were recruited for a study to identify energy efficiency measures installed during the calendar year 2017.
- Available documentation from the participants was reviewed, with attention given to proof of purchase, verification of equipment installation, and verification of the quantity of equipment installed.
- On-site data collection visits were conducted to gather information to facilitate calculation of CAP energy savings and peak demand impacts.
- Per Ohio RC §4928.662, for all measure types listed in the Ohio TRM; 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 ex post energy savings (kWh) and peak demand reduction (kW) represent the higher calculated value obtained from both methodologies.
- Program energy savings were estimated using the Ohio TRM:
    - Analysis of lighting savings was accomplished using ADM's custom-designed lighting evaluation tool with system parameters (fixture wattage, operating characteristics, etc.) based on information on operating parameters collected on-site, from the Ohio TRM, and, if appropriate, industry standards.
    - Analysis of non-lighting measures was accomplished using ADM's custom-designed non-lighting evaluation tool based on information on operating parameters collected on-site, from the Ohio TRM, and, if appropriate, industry standards.

The research questions for the CAP C&I include:

- Are the Companies' C&I customers purchasing energy efficient equipment outside of efficiency programs?
- Will C&I customers willingly provide information on energy efficient equipment installed in 2017?

2.2.1 Participant Commercial and Industrial Market Data Acquisition

ADM developed a sample of the Companies' C&I customers to facilitate measurement and verification of CAP energy savings achieved by the population of C&I customers. The Companies provided ADM with customer-level data on the energy use of their C&I customers. The data included customer contact information that assisted ADM's survey administration efforts. To generate the appropriate population of C&I customers, the database was filtered to remove the following customers:

- Customers without 12 prior months of meter data (07/2016-07/2017).
- Customers with non-current or expected non-current accounts.
- Customers with any months of zero or negative savings within the chosen 12-month period.[3]
- Customers with less than 2,000 annual kWh usage.
- Opt-out customers of the Companies' energy efficiency programs.
- Meter locations classified as STL, TRF, and POLS.
- Customers who participated in other utility administered efficiency programs

For each EDC, the remaining population of C&I customers (162,483) were grouped into strata based on the customer level of annual energy usage. The sample size facilitated estimation of C&I CAP energy savings at +/-10% statistical precision at a 95% confidence level for each EDC. The target sample size was further augmented to account for a certain number of respondent refusals of on-site visits and to create four sampling strata for each EDC. To achieve the desired number of survey respondents, many businesses were randomly chosen for the sample. The size of the sample is designed to meet a 95% confidence interval and 10% precision for the sample. The total number of businesses chosen from the population in which sampling was performed was 32,347. ADM contacted customers by referencing phone contact information contained in data provided to ADM by the Companies. A total of 2,549 sites who were contacted completed decision maker surveys.

The survey population was presented a survey to determine:

- Energy efficiency equipment installed in 2017
- Which energy efficiency equipment was installed in 2017

To obtain businesses to participate in the survey, they were called over the course of 5 weeks. Callbacks were made at different times of the day, and different days of the week. A survey was complete if the respondent agreed to the survey and answered whether energy efficient equipment was installed or planned to be installed in 2017. However, surveys were considered to have a response if a conversation was initiated.

[3] The provided database of commercial and industrial businesses contained negative meter data for some businesses.

After this point, detailed information about the equipment was acquired. Energy efficiency equipment was broken down into the following categories:

- Lighting
- HVAC
- Refrigeration
- Water Heating
- Refrigerated Vending Machines
- Washing Machines and other Appliances
- Motors
- Other

These categories of topic areas were chosen based on information provided in the Ohio TRM and Department of Energy's list of Standards and Procedures for calculating energy savings. A category listed as "other" was included to cover any warranted energy savings measures that may have been installed.

Upon completion of the survey, each respondent willing to participate was contacted by an ADM Associate through a follow-up phone call. The intent of the phone call was to gather documentation and information not acquired during the survey. Documentation included:

- Letter of Attestation for equipment installed in 2017
- Proof of purchase: invoices, receipts, etc.
- A signed W-9

Upon further communication with each respondent, a site visit was scheduled, for those willing to continue their participation, to gather the necessary information to calculate accurate energy savings. Site visits included the verification of each energy efficiency measure installed within the business.

A summary of statistics for participant acquisition is shown in Table 2-4.

Table 2.2: Participation Statistic

Sample	Customers
Sample Size	32,347
Survey Respondents	2,549
Businesses with reported Installed Measures or planned to install in 2017	267
Site Visits	110
Sites with Verified Energy Savings	58

Of the businesses who claimed measures in 2017, 110 were visited by ADM field technicians. ADM visited every business accepting a site visit.

3 CAP Residential

3.1 Program Description

The primary objective of CAP is to determine the energy savings from the Companies' customers without participating in a utility-administered efficiency program. CAP is a Market Research Study in which participants are chosen randomly such that energy savings findings can be extrapolated to the population within the Companies' service territories.

The residential CAP quantifies energy savings for the population of the Companies' residential customers occurring from actions taken outside of a program design. The energy efficiency measures considered for residential CAP in 2017 include lighting, HVAC, and refrigeration. Primary data associated with the Companies' customers' energy efficiency actions and purchasing behaviors was collected via an RDD telephone survey as described in Section 2.1, as well as through site visits.

3.1.1 Dual Participation Considerations

To ensure savings verified in the CAP were not originally generated through any other program in the Companies' portfolio offerings, ADM crosschecked participation with the 2013-2017 Community Connections Program and the 2017 Residential EE Programs. If a CAP survey respondent was included as a participant in another program offering their calculated savings were not included in CAP or extrapolated to the CAP population.

3.2 Methodology

This chapter provides a description of the methodology applied by ADM in the evaluation of the CAP during 2017.

ADM employed varying evaluation strategies in performing an impact evaluation of the residential measures of the program. For each measure, ADM employed two strategies to calculate ex-post savings:

- A bottom-up approach utilizing primary data collected from the Companies' service territories via a telephone survey.
- A top-down approach utilizing macro-level data.

The evaluation strategies for each measure are discussed in more detail in the following sections.

3.2.1 Sampling Design and Extrapolation Methods

In order to ascertain information about the energy efficient measures purchased by the Companies' residential customers during 2017, ADM conducted a telephone survey. The survey asked a plethora of questions about the customer's energy efficient equipment purchases and resulted in a rich data set of information from 3,600 customers.

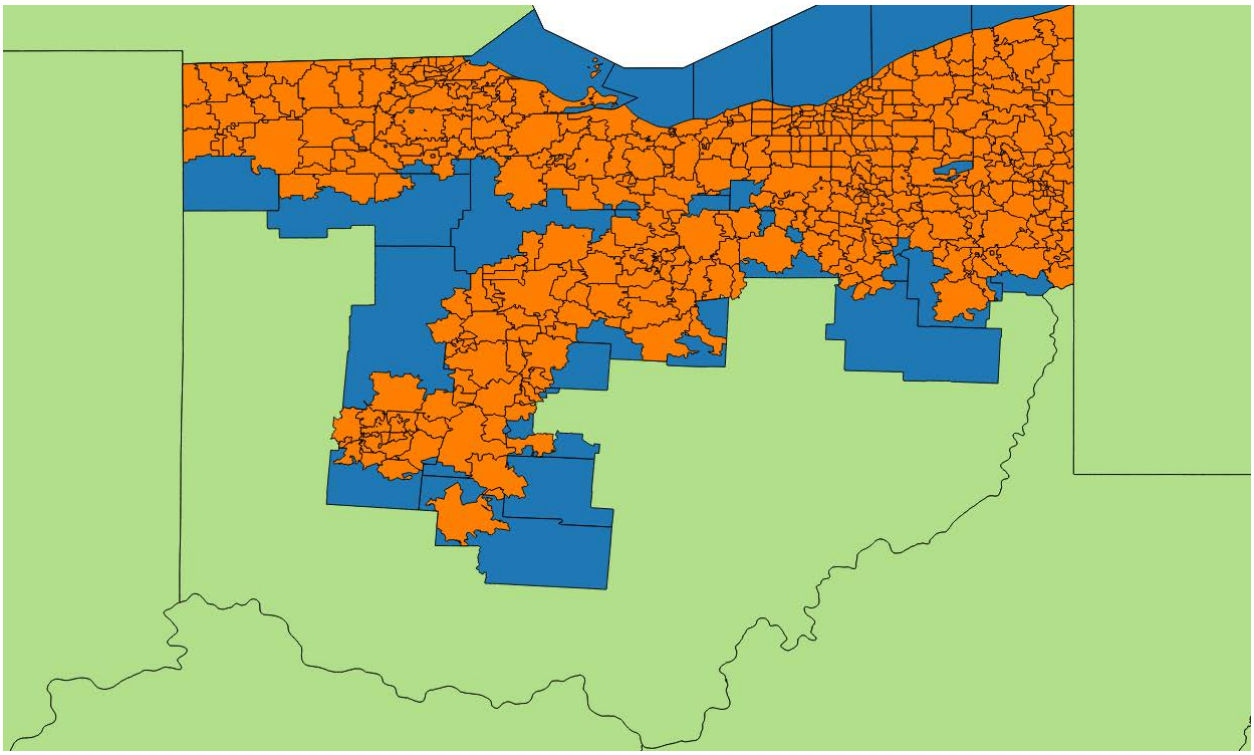
For the impact analyses of the residential measures in the program, data from the telephone survey was extrapolated to the entire population of the Companies' residential households. ADM ensured the statistical representation of the telephone survey sample through several steps.

First, ADM purchased a telephone database for residents in the OH zip codes within the Companies' service territories. Customers from this database were then contacted by a third-party survey implementer in accordance with RDD principles[4]. The number of completes were then frequency matched to the Companies' service territories at the county level.

Next, statistical comparisons were made to ensure there wasn't a statistically significant difference between the RDD survey sample and the Companies' service territories with respect to demographic characteristics that may influence energy efficient purchasing behavior. The following comparison uses the 3,600 survey responses collected for the Companies with gold-standard Census Bureau data for Ohio. The data used is the 2015 five-year household level Public Use Microdata Set (PUMS) of the American Community Survey (ACS). This dataset was chosen because it assures coverage of all census blocks over a 5-year period and has the most granular geography available from the Census Bureau. Other datasets, such as the one and three-year ACS and American Household Survey (AHS), lack coverage and the geographic identifiers below state level to conduct this analysis. Two geographies were covered, the state of Ohio, and all the Public Use Microdata Areas (PUMAs) that contained the Companies' service territories. Each is a Census Bureau geographic area constructed of census blocks and contains at least 100,000 residents. Figure 3.1 below illustrates how well the PUMAs (orange) were contained within the Companies' service territories (blue).

[4] Before offering customers the opportunity to complete the survey, the survey implementer confirmed that the household was in fact a customer of one of the Companies.

Figure 3.1: Census Tabulation Areas Containing the Companies' Service Territories Compared to PUMAs Containing the Companies' Service Territories



The first technique used was multiple imputation, to replace missing data. The R function aregImpute from the package Hmisc was used because of its robust algorithm. After missing data was replaced, target values were generated from ACS data for PUMAs that covered the Companies' service territories and for EDC, customer counts from the Companies. The survey data was then adjusted to the targets through an iterative procedure called raking. The specific R package used was anesrake, which implements the procedures used to weight the American National Election Study[5]. Adjusting a survey in this way influences outcomes by correcting correlated variables to known population totals. A comparison of the population targets, original sample, and weighted sample is shown in Table 3.1 below.

[5] DeBell, M. and J.A. Krosnick. (2009). Computing Weights for American National Election Study Survey Data, ANES Technical Report Series, No. nes012427. Available from: ftp://ftp.electionstudies.org/ftp/nes/bibliography/documents/nes012427.pdf

Table 3.1: Population, Sample, and Weighted Sample Counts and Percentages for Demographics Used

Length of Residence	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Less than 2 years	18.30%	338	9.39%	659	18.30%	8.91%
2 to 4 years	16.80%	298	8.28%	605	16.80%	8.52%
5 to 9 years	17.50%	495	13.75%	630	17.50%	3.75%
10 to 19 years	21.60%	864	24.00%	778	21.60%	-2.40%
20 to 29 years	11.20%	570	15.83%	403	11.20%	-4.63%
30 years or more	14.60%	1,035	28.75%	526	14.60%	-14.15%
Household Income	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
Less than $10,000	8.10%	388	10.78%	292	8.10%	-2.68%
$10,000 to $29,999	23.10%	808	22.44%	832	23.10%	0.66%
$30,000 to $49,999	20.20%	800	22.22%	727	20.20%	-2.02%
$30,000 to $89,999	26.60%	938	26.06%	958	26.60%	0.54%
$90,000+	22.00%	666	18.50%	792	22.00%	3.50%
Building Type	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
Other	3.30%	109	3.03%	119	3.30%	0.27%
Single Family	74.70%	3,087	85.75%	2,689	74.70%	-11.05%
Multi-Family	22.00%	404	11.22%	792	22.00%	10.78%
Heating Fuel	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
Gas/LP	77.00%	2,698	74.94%	2,772	77.00%	2.06%
Electricity	17.50%	440	12.22%	630	17.50%	5.28%
Other	5.50%	462	12.83%	198	5.50%	-7.33%
EDC	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
CEI	35.60%	1,311	36.42%	1,282	35.60%	-0.82%
OE	49.70%	1,773	49.25%	1,789	49.70%	0.45%
TE	14.70%	516	14.33%	529	14.70%	0.37%

Home Ownership	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
Owned Outright	35.60%	1,395	38.75%	1,282	35.60%	-3.15%
Owned with mortgage or loan	49.70%	1,541	42.81%	1,789	49.70%	6.89%
Rent or other	14.70%	664	18.44%	529	14.70%	-3.74%
Home Age	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
1949 or earlier	29.10%	866	24.06%	1,048	29.10%	5.04%
1950-1969	27.40%	1,200	33.33%	986	27.40%	-5.93%
1970-1989	21.70%	775	21.53%	781	21.70%	0.17%
1990 or later	21.80%	759	21.08%	785	21.80%	0.72%
Number of Rooms	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
1 to 4	21.80%	498	13.83%	785	21.80%	7.97%
5 to 6	39.70%	1,333	37.03%	1,429	39.70%	2.67%
7 to 8	25.80%	1,172	32.56%	929	25.80%	-6.76%
9+	12.70%	597	16.58%	457	12.70%	-3.88%
Number of Bedrooms	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
1	10.10%	163	4.53%	364	10.10%	5.57%
2	25.60%	769	21.36%	922	25.60%	4.24%
3	43.50%	1,696	47.11%	1,566	43.50%	-3.61%
4+	20.80%	972	27.00%	749	20.80%	-6.20%
Number of Occupants	**Population**	**Sample n**	**Sample %**	**Weighted n**	**Weighted %**	**Change in %**
1	30.00%	919	25.53%	1,080	30.00%	4.47%
2	35.00%	1,494	41.50%	1,260	35.00%	-6.50%
3	15.00%	521	14.47%	540	15.00%	0.53%
4	11.80%	363	10.08%	425	11.80%	1.72%
5+	8.20%	303	8.42%	295	8.20%	-0.22%

Table 3.2 compares the total counts of the outcome variables for each measure and the difference between the weight adjusted count for each measure and the original count. Of the measures, only the count for refrigeration changed enough to be slightly outside its original confidence interval. The effect on lighting measures was very small, less than

three percent for each bulb type. This implies that for most of the outcome variables, bias cannot be distinguished from sample error, and that the most conservative choice is to not use the weight. Put another way, the demographics of the sample were different from those of the population, but their collective effect on the outcome variables and thus the energy savings was not large enough to warrant a statistical correction.

Table 3.2: Measure Counts, Percentages, and Differences by Weight

Measure	Weighting	Lower C.I.	Total	Upper C.I.	Difference	Difference %
Refrigeration	Adjusted	379	470	559	57	13.80%
	Not adjusted	356	413	467		
HVAC	Adjusted	198	234	270	2	0.86%
	Not adjusted	208	232	256		
LED	Adjusted	14,302	16,128	17,954	2	0.01%
	Not adjusted	14,586	16,126	17,667		
CFL	Adjusted	10,517	12,335	14,154	-102	-0.82%
	Not adjusted	10,995	12,437	13,878		
Halogen	Adjusted	8,029	9,740	11,450	-283	-2.82%
	Not adjusted	8,588	10,023	11,458		

Table 3.3 compares the frequency distributions of the building types in the Companies' service territories to the sample of RDD survey respondents. The distributions are very similar and are dominated by single-family homes.

Table 3.3: Comparison of Telephone Survey Sample and the Companies' Service Territories Building Type Frequency Distributions

Building Type	Service Territory	Telephone Survey
Single-Family	83%	86%
Mobile Home	3%	2%
Apartment	13%	9%
Condominium	1%	0%
Other	0%	4%

Finally, ADM cross-checked to ensure they had not been a participant in another program offering.

3.2.2 Residential Impact Analysis Methods

There were three residential measure categories investigated in the evaluation of the CAP: Lighting, Refrigeration, and HVAC. The sections below detail the impact analysis methodologies for each of these measure categories.

3.2.2.1 Lighting

ADM calculated the energy savings and demand reductions produced by the Companies' customers installing energy efficient lighting during 2017. ADM investigated the following bulb types: halogens, CFLs, and LEDs. ADM employed two evaluation strategies in performing an impact evaluation of the program. The two strategies were:

- A bottom-up approach utilizing primary data collected from the Companies' service territories via an RDD telephone survey. This method was used to calculate ex-post savings.
- A top-down approach utilizing a lighting consumption model. This method was used to corroborate the bottom-up approach.

Bottom-Up Approach

Using the bottom-up strategy, ADM estimated energy savings and demand reduction for each lighting measure using the OH TRM algorithms with data obtained from the telephone survey and augmented as necessary from site visits and ancillary studies.

ADM quantified the total energy savings ($kWhSavingsLighting$) and demand reduction ($kWSavingsLighting$) associated with the Companies' customers installing energy efficient lighting during 2017 by first calculating the total annual savings for each bulb type *t* (Equation 1), and then summing all of the annual savings values calculated using Equation 1 (Equation 2).

$$kWhSavings_t = kWh\ Savings_{Bulb_t} * n_{Bulb_t/Household} * n_{FE\ Households}$$

Equation 1

$$kWhSavingsLighting \quad = \sum kWhSavings_t$$

Equation 2

Where:

t	= the type of light bulbs
	= Halogens, CFLS, and LEDs
$kWh\ Savings_{Bulb_t}$	= the average annual savings per bulb for each bulb type *t*
$n_{Bulb_t/Household}$	= the average number of bulbs replaced in each household for each bulb type *t*
$n_{FE\ Households}$	= the number of households in the Companies' service territories[6]

[6] This value is 2,175,914.

The average annual savings per bulb for each bulb type was calculated using the following OH TRM algorithms for energy and demand.

$$kWh\ Savings_{Bulb_t} = ((\Delta Watts_{Bulb_t})/1000) * HOU_{Bulb_t} * WFHe * ISR$$

Equation 3

Where:

$\Delta Watts_{Bulb_t}$ = The difference between the average wattage for bulb type *t* and the average wattage of the type of bulb type *t* replaced (the "As Found" wattage)[7];

HOU_{Bulb_t} = Average annual hours of use for bulb type *t*;

$WFHe$ = Waste Heat Factor for energy[8];

ISR = In Service Rate[9].

To remove the LED bulbs that could have potentially come from the 2017 EE Products upstream lighting program, when $t = LEDs$, the input in Equation 1 $n_{Bulb_t/Household} * n_{FE\ Households}$ is equal to Equation 4.

$$n_{Bulb_{LED}/Household} * n_{FE\ Households}$$

$$= P_{Participating\ Stores} * \left(\left(n_{\frac{Bulb_{LED}}{Household}} * n_{FE\ Households}\right) - C_{Program\ LEDs}\right)$$
$$+\ P_{Non-Participating\ Stores} * (n_{\ Bulb_{LED}} *\ n_{FE\ Households})$$

Equation 4

Where:

$P_{Participating\ Stores}$ = The percentage of the RDD respondents who purchased LEDs at a store that possibly participated in the EE Products program.

$C_{Program\ LEDs}$ = The number of LED bulbs incentivized during the 2017 EE Products program year.

[7] The "As Found" wattage is a blended value determined from survey questions that captured the various bulb types customers replaced with their newly purchased energy efficient bulbs.

[8] Parameter to account for effects on heating/cooling from efficient lighting. This value is 1.07 and from the OH TRM.

[9] This value is 1. The installation rates associated with the bulbs purchased by the Companies' customers was accounted for in the equation that calculates the average number of bulbs replaced in each household.

$P_{Non-Participating\ Stores}$ = The percentage of the RDD respondents who purchased LEDs at a store that was not on the list of participating EE Products program stores.

$$kW\ Savings_{Bulb_t} = ((\Delta Watts_{Bulb_t})/1000) * WFHd * CF * ISR$$

Equation 5

$$kWSavingsLighting \quad = \sum kWSavings_t$$

Equation 6

Where:

$\Delta Watts_{Bulb_t}$ = The difference between the average wattage for bulb type *t* and the average wattage of the type of bulb type *t* replaced (the "As Found" wattage)[10];

CF = Summer Peak Coincidence Factor[11];

$WFHd$ = Waste Heat Factor for demand[12];

ISR = In Service Rate.

$$n_{Bulb_t/Household} = \sum Survey_{Bulb_t} / \sum Survey_{Participants}$$

Equation 7

Where:

$\sum Survey_{Bulb_t}$ = The sum of all bulbs *t* verified to have been installed by telephone survey participants[13].

[10] The "As Found" wattage is a blended value determined from survey questions that captured the various bulb types customers replaced with their newly purchased energy efficient bulbs.

[11] Parameter for accounting for how much of the energy savings coincides with summer peak demand hours. This value is 0.11 and from the OH TRM.

[12] Parameter to account for cooling savings from efficient lighting. This value is 1.21 and from the OH TRM.

[13] This value was derived from a question that asked survey participants how many of each bulb type they purchased during 2017. The value was filtered by several factors including: 1) A verification/installation rate based on site visits 2) consistency check questions in the survey 3) the participant's familiarity with light bulb technologies.

$\sum Survey_{Participants}$ = The sum of all customers who participated in the telephone survey[14].

Top-Down Approach

The following top-down approach employs a lighting consumption model as an independent check on the ex-post savings calculated via the bottom-up approach described above. Total 2017 calendar year kWh savings from energy efficient lighting by the Companies' residential households is represented by $kWhSavingsLighting^{2017}$.

To calculate $kWhSavingsLighting^{2017}$, ADM examined the difference between the Companies' residential households' total calendar year 2017 lighting consumption (kWh) (the baseline year) and the Companies' residential households' total calendar year 2017 lighting consumption (kWh). This is illustrated in Equation 8 below:

$$kWhSavingsLighting^{2017} = ConsumptionLighting^{2016} - ConsumptionLighting^{2017}$$

Equation 8

Lighting consumption for bulb type *t* (incandescent, halogen, CFL and LED) in year *y* is a function of the bulb counts (units) for each bulb type *t* (Incandescent, Halogen, CFL and LED) at the end of each year y (December 31st) multiplied by the average annual consumption (kWh) for each bulb type *t*. This is illustrated in Equation 9 below.

$$ConsumptionLighting_t^y = n_{Bulb_t}^y * AverageConsumption_{Bulb_t}$$

Equation 9

To remove the bulbs that were incentivized by the 2017 EE products program, we subtract the LED bulb counts from Equation 9 as follows:

when $t = LED$, $n_{Bulb_{LED}}^{2017} = n_{Bulb_t}^y - C_{Program\ LEDs}$.

The summation of the annual lighting consumption across all three bulb types t is equal to the total lighting consumption in year *y*.

$$ConsumptionLighting^y = \sum ConsumptionLighting_t^y$$

Equation 10

[14] There were 3,600 of the Companies' customers who completed the RDD telephone survey.

The bulb count at 12/31/2017 in the Companies' residential households is derived by multiplying the percent of sockets occupied by bulb type t[15] by the average number of sockets per household[16] by the total number of households[17]. This is illustrated in Equation 11 below:

$$n^{y}_{Bulb_t} = \%SocketsOccupied_{Bulb_t} * nSockets_{Bulb_t} * n_{FE\ Households}$$

Equation 11

The average annual consumption for each bulb type b calculated by multiplying the expected annual hours of use for each bulb type b by the average load (W) per bulb type t[18] and dividing by 1,000. This is illustrated in Equation 12 below:

$$AverageConsumption_{Bulb_t} = (ExpectedAnnualHOU_{Bulb_t} * AverageLoad_{Bulb_t})/1000$$

Equation 12

The expected annual hours of use for each bulb type *t* is calculated by multiplying the expected daily hours of use[19] by 365. This is illustrated in Equation 13 below.

$$ExpectedAnnualHOU_{Bulb_t} = ExpectedDailyHOU_{Bulb_t} * 365$$

Equation 13

The bulb count at 12/31/2017 in the Companies' residential households begins with the bulb type *t* count at 12/31/2016 in the Companies' residential households calculated in Equation 11 and then subtracts the number of bulb type *t* that burnout during 2017 and then adds back the number of bulb type *t* that would be replaced in 2017. This is illustrated in Equation 14 below:

$$n^{2017}_{Bulb_t} = n^{2016}_{Bulb_t} - nBurn^{2017}_{Bulb_t} + nReplace^{2017}_{Bulb_t}$$

Equation 14

The count of bulb type *t* that will burn out in 2017 is calculated by multiplying the bulb count at 12/31/2017 by the rate at which bulb type *t* burns out (Equation 15).

[15] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf
[16] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf
[17] This value is 2,175,914.
[18] http://www.eia.gov/todayinenergy/detail.cfm?id=415
[19] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

$$nBurn_{2017} = n_{Bulb_t}^{2016} * BurnRate_t$$

Equation 15

Each bulb type's burn rate is calculated by dividing unity by bulb type *t*'s measure life (years)[20].

$$BurnRate_t = 1/MeasureLife_t$$

Equation 16

The number of type *t* bulbs that replace each of the burned-out bulbs[21] was calculated by multiplying the count of bulb type *t* that will burn out in 2017 by the rate at which each bulb type *t* is likely to replace a burned-out bulb[22].

$$nReplace_{Bulb_t}^{2017} = nBurn_{2017} * ReplaceRate_{Bulb_t}$$

Equation 17

3.2.2.2 HVAC

ADM calculated energy savings and demand reductions produced by the Companies' residential customers purchasing energy efficient HVAC equipment during 2017. ADM investigated the following HVAC measures: Room Air Conditioners (RAC), Central Air Conditioners (CAC), and Heat Pumps. ADM performed an analysis with data provided by the Companies, the United States Census Bureau, the Energy Information Administration (EIA), and the Air-Conditioning, Heating, & Refrigeration Institute (AHRI). In 2017, there were no active residential HVAC EE Programs, no cross-participation removal calculations were performed.

The total annual energy (kWh) savings for each HVAC type *t* was calculated using Equation 18 below.

$$kWSavingsHVAC_t = kWh\,Savings_{HVAC_t} * n_{HVAC_t}$$

Equation 18

[20] Each bulb types average life in years was calculated by dividing each bulb's typical rated life (hours) (http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/lifetime_white_leds.pdf) by $ExpectedAnnualHOU_{Bulb_t}$

[21] The Lighting Consumption model assumes that all bulbs which burned out in 2017 were replaced. This was probably not the case and the reason why the savings estimated using the top-down approach is slightly larger than the bottom-up approach.

[22] The bulb *t* replacement rates were derived from questions RP3-RP24 in the RDD telephone survey and question 16 in the April 2015 FE OH Market Potential survey.

Where:

t = the types of HVAC units

= CAC, RAC, and Heat Pumps

$kWh\ Savings_{HVAC_t}$ = Annual kWh savings per HVAC unit type *t*

n_{HVAC_t} = Number of type *t* HVAC units purchased in 2017

Summing across the annual savings for all HVAC types *t* provides the total savings for the residential HVAC measure.

$$kWSavingsHVAC = \sum kWSavingsHVAC_t$$

Equation 19

The number of type *t* HVAC units (n_t) purchased in 2017, was calculated by first obtaining the percentage of residences in Ohio in each zip code per income bracket. Next, the percentage of residential households in each zip code per income bracket that purchased a unit in 2017 was determined, as well as the number of the Companies' residential households in each zip code per income bracket. Finally, the above inputs are used in conjunction with the Climate Factor to calculate the number of HVAC units of type *t* in the Companies' service territories during 2017.

The above steps are summarized in Equation 20 below:

$$n_{HVAC_t} = \sum_z \sum_i P_{z_i} * R_i * CF_z * V$$

Equation 20

Where:

z = Zip Codes in the Companies' service territories[23]

[23] Provided by the Companies.

i = Income Bracket Levels[24]

= Annual Income per Residence

= [0,20,000) u [20,000,40,000) u [40,000,60,000) u [60,000,100,000) u [100,000,∞)

P_{z_i} = Number of residential households in Zip Code *z*, with Income Bracket *i*

R_i = Percentage or residential households, with income bracket *i*, with a unit purchased in 2017[25]

CF_z = Climate Factor for Zip Code *z*

= Region rate which effects usage and sales of units[26]

V = Verification Rate

$$= \frac{Number\ of\ Sites\ Visited\ with\ Verified\ Measure\ Installed}{Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed}$$

= 20% for Room AC; 71.4% for Central AC; *NA* for Heat Pump

Where:

$Number\ of\ Sites\ Visited\ with\ Verified\ Measure\ Installed$ [27]

$Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed$ [28]

Utilizing data provided by US Census Bureau, the percentage of Ohio households in each zip code per income bracket (P_{z_i}) was calculated using Equation 21:

$$\%OhioRes_{z_i} = \frac{nRes_{z_i}}{nRes_z}$$

Equation 21

[24] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

[25] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1

[26] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1

[27] Number of sites ADM visited that claimed to have the measure installed and verified the installation.

[28] Number of customers that claimed to have the measure installed from the participant survey.

Where:

$\%OhioRes_{z_i}$ = Percentage of Ohio residential households in zip code *z* with income bracket *i*

$nRes_{z_i}$ = Number of Ohio residential households in zip code *z* with income bracket *i*[29]

$nRes_z$ = Total number of Ohio residential households in zip code *z*[30]

In Equation 22 below, the percentage of Ohio residences in zip code *z* with income bracket *i* is multiplied by the number of the Companies' residential households in zip code *z.*

$$P_{z_i} = P_z * \%OhioRes_{z_i}$$

Equation 22

Where:

P_z = the Companies' residential households in zip code z[31]

The tables below (Table 3.4, Table 3.5, Table 3.6) detail the percentage of residences per income bracket who purchased HVAC measures of type *t* (R_i).

Table 3.4: Percent of Residences with an CAC Purchase in 2017[32]

% of Residences that purchased an CAC in 2017 (From Energy Information Administration)					
	<20	**20-40**	**40-60**	**60-100**	**>100**
Total	8.80	13.00	11.40	12.53	10.41
Number < 2 Yrs.	0.65	1.08	1.14	1.12	1.17
Number in 2017	0.32	0.54	0.57	0.56	0.59
% Sold 2017	3.67%	4.14%	5.00%	4.46%	5.64%

[29] United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

[30] United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

[31] Provided by the Companies.

[32] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1

Table 3.5: Percent of Residences with a Heat Pump Purchase in 2017[33]

% of Residences that purchased a HP in 2017 (From Energy Information Administration)					
	<20	**20-40**	**40-60**	**60-100**	**>100**
Total	2.10	2.70	2.60	3.17	2.89
Number < 2 Yrs.	0.15	0.22	0.26	0.28	0.33
Number in 2017	0.08	0.11	0.13	0.14	0.16
% Sold 2017	3.67%	4.14%	5.00%	4.46%	5.64%

Table 3.6: Percent of Residences with a Room AC Purchase in 2017[34]

% of Residences that purchased an AC in 2017 (From Energy Information Administration)					
	<20	**20-40**	**40-60**	**60-100**	**>100**
Total	7.6	6.8	4.3	4.4	2.6
Number < 2 Yrs.	1.2	0.9	0.6	0.5	0.5
Number in 2017	0.6	0.45	0.3	0.25	0.25
% Sold 2017	7.90%	6.62%	6.98%	5.68%	9.62%

Climate Factors (CF_z) represents the rate at which climate effects usage and sales of HVAC units type t. They were determined by using EIA data to categorize each zip code as a climate zone. The climate factors are detailed in Tables 3.7 - 3.9 below.

[33] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1

[34] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption Residential Energy Consumption Survey (RECS)-b1

Table 3.7: Climate Factor Central Air Conditioning

% of Homes w/ Central Air Conditioning in FE Territory (From Energy Information Administration)						
	Total	**Very Cold/Cold**	**Mixed-Humid**	**Mixed-Dry/Hot-Dry**	**Hot-Humid**	**Marine**
% of Homes w/ A/C w/o HP	49%	46%	52%	51%	64%	11%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.2	19.0	6.3
W/o Heat Pump	56.1	17.7	18.4	7.2	12.1	0.7
W/ Heat Pump	13.5	1.3	6.9	1.4	3.6	0.4
Do Not Have or use Central Air Conditioning Equipment	44.0	19.8	10.1	5.6	3.3	5.2

Table 3.8: Climate Factor Heat Pump[35]

% of Homes w/ Heat Pump in FE Territory (From Energy Information Administration)						
	Total	**Very Cold/Cold**	**Mixed-Humid**	**Mixed-Dry/Hot-Dry**	**Hot-Humid**	**Marine**
% of Homes w/ HP	12%	3%	19%	10%	19%	6%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.2	19.0	6.3
W/o Heat Pump	56.1	17.7	18.4	7.2	12.1	0.7
W/ Heat Pump	13.5	1.3	6.9	1.4	3.6	0.4
Do Not Have or use Central Air Conditioning Equipment	44.0	19.8	10.1	5.6	3.3	5.2

Table 3.9: Climate Factor Room Air Conditioning[36]

% of Homes w/ Room Air Conditioning in FE Territory (From Energy Information Administration)						
	Total	**Very Cold/Cold**	**Mixed-Humid**	**Mixed-Dry/Hot-Dry**	**Hot-Humid**	**Marine**
% of Homes w/ Room AC	23%	30%	24%	16%	15%	16%
Housing Units Served by Central Air Conditioning Equipment	113.6	38.8	35.4	14.1	19.1	6.3
W/Window or Wall Unit	25.9	11.6	8.4	2.2	2.8	1.0

[35] Ibid.
[36] Ibid.

Energy savings per CAC/RAC unit was calculated via Equation 23:

$$kWh_{Annual} = \frac{EFLH_{Cool} * Cap * [\frac{1}{SEER_{Existing}} - \frac{1}{SEER_{Installed}}]}{1000}$$

Equation 23

Where,

$EFLH_{Cool}$ = weighted average of effective full load hours per EFLH location by the Companies residential households[37]

= 448.81

Cap = Capacity (kBTU)

= Size of the equipment installed

= 34.04[38]

$SEER_{Existing}$ = SEER efficiency of existing unit

= 10

$SEER_{Installed}$ = SEER efficiency of installed unit

= 14

ADM calculated energy savings per Heat Pump unit with the following Equation 24[39].

$$kWh_{Annual} = \frac{EFLH_{Cool} * CAP * [\frac{1}{SEER_{Existing}} - \frac{1}{SEER_{Installed}}]}{1000} + \frac{EFLH_{Heat} * CAP * [\frac{1}{HSPF_{Existing}} - \frac{1}{HSPF_{Installed}}]}{1000}$$

Equation 24

Where,

$EFLH_{Cool}$ = weighted average of effective full load hours per EFLH location by the Companies' residential households

= 448.81

[37] Weighted average of Run Hours compared to number of residences per location 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 31.

[38] Weighted average of capacity compared to number sold nationally. http://www.ahrinet.org/App_Content/ahri/files/Statistics/Monthly%20Shipments/2017/December_2017.pdf

[39] 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 33.

$EFLH_{Heat}$ = weighted average of effective full load hours per EFLH location by the Companies' residential households

= 1538.92[40]

Cap = Capacity (kBTU)

= Size of the equipment installed

$SEER_{Existing}$ = SEER efficiency of existing unit

= 13

$SEER_{Installed}$ = SEER efficiency of installed unit

= 15

$HSPF_{Existing}$ = Heating Season Performance Factor of existing unit

= 7.7[41]

$HSPF_{Installed}$ = Heating Season Performance Factor of installed unit

= 8.2

3.2.2.3 Refrigeration

ADM calculated the energy savings and demand reductions produced by the Companies' residential customers installing energy efficient Refrigerators and Freezers during 2017. ADM developed two analysis approaches to calculate the quantity of residences who purchased refrigerators and freezers in 2017.

- A top-down approach utilizing data market research data from U.S. Energy Information Administration and the Association of Home Appliance Manufacturers. The quantities estimated from this method, minus the quantity of measures that were incentivized in the 2017 EE Products program, were used to calculate the quantity of refrigerators and freezers utilized in the ex post savings calculation.
- A bottom-up approach utilizing primary data collected from the Companies' service territories via an RDD telephone survey. This method was used to corroborate the quantity of refrigerators and freezers, minus the quantity incentivized in the 2017 EE Products program, utilized in the ex post savings calculation via the top-down approach.

[40] Weighted average of Run Hours compared to number of residences per location 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 34

[41] 2010 Ohio Technical Reference Manual, August 6, 2010. Vermont Energy Investment Corporation, pp. 67.

Top-Down Approach

ADM performed an analysis with data provided by FE OH, the United States Census Bureau, the Energy Information Administration (EIA), and the Association of Home Appliance Manufacturers (AHAM).

The total annual energy (kWh) savings for Refrigeration appliance type *t* using Equation 25 below.

$$kWhSavingsRef_t = kWh\,Savings_{Ref_t} * n_{Ref_t}$$

Equation 25

Where:

t = the types of Refrigeration appliance

= Bottom-freezer, top-freezer, and side-by-side,

= Upright freezer, chest freezer.

$kWh\,Savings_{Ref_t}$ = Annual kWh savings per Refrigeration unit type *t*

n_{Ref_t} = Number of type *t* Refrigeration units purchased in 2017 *minus the number of incentivized units in the EE Products program*.

Summing across the annual savings for all Refrigeration types *t* provides the total savings for the residential Refrigeration measure.

$$kWSavingsRef = \sum kWSavingsRef_t$$

Equation 26

The number of type *t* Refrigeration units (n_{Ref_t}) purchased in 2017, was calculated by first obtaining the percentage of residential households in Ohio in each zip code per income bracket. Next, the percentage of residential households in each zip code per income bracket that purchased a unit in 2017 was determined, as well as the number of the Companies' residential households in each zip code per income bracket.

The above steps are summarized in Equation 27 below:

$$n_{Ref_t} = \sum_z \sum_i P_{z_i} * R_i * V$$

Equation 27

Where:

z = Zip Codes in the Companies' service territories[24]

i = Income Bracket Levels[25]

= Annual Income per Residential Household

= [0,20,000) u [20,000,40,000) u [40,000,60,000) u [60,000,100,000) u [100,000,∞)

P_{z_i} = Number of residential households in Zip Code *z*, with Income Bracket *i*

R_i = Percentage or residential households, with income bracket *i*, with a unit purchased in 2017[26]

V = Verification Rate Refrigerators = 91.43%, Freezers = 78.57%

$$= \frac{Number\ of\ Sites\ Visited\ with\ Verified\ Measure\ Installed}{Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed}$$

Where:

$Number\ of\ Sites\ Visited\ with\ Verified\ Measure\ Installed$ [42]= 32, 11

$Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed$ [43]= 35, 14

Refrigerators and Freezers, respectively.

Utilizing data provided by US Census Bureau, the percentage of Ohio residential households in each zip code per income bracket (P_{z_i}) was calculated using Equation 28:

$$\%OhioRes_{z_i} = \frac{nRes_{z_i}}{nRes_z}$$

Equation 28

Where:

$\%OhioRes_{z_i}$ = Percentage of Ohio residential households in zip code *z* with income bracket *i*

$nRes_{z_i}$ = Number of Ohio residential households in zip code *z* with income bracket *i*[44]

[42] Number of sites ADM visited that claimed to have the measure installed and verified the installation.
[43] Number of customers that claimed to have the measure installed from the participant survey.
[44] United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

$nRes_z$ = Total number of Ohio residential households in zip code *z*[45]

In Equation 29 below, the percentage of Ohio residential households in zip code *z* with income bracket *i* is multiplied by the number of the Companies residential households in zip code *z.*

$$P_{z_i} = P_z * \%OhioRes_{z_i}$$

Equation 29

Where:

P_z = the Companies' residential households in zip code *z*[46]

Table 3.10 and Table 3.11 below detail the percentage of residential households per income bracket who purchased Refrigeration measures (R_i).

Table 3.10: Percent of Residences that Purchased a Refrigerator in 2017

% of Residences that purchased a Refrigerator in 2017 (From Energy Information Administration)					
Income	**<20k**	**20k-40k**	**40k-60k**	**60k-100k**	**>100k**
Total	23.80	27.50	21.20	23.60	17.80
Number < 2 Yrs.	2.80	2.90	2.60	3.00	2.70
Number in 2017	1.44	1.49	1.34	1.54	1.39
% Sold 2017	6.052%	5.425%	6.309%	6.540%	7.803%

Table 3.11: Percent of Residences that Purchased a Freezer in 2017

% of Residences that purchased a Freezer in 2017 (From Energy Information Administration)					
Income	**<20k**	**20k-40k**	**40k-60k**	**60k-100k**	**>100k**
Total	3.00	4.60	4.00	4.80	3.00
Number < 2 Yrs.	0.50	0.60	0.40	0.70	0.60
Number in 2017	0.26	0.31	0.21	0.36	0.31
% Sold 2017	8.57%	6.71%	5.14%	7.50%	10.28%

[45] United States Census Bureau - http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B19001&prodType=table

[46] Provided by the Companies.

The annual kWh savings per refrigerator unit type *t* ($kWh\ Savings_{Ref_t}$) was derived from the Ohio TRM, and are detailed in the Table 3.12 below:

Table 3.12: Annual Savings for Refrigerators and Freezers

Refrigerator Type	kWh
Bottom Freezer	119
Top Freezer	100
Side by Side	142
Freezer Type	**kWh**
Chest Freezer	133
Upright Freezer	133

The demand savings was calculated using the following formula:

$$kWSavingsRef_t = kW\ Savings_{Ref_t} * n_{Ref_t}$$

Equation 30

n_{Ref_t} was calculated according to Equation 27 and the annual kW savings per refrigerator unit type *t* ($kW\ Savings_{Ref_t}$) was derived from the Ohio TRM, and are detailed in Table 3.13 below:

Table 3.13: Refrigerators and Freezers Summer Coincidence Peak Savings

Refrigerator Type	kW
Bottom Freezer	0.021
Top Freezer	0.018
Side by Side	0.025
Freezer Type	**kW**
Chest Freezer	0.02
Upright Freezer	0.02

Bottom-Up Approach

ADM corroborated n_{Ref_t} by calculating the percent of households in the RDD telephone survey sample that purchased and installed refrigerators during 2017. This was via Equation 31 below and used to calculate savings as shown in Equation 25 with the number of incentivized units removed.

$$n_{Ref_t} = (\sum Survey_{Ref_t} / \sum Survey_{Participants}) * n_{FE\ Households}$$

Equation 31

3.3 Detailed Evaluation Findings

During the 2017 residential CAP evaluation, ADM surveyed 3,600 residential customers across all zip codes in the Companies and performed 100 on-site visual verification visits.

3.3.1 Verification of Residential Lighting

Out of the 3,600 RDD sample respondents, 67% indicated that they purchased energy efficient light bulbs during 2017. The site verifications determined that 78.2% of the bulbs reported as purchased during the phone survey were in fact installed[47]. After accounting for survey answer consistency checks, applying verification rates and extrapolating to the Companies' service territories, ADM determined the following energy efficient light bulb installations by bulb type in Table 3.14.

Table 3.14: Residential Light Bulb Installations

Bulb Type	Count
Halogen	299,112
CFL	670,601
LED	1,624,554

The 2017 EE Products lighting program incentivized 83,225 LEDs. In the verified savings below, the number of incentivized bulbs were subtracted from the LED bulb counts before calculating the energy and demand savings as shown in the methods section above.

Table 3.15 below details which rooms survey respondents installed the energy efficient bulbs they purchased in 2017.

[47] To be counted as "installed", the bulb had to be visually verified and the customer had to verbally confirm the installation date as well as the method of procurement. Bulbs that were either installed during a year other than 2017 or obtained through a utility program were not counted.

Table 3.15: Residential Light Bulb Installations

Location	CFL	LED	Halogen
Basement	7.08%	6.41%	6.10%
Bathrooms	12.78%	13.21%	13.41%
Bedrooms	15.20%	14.64%	12.80%
Den	1.90%	1.82%	1.83%
Dining Room	6.04%	6.32%	4.88%
Entry Way	2.76%	4.11%	2.44%
Garage	4.66%	4.88%	5.49%
Hallway	5.01%	6.12%	3.05%
Kitchen	13.47%	16.84%	25.61%
Living Room	17.96%	15.69%	14.63%
Office	2.07%	2.39%	0.00%
Other Room/Location	3.11%	3.54%	6.71%
Outdoor	4.66%	0.00%	0.00%
Stairway	2.25%	2.11%	0.00%
Store for later installation	1.04%	1.91%	3.05%

Table 3.16 below details which kind of bulbs respondents indicated they replaced with the energy efficient bulbs they purchased in 2017.

Table 3.16: Bulb Replacement Type

Pre-existing bulb	CFL	LED	Halogen
Incandescent	62.52%	60.39%	40.61%
Halogen	5.01%	7.60%	42.40%
CFL	29.90%	22.94%	12.70%
LED	2.57%	9.07%	4.29%

Table 3.17 below shows the kWh savings calculated during the impact evaluation of residential lighting. Table 3.18 shows the kW reduction.

Table 3.17: Residential Lighting Annual Energy kWh Savings

Measure	CEI	OE	TE	Total
Halogen	145,085	201,507	56,422	403,014
CFL	6,836,031	9,494,488	2,658,457	18,988,975
LED	17,001,629	23,613,373	6,611,744	47,226,746
Total	**23,982,745**	**33,309,368**	**9,326,623**	**66,618,736**

Table 3.18: Residential Lighting Summer Peak Coincidence kW Savings

Measure	CEI	OE	TE	Total
Halogen	19.67	27.32	7.65	54.64
CFL	860.88	1,195.67	334.79	2,391.33
LED	2,155.99	2,994.42	838.44	5,988.85
Total	**3,036.53**	**4,217.41**	**1,180.87**	**8,434.82**

Customers were generally willing to participate in the data collection effort and interested in sharing information about their energy efficiency actions/purchasing behaviors. Customers seem relatively familiar with CFL and LED lighting technologies and are comfortable with using them to replace traditional incandescent bulbs.

3.3.2 Verification of Residential HVAC

ADM calculated 1.5% of the Companies' residential households purchased a Central Air Conditioner, 0.2% a Heat Pump during the 2017 calendar year and an additional 0.4% purchased a Room Air Conditioner. The savings calculation was performed for a quantity of 32,340 Central Air Conditioners, 3,325 Heat Pumps, and 9,498 Room Air Conditioners.

Table 3.19 shows the kWh savings calculated during the impact evaluation of HVAC. Table 3.20 shows the kW reduction.

Table 3.19: Residential HVAC Savings (kWh) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	5,026,023	7,016,667	2,075,352	14,118,043
Room Air Conditioners	31,614	44,135	13,054	88,802
Heat Pumps	676,664	944,669	279,409	1,900,741
Total	**5,734,301**	**8,005,471**	**2,367,815**	**16,107,587**

Table 3.20: Residential HVAC demand (kW) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	5,599.29	7,816.99	2,312.07	15,728.35
Room Air Conditioners	40.57	56.64	16.75	113.97
Heat Pumps	219.85	306.93	90.78	617.56
Total	**5,859.72**	**8,180.56**	**2,419.60**	**16,459.88**

3.3.1 Verification of Residential Refrigerators and Freezers

Out of the 3,600 RDD sample respondents, ADM identified 381 refrigerators and 135 freezer respondents who completed all survey questions relevant to purchase and installation of energy efficient appliances. 10.83% and 3.81% of sample respondents reported purchasing and installing a refrigerator or freezer (respectively) during the 2017 calendar year. ADM used a supplemental analysis approach to corroborate the primary

data and check survey bias potential. The secondary analysis approach described in the methodology section concluded that 6.37% and 7.62% of residences purchased a refrigerator or freezer during the 2017 calendar year. The savings calculation was performed for a quantity of 139,683 refrigerators and 166,962 freezers determined by the primary data collection effort. These quantities have had the EE Products appliance program incentivized refrigerators (1,538) and freezers (1,029) subtracted from the CAP program counts as described in the methods section above. The breakout by refrigerator and freezer type is shown in Table 3.21.

Table 3.21: Installations by Unit Type

Refrigerator Type	Energy Star Quantity Installed	Percent
Bottom-freezer	131	34.38%
Side-by-side	111	29.13%
Top-freezer	139	36.48%
Total	**381**	**100.00%**
Freezer Type	**Energy Star Quantity Installed**	**Percent**
Chest Freezer	68	50.37%
Upright Freezer	67	49.63%
Total	**135**	**100.00%**

Table 3.22 shows the kWh savings calculated during the impact evaluation of refrigerators. Table 3.23 shows the kW reduction.

Table 3.22: Residential Refrigeration kWh Savings

Refrigerator Type	CEI	OE	TE	Total
Bottom-freezer	3,066,876	4,281,566	1,266,379	8,614,821
Side-by-side	2,183,740	3,048,649	901,713	6,134,102
Top-freezer	3,883,123	5,421,101	1,603,424	10,907,649
Total	9,133,739	12,751,316	3,771,516	25,656,571
Freezer Type	**CEI**	**OE**	**TE**	**Total**
Chest Freezer	1,501,981	2,096,866	620,200	4,219,047
Upright Freezer	1,524,398	2,128,163	629,457	4,282,018
Total	3,026,379	4,225,029	1,249,657	8,501,065
Refrigeration Total	**12,160,119**	**16,976,345**	**5,021,173**	**34,157,636**

Table 3.23: Residential Refrigeration kW Reduction

Refrigerator Type	CEI	OE	TE	Total
Bottom-freezer	541.21	755.57	223.48	1,520.26
Side-by-side	393.07	548.76	162.31	1,104.14
Top-freezer	683.65	954.42	282.29	1,920.36
Total	1,617.94	2,258.75	668.08	4,544.76
Freezer Type	**CEI**	**OE**	**TE**	**Total**
Chest Freezer	226.54	316.27	93.54	636.36
Upright Freezer	229.92	320.99	94.94	645.85
Total	456.47	637.26	188.49	1,282.21
Refrigeration Total	**2,074.40**	**2,896.01**	**856.57**	**5,826.97**

3.4 Conclusions

This chapter reports the conclusions resulting from the impact evaluation of the 2017 CAP residential program. The savings by EDC and measure groups are presented in Table 3.24 and Table 3.25.

Table 3.24: kWh by Operating Company

	CEI	OE	TE	Total
Res Lighting	23,982,745	33,309,368	9,326,623	66,618,736
Res Refrigerator	12,160,119	16,976,345	5,021,173	34,157,636
Res HVAC	5,734,301	8,005,471	2,367,815	16,107,587
Total	**41,877,164**	**58,291,184**	**16,715,611**	**116,883,959**

Table 3.25: kW by Operating Company

	CEI	OE	TE	Total
Res Lighting	3,036.53	4,217.41	1,180.87	8,434.82
Res Refrigerator	2,074.40	2,896.01	856.57	5,826.97
Res HVAC	5,859.72	8,180.56	2,419.60	16,459.88
Total	**10,970.65**	**15,293.97**	**4,457.04**	**30,721.67**

The residential portion of the CAP resulted in finding 116,883,959 kWh of annual energy savings and 30,721.67 kW reduction across the three operating Companies.

4 CAP Commercial & Industrial

4.1 Program Description

The primary objective of CAP is to determine the energy savings from the Companies' customers without taking advantage of rebates offered through the Companies' energy efficiency programs. CAP is a Market Research Study in which participants are chosen randomly such that energy savings findings can be extrapolated to the population of businesses within the Companies' service territories.

The C&I CAP quantifies energy savings for the population of the Companies' C&I customers occurring from actions taken outside of a program design. High energy users were omitted from CAP, but all other commercial and industrial businesses are eligible for the program and have the option to opt out or not participate. High energy users were omitted from CAP 2017 due to the high likelihood that they will be participating in the utility sponsored efficiency programs. Furthermore, previous years of CAP have indicated that there is a greater impact on the extrapolated energy savings of non-high energy users. High energy users were considered to be businesses with greater than the following average annual energy usage (across 2015 and 2016):

CEI: 5,936,425 kWh

OE: 4,832,116 kWh

TE: 9,269,906 kWh

Business customers within the Companies were acquired through the process outlined in Section 2.2.1. Participants were chosen randomly into a stratified sample based on average annual energy usage (kWh). The population considered for CAP included 162,483 businesses. Energy savings were calculated for each business based on the number of energy efficient measures installed during 2017. Energy savings could only be calculated for businesses that could provide the necessary information and documentation to verify the date of installation as well as specifications on the equipment and use.

The energy efficiency measures considered for C&I CAP include: lighting, HVAC, refrigeration, motors, washing machines and other appliances, refrigerated vending machines, and other equipment. The category of other includes custom equipment, process equipment, and other measures that are quantifiable by EM&V best practices.

Site level analysis for each business provided the information to calculate annual energy savings (kWh), summer coincident peak savings (kW), and a weighted average estimated useful life for all measures installed in 2017. The site level analyses by stratum were used to extrapolate savings, summer coincident peak savings, and estimated useful life to the

population. Estimated useful life is used to calculate lifetime energy savings (kWh) for the population.

4.1.1 Dual Participation Considerations

To ensure savings verified in the CAP were not originally generated though any other program in the Companies' portfolio offerings, ADM crosschecked participation with the 2013-2017 Mercantile and 2013-2017 C&I program data. If a CAP survey respondent was included as a participant in another program offering their calculated savings were not included in CAP or extrapolated to the CAP population. Opt-out customers were also removed from the population before a random sample was drawn.

4.2 Methodology

ADM'S evaluation of the 2017 C&I CAP consisted of an impact evaluation. The impact evaluation methodology is described in this section.

4.2.1 Sampling Design and Extrapolation Methods

For the C&I portion of the CAP a sample of the population was drawn to generate participants that would provide a +/-10% statistical precision at a 90% confidence level. The sample was drawn randomly to create four strata for each operating company based on average annual energy usage. Due to uncertainties in response rate for the survey, a larger sample was generated. Confidence interval and precision was based on the total of average annual usage (across two to three years) for each stratum compared to the population.

A multiple of the stratified sample was taken to account for the response rate of the survey as well as participant willingness to continue with the program beyond the survey.

4.2.2 Review of Documentation

After respondents agreed to participate in the CAP, documentation was requested by phone and/or email (if necessary). The documentation requested is described in Section 2.2.1. Remaining documentation was collected on-site during the site visit.

4.2.3 On-Site Data Collection Procedures

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

Every business that agreed to participate in the program and responded that they had installed energy efficient equipment was chosen for site visits. Each company was contacted via phone to set up a time for the site visit.

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

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

When necessary, monitoring was conducted to gather more information on the operating hours of the installed measures. Monitoring was conducted at sites where it was judged that the monitored data would be necessary an accurate calculation of energy savings. Monitoring was not considered necessary for sites where documentation and on-site verification allowed for sufficiently detailed calculations.

4.2.4 Procedures for Estimating Savings from Measures

The method ADM employs to determine savings impacts depends on the types of measures being analyzed. Categories of measures include the following:

- Lighting
- HVAC
- Motors
- Water Heating
- Appliances
- Refrigeration
- Other

ADM uses a specific set of methods to determine energy savings for projects that depend on the type of measure being analyzed. For the CAP, the Ohio TRM savings algorithms are utilized first and if additional calculations are necessary, EM&V best practices are used. Typical EM&V methods employed are summarized in Table 4.1.

Table 4.1 Typical Methods to Determine Savings for Custom Measures

Type of Measure	Method to Determine Savings
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 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.
Water Heating	Engineering analysis, with monitored data on load factor and schedule of operation.
Refrigeration	Simulations with EQUEST engineering analysis model, with monitored data.
Other	Engineering analysis, with monitored data on load factor and schedule of operation.

Each measure specific energy savings calculation was verified to have not received a rebate from a prescriptive energy efficiency program implemented by the Companies. Projects by measure type were checked against C&I program participation in 2017 to avoid any double counting scenarios.

The following discussion describes the basic procedures used for estimating savings from various measure types.

4.2.4.1 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 were 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 were taken from a table of standard wattages, with corrections made for non-operating fixtures. Hours of operation were determined from communications with site contact or 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 used industry standard data on standard wattages of lighting fixtures and ballasts to determine demand values for lighting fixtures. These data provide information on wattages for common lamp and ballast combinations.

ADM used 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 identified hours of use and the fixture wattages are used to calculate post-retrofit kWh usage. Fixture peak demand is calculated by dividing the total kWh usage calculated peak period of the day 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.

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

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

$$Annual\ Energy\ Savings = kWh_{Before} - kWh_{After}$$

Equation 32

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

1) Results from the on-site visit are used to determine if deemed hours of use or as-found hours of use should be applied. The data are extrapolated to develop the annual operating profile of the lighting.
2) These average operating hours are then applied to the baseline and post-installation average demand for each usage area to calculate the energy usage and peak period demand for each usage area.
3) The annual baseline energy usage is calculated as the sum of the annual baseline kWh for all of the usage areas. The 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 the region-specific, building type-specific heating cooling interaction factors to calculate total savings attributable to lighting measures, inclusive of impacts on HVAC operation. These factors are based on the Ohio TRM.

4.2.4.2 HVAC Measures

Savings estimates for HVAC measures installed at a facility are calculated based on the calculations provided in the Ohio TRM or derived by using the energy use estimates developed through DOE-2 simulations. 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 prepared estimates of the energy savings for the energy efficient equipment and measures installed in each of the participant facilities.

When a simulation was necessary, engineering staff prepared 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 idiosyncrasies of facilities (e.g., multiple buildings, discontinuous occupancy patterns, etc.).

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

- First, an analysis of energy use at a facility under the assumption that the energy efficiency measures are not installed is performed. If the measure involves replacement of equipment on failure, the required minimum efficiencies given by the appropriate energy efficiency standard would be used. This methodology holds true for all programs/measures being considered.
- Second, energy use at the facility with all conditions the same but with the energy efficiency measures now installed is analyzed.
- Third, the results of the analyses from the preceding steps are compared to determine the energy savings attributable to the energy efficiency measure.

4.2.4.3 Motors

The energy savings from use of high efficiency motors on HVAC and non-HVAC applications are derived from the Ohio TRM. Energy use is measured only for the high efficiency motor and only after it has been installed. The data thus collected are then used in estimating what energy use would have been for the motor application if the high efficiency motor had not been installed. The equivalent full load hours are determined from on-site interviews with the site contact.

4.2.4.4 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 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 of time in order 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 when the 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.

4.2.4.5 Water Heating

The calculation of savings from water heating is derived from the Ohio TRM. In the case of a custom water heating application, engineering calculations are applied. Aside from nameplate information on the water heating device, these calculations involve (1) determining the amount of hot water consumed over a specified period and (2) the temperature and condition of the water exiting the heating device.

4.2.4.6 Refrigeration and Process Improvements

Analysis of savings from refrigeration and process improvements is inherently project-specific; however, savings algorithms from the Ohio TRM, if available, and applicable, are used. 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. In the case where monitoring is not applicable, detailed information from the site contact is necessary.

4.2.4.7 Appliances

Calculation of energy savings from appliances are derived from the Ohio TRM. This includes refrigerators, washing machines, refrigerated vending machines, and commercial kitchen equipment.

4.2.4.8 Other Equipment

Other equipment is considered for energy savings calculations if calculations are provided in the Ohio TRM and the equipment has federally acknowledged standards and practices. Calculation methods for these measures involve custom engineering algorithms from industry standard procedures.

4.2.5 Summer Coincident Peak Savings

Summer coincident peak savings are calculated using the coincidence factors from the Ohio TRM. However, if the as-found annual energy savings (kWh) are higher, then an average value across the summer coincident peak period is used. The summer coincident peak period is defined as 3:00 PM until 6:00 PM on non-holiday weekdays from June 1st until the end of September.

4.2.6 Energy Savings Extrapolation

Energy savings for all measures within a site were added to develop a site level energy savings. A strata level energy savings is determined by summing all the savings within each site in the strata. An energy reduction was determined for each strata by taking the sum of calculated energy savings per strata and dividing by the sum of average annual energy usage.

$$\%\ Reduction\ in\ Energy\ Usage = \Sigma kWh_{Annual\ Savings} / \Sigma kWh_{Annual\ Usage}$$

Equation 33

The percent reduction in annual energy usage from the sample is applied to each site in the population that falls into the same stratum. For each site in the population, the percent reduction in annual energy usage is multiplied by the average annual energy usage for the site to calculate an estimated annual energy savings. Program level energy savings are then determined by summing all the energy savings of sites within a rate class for each operating company.

The lifetime savings for the population is determined by extrapolating the estimated useful life (EUL) from the sample. A weighted EUL for each site in the sample was determined by the EUL of each measure within the site. The EUL is weighted by the percent of savings provided a measure to the total annual energy savings for the site. An average EUL was then derived for each stratum based on the weighted average EUL for each site. The strata level EUL was applied to each site in the population to determine the lifetime savings for the population. Lifetime savings are reported by rate class for each operating company.

The summer coincident peak savings (kW) was determined for each site based on the calculated summer coincident peak savings for each measure within a site in the sample. The strata level sample kW is the sum of all summer coincident peak savings of sites within the strata. A peak reduction factor is generated by strata by dividing the summer coincident peak savings by the annual energy savings.

$$Summer\ Coincident\ Peak\ kW\ Savings = \Sigma\ kW / \Sigma kWh_{Annual\ Savings}$$

Equation 34

This peak reduction factor is then applied to each site in the population based on its strata. By multiplying the site specific annual energy savings by the peak reduction factor, a summer coincident peak savings is generated for each site in the population. Summer coincident peak savings is reported by rate class for each operating company.

4.2.7 Commercial & Industrial Impact Analysis Summary

The methodology described above allows the results of a sample with +/-10% statistical precision at a 90% confidence level to be applied to the population. The calculations extrapolated to the commercial and industrial population are for: annual energy savings (kWh), summer coincident peak savings (kW), and lifetime savings (kWh).

4.3 Detailed Evaluation Findings

4.3.1 Impact Evaluation Findings

This section provides the results of energy savings for the C&I CAP. Upon completion of the interview process, 110 business locations opted to participate in a site visit performed by an ADM field technician or engineer. Of these 110 sites, 85 sites provided all the required documentation to verify installation. Of the 110 sites, 58 installed verified energy efficient equipment in 2017 that resulted in energy savings.

The C&I component of CAP requires a unique evaluation effort because of the recruitment of the sampled respondents. Sample respondents are invited to provide information and supporting documentation for energy efficiency installations that occurred outside of the incentive structure of a utility rebate program. The information collected provides a snapshot of energy efficiency activity based on market conditions.

Since participating in the evaluation process is optional, one of the challenges presented in some cases was acquiring the proper documentation to determine an in-service date and validate installation. Because there was no prior knowledge of an energy efficiency program, some businesses had not retained the invoices or purchases orders required to validate a proof of purchase. Other businesses reported installations in the initial survey process but opted out of the evaluation process prior to gathering the proof of purchase information.

The documentation validation component of the evaluation plan provided a degree of conservatism to the savings calculations. For example, of the 110 sites that had a site visit performed, 24 provided enough information to estimate savings but not enough to provide substantial proof the measures were installed in 2017. While the remaining sites provided all the required documentation to verify installation, a total of 58 implemented energy efficient equipment that resulted in energy savings.

At a confidence interval of 90%, a relative precision of 9.1% was calculated for the sample of 2,528 businesses. Table 4.2 shows the distribution of businesses in each stratum.

Table 4.2: CAP C&I Sample Precision

Strata	Population Count of businesses	Sample Count of businesses	Population Average [48]	Sample Average Annual kWh usage
CE01 1	36,190	539	305,624,171	4,937,701
CE01 2	17,257	251	1,205,399,376	18,231,535
CE01 3	3,875	42	1,789,319,237	17,894,897
CE01 4	829	5	1,812,125,040	7,579,860
OE01 1	44,948	722	327,117,449	5,936,694
OE01 2	27,811	453	1,463,032,248	22,552,153
OE01 3	6,052	78	2,177,725,243	27,750,331
OE01 4	1,126	21	2,074,422,272	34,444,130
TE01 1	18,398	332	246,776,300	4,653,224
TE01 2	4,708	75	524,829,063	7,584,465
TE01 3	1,074	9	661,734,426	6,852,081
TE01 4	215	1	689,028,844	6,128,688
Total	**162,483**	**2,528**	**13,277,133,669**	**164,545,759**
Relative Precision				9.1%

The breakdown of savings in the sample by operating company and measure are shown in Table 4.3. The overall sample annual energy savings are 1,124,178 kWh.

[48] Average Annual kWh usage: Average daily usage per customer for the 7-2015 to 7-2017 timespan, multiplied by 365 days.

Table 4.3: CAP C&I Sample Savings (kWh) Summary

Measure	CEI	OE	TE
Lighting	208,327	795,587	80,946
HVAC	8,700	1,816	5,118
Appliances	0	2,783	0
Water Heating	331	321	86
Motors	0	167	0
Refrigeration	3,107	287	934
Others	2,099	163	13,406
Total	**222,564**	**801,124**	**100,490**

4.3.1.1 Verification of Commercial & Industrial Lighting

Out of the 58 sites with verified energy savings in the sample, 55 included lighting measures. Lighting measures included both retrofits and new construction, including controls. Savings values ranged from 342 kWh per year to 244,936 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.4.

Table 4.4: CAP C&I Sample Lighting Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	25	208,327	34.32
OE	19	795,587	163.30
TE	11	80,946	18.44
Total	**55**	**1,084,860**	**216.06**

Out of the 58 sites with verified energy savings in the sample, 12 included HVAC measures. HVAC measures included split AC units, packaged AC units, window AC units, and rooftop units. Savings values ranged from 89 kWh per year to 4,450 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.5.

Table 4.5: CAP C&I Sample HVAC Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	8	8,700	7.89
OE	2	1,816	1.21
TE	2	5,118	4.45
Total	**12**	**15,634**	**13.55**

4.3.1.2 Verification of Commercial & Industrial Refrigeration

Out of the 58 sites with verified energy savings in the sample, 5 included refrigeration measures. Refrigeration measures included various types of food storage refrigerators including under-counter refrigerators, upright freezers, and ice makers. Savings values ranged from 287 kWh per year to 1,812 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.6.

Table 4.6: CAP C&I Sample Refrigeration Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	3	3,107	0.28
OE	1	287	0.03
TE	1	934	0.11
Total	**5**	**4,328**	**0.42**

4.3.1.3 Verification of Commercial & Industrial Water Heating

Out of the 58 sites with verified energy savings in the sample, 7 included water heating measures. Water heating measures included storage water heaters, mini tank water heaters, and tankless water heaters. Savings values ranged from 9 kWh per year to 176 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.7.

Table 4.7: CAP C&I Sample Water Heating Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	2	331	0.02
OE	3	321	0.01
TE	2	86	0.00
Total	**7**	**738**	**0.03**

4.3.1.4 Verification of Commercial & Industrial Motors

Out of the 58 sites with verified energy savings in the sample, 1 included a motor measure. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.8.

Table 4.8: CAP C&I Sample Motor Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	0	0	0.00
OE	1	167	0.05
TE	0	0	0.00
Total	**1**	**167**	**0.05**

4.3.1.5 Verification of Energy Star Appliances

Out of the 58 sites with verified energy savings in the sample, 1 included an appliance measure. Appliance measure included clothes washing machines. Calculations were based on algorithms from the Ohio TRM. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.9.

Table 4.9: CAP C&I Sample Appliances Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	0	0	0.00
OE	1	2,783	0.01
TE	0	0	0.00
Total	**1**	**2,783**	**0.01**

4.3.1.6 Verification of Commercial & Industrial Process and other Measures

Out of the 58 sites with verified energy savings in the sample, 3 included custom energy efficiency equipment, such as dishwashers and an air compressor. Energy savings for these measures were based on engineering calculations from EM&V best practices. Annual energy savings and summer coincident peak savings by operating company are shown in Table 4.10.

Table 4.10: CAP C&I Sample Process and other Measure Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	1	2,099	0.30
OE	1	163	0.02
TE	1	13,406	2.23
Total	**3**	**15,668**	**2.55**

4.3.1.7 Total Energy Savings

The total 2017 annual energy savings from the sampled sites are 1,124,178 kWh. The total peak demand reduction from the sampled sites are 232.67 kW. Most the energy savings came from lighting projects, representing 97% of the sample energy savings.

Energy savings extrapolation was conducted by applying a rate of energy reduction for each stratum in the sample; which was based on average annual energy usage. Energy savings reduction rates by stratum ranged from 0 to 0.0211. The highest reductions occurred for the stratum with the lowest average annual energy usage for each Company.

Extrapolation to the population of 162,483 business locations resulted in annual energy savings of 51,877,711 kWh. Summer coincident peak savings resulted in 11,114.16 kW. A summary of extrapolated energy savings, summer coincident peak savings, and lifetime energy savings is shown in Table 4.11.

Table 4.11: Energy Savings Extrapolation Summary

Strata	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)	Lifetime Savings (kWh)
CE-GP	69,983	31.62	888,530
CE-GS	11,989,910	2,724.38	129,374,466
CE-GSU	288,096	120.11	3,586,293
CE-GT	0	0.00	0
CEI Total	**12,347,989**	**2,876.11**	**133,849,288**
OE-GP	6,333,277	980.17	89,604,061
OE-GS	28,630,471	6,207.47	393,036,748
OE-GSU	746,295	95.08	10,641,876
OE-GT	840,871	108.28	11,983,738
OE Total	**36,550,914**	**7,390.99**	**505,266,423**
TE-GP	6,523	1.88	95,168
TE-GS	2,972,261	845.18	41,601,622
TE-GSU	0	0.00	0
TE-GT	25	0.01	370
TE Total	**2,978,808**	**847.06**	**41,697,159**
Total	**51,877,711**	**11,114.16**	**680,812,871**

4.4 Conclusions

This chapter reports the conclusions resulting from the impact evaluation of the 2017 CAP. The savings by EDC, sector, and rate class, are presented in Table 4.12 and Table 4.13.

Table 4.12: kWh by Operating Company

	CEI	OE	TE	Total
C&I	12,347,989	36,550,914	2,978,808	51,877,711

Table 4.13: kW by Operating Company

	CEI	OE	TE	Total
C&I	2,876.11	7,390.99	847.06	11,114.16

5 Appendix A: Required Savings Tables

Tables showing measure-level participation counts and savings for the Program were provided in various locations throughout this report. This appendix provides additional tables summarizing savings results. Lifetime savings were calculated as shown in Equation 35: Calculation of Lifetime Savings.

Lifetime Savings = Measure Life x Annualized Savings

The annual energy savings from CAP 2017 for both residential and C&I is shown in Table 5.1. The lifetime energy savings from CAP 2017 for both residential and C&I is shown in Table 5.2.

Table 5.1: Annual kWh & KW Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants	Annual kWh Savings	Annual kW Savings
CAP C&I	CEI	GP	75	69,983	31.62
	CEI	GS	57,735	11,989,910	2,724.38
	CEI	GSU	341	288,096	120.11
	CEI	GT	0	0	0.00
	CEI Total		**58,151**	**12,347,989**	**2,876.11**
	OE	GP	904	6,333,277	980.17
	OE	GS	78,910	28,630,471	6,207.47
	OE	GSU	61	746,295	95.08
	OE	GT	62	840,871	108.28
	OE Total		**79,937**	**36,550,914**	**7,390.99**
	TE	GP	413	6,523	1.88
	TE	GS	23,971	2,972,261	845.18
	TE	GSU	2	0	0.00
	TE	GT	9	25	0.01
	TE Total		**24,395**	**2,978,808**	**847.06**
C&I Total	**Total**		**162,483**	**51,877,711**	**11,114.16**
CAP Residential HVAC	CEI	RS	16,259	5,734,301	5,859.72
	OE	RS	22,581	8,005,471	8,180.56
	TE	RS	6,323	2,367,815	2,419.60
	Total		**45,163**	**16,107,587**	**16,459.88**
CAP Residential Refrigeration	CEI	RS	103,224	12,160,119	2074.4
	OE	RS	164,906	16,976,345	2896.01
	TE	RS	38,514	5,021,173	856.57
	Total		**306,645**	**34,157,636**	**5,826.97**
CAP Residential Lighting	**CEI**	RS	933,936	23,982,745	3,036.53
	OE	RS	1,297,134	33,309,368	4,217.41
	TE	RS	363,197	9,326,623	1,180.87
	Total		**2,594,267**	**66,618,736**	**8,434.82**
RES Total	**Total**		**2,946,075**	**116,883,959**	**30,722.67**
CAP Residential & C/I	**Total**		**3,108,558**	**168,761,670**	**41,835.83**

Table 5.2: Lifetime kWh Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants	Lifetime kWh Savings
CAP C&I	CEI	GP	75	888,530
	CEI	GS	57,735	129,374,466
	CEI	GSU	341	3,586,293
	CEI	GT	0	0
	CEI Total		**58,151**	**133,849,288**
	OE	GP	904	89,604,061
	OE	GS	78,910	393,036,748
	OE	GSU	61	10,641,876
	OE	GT	62	11,983,738
	OE Total		**79,937**	**505,266,423**
	TE	GP	413	95,168
	TE	GS	23,971	41,601,622
	TE	GSU	2	0
	TE	GT	9	370
	TE Total		**24,395**	**41,697,159**
C&I Total	**Total**		**162,483**	**680,812,871**
CAP Residential HVAC	CEI	RS	16,259	103,027,734
	OE	RS	22,581	143,833,662
	TE	RS	6,323	42,542,351
	Total		**45,163**	**289,403,747**
CAP Residential Refrigeration	CEI	RS	103,224	188,563,740
	OE	RS	164,906	263,247,694
	TE	RS	38,514	77,861,994
	Total		**306,645**	**529,673,428**
CAP Residential Lighting	CEI	RS	933,936	296,554,038
	OE	RS	1,297,134	411,880,609
	TE	RS	363,197	115,326,571
	Total		**2,594,267**	**823,761,218**
RES Total	**Total**		**2,946,075**	**1,642,838,393**
CAP Residential & C/I	**Total**		**3,108,558**	**2,323,651,264**

6 Appendix B: Survey Instruments

1. Residential Survey Instruments

2017 FirstEnergy's Ohio Utilities' Customer Action Program

Random Digit Dial Telephone Survey

2017 FirstEnergy's Ohio Customer Action Program/ EE Products

Random Digit Dial Telephone Survey (Upstream)

[START]

INTRO. Hello, my name is _____, and I'm calling from ADM Associates, an independent research firm, conducting a survey regarding household lighting and appliance or electronics purchases in Ohio on behalf of the FirstEnergy's Ohio Utilities. First I want to assure you that I'm not selling anything. I am calling to ask a few brief questions about any light bulbs or appliances you may have purchased for your home in 2017. The survey should only take about ten minutes, and your answers will be completely anonymous. We are offering a $5.00 Walmart gift card for your participation. May I please speak with an adult in the household who is responsible for purchasing the light bulbs or appliances/electronics for your home?

Yes, I purchase lights	01 [GO TO U1]
Someone else does it	02 [ASK TO SPEAK WITH PERSON, REPEAT INTRODUCTION THEN GO TO INTRO2]
No	03 [TRY TO RESCHEDULE AND THEN TERMINATE]

INTRO2	01	Person available [CONTINUES]
	02	Person not available [SETUP CALL-BACK]
	03	Refused to transfer to correct person. [TERMINATE]

Electric Utility and Location Information

U1. First of all, to ensure your eligibility to participate, we need to determine that you are a customer of one of FirstEnergy's Ohio utilities. What is the name of your electric utility? [DO NOT READ, LET PARTICIPANT ANSWER]

Ohio Edison	01
The Illuminating Company	02
Toledo Edison	03
FirstEnergy	04
Other	05 [RECORD ANSWER]

U2. [SKIP IF U1 != 05] Based on your electric utility it does not appear you are eligible for this survey. Thank you for your time and have a nice day. [TERMINATE]

U3. Would you mind providing me with your zip code?

_____ [RECORD 5 DIGIT ZIP]	
Don't know	98
Refused	99

Awareness of Bulb Types

I'd like to ask you a few questions about your awareness of different types of light bulbs. The most common type of CFL is made with a glass tube bent into a spiral. It generally looks like a corkscrew and uses less energy than a typical incandescent light bulb.

B1. Before this call today, had you ever heard of compact fluorescent light bulbs, or CFLs?

Yes	01
No	02
Don't know	98
Refused	99

LED light bulbs are a newer light bulb technology that fit in regular light bulb sockets, but have various appearances. LED bulbs are typically a lot heavier than incandescent bulbs. They use less energy and last much longer than typical incandescent light bulbs.

B2. Before this call today, had you ever heard of light emitting diode light bulbs, or LEDs?

Yes	01
No	02
Don’t know	98
Refused	99

In 2012 the federal government began enforcing a law that required regular light bulbs to use less energy but produce the same amount of light. The technology in these increased efficiency incandescent light bulbs changed from filament style to halogen bulbs. The halogen bulbs are typically marketed using wattage equivalents, which are designed to show the increased energy efficiency of the halogen bulbs compared to the standard incandescent bulbs. For example, the 72 Watt halogen bulb packaging will show a lighting equivalent of a 100 Watt standard incandescent bulb.

B3. Before this call today, had you ever heard of increased efficiency incandescent bulbs, or halogens?

Yes	01
No	02
Don’t know	98
Refused	99

B4. Conventional light bulbs are known as incandescent light bulbs. Do you think you could correctly identify the following types of light bulbs, a typical incandescent light bulb, CFL light bulb, LED light bulb, and a halogen light bulb if all four were placed in front of you?

	Yes	No	Don’t Know	Refused
a. A typical incandescent light	1	2	98	99
b. CFL light bulb	1	2	98	99
c. LED light bulb	1	2	98	99
d. Halogen light bulb	1	2	98	99

Recent Light Bulb Purchases

RL1. I’d like to ask you a few questions about bulbs you purchased this year. In 2017, have you purchased any light bulbs?

Yes	01

No	02
Don’t know	98
Refused	99

RL2. Do you plan on purchasing any light bulbs or fixtures during the remainder of this year? If so what type do you plan on purchasing?

Halogen	01
CFL	02
LED	03
LED fixture	04
Incandescent	05
Other(Specify)	06
No plans to purchase	99

[IF RL2 = 99 SKIP TO PP1]

RL3. In 2017, about how many light bulbs would you say you have purchased? [READ ANSWERS If respondent unsure, say “Your best estimate is OK.”]

Record exact respondent estimate_____	
None	97
Don’t know	98
Refused	99

RL4. Have you purchased any compact fluorescent light bulbs, also known as CFLs, during 2017?

Yes	01
No	02
Don’t know	98
Refused	99

RL5. Have you purchased any light emitting diode bulbs, also known as LEDs, during 2017?

Yes	01
No	02
Don’t know	98
Refused	99

RL6. LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in. They typically have a lower wattage and longer lifespan that equivalent screw in bulbs. Have you purchased any light emitting diode fixtures, also known as LED fixtures, during 2017?

Yes	01
No	02
Don’t know	98
Refused	99

RL7. Have you purchased any increased efficiency incandescent bulbs, also known as halogens, during 2017?

Yes	01
No	02
Don’t know	98
Refused	99

RL8. [SKIP IF RL4=02, 98, or 99 AND RL5=02, 98, or 99 AND RL6=02, 98, or 99 AND RL7=02, 98, or 99] SKIP IF RL3 = 97, 98 or 99] I’d like to ask you about the number of different bulb types you have purchased in 2017. You mentioned earlier that you have purchased [ANSWER FROM RL3] light bulbs in 2017. How many of those bulbs were CFLs, LEDs, LED fixtures or halogen bulbs? An example would be 5 CFLs, 5 LEDs, and 5 halogens. [If respondent unsure, say “again, your best estimate is OK.”] [IF RESPONDENT INDICATES BELOW/ABOVE [ANSWER TO RL3] TOTAL, PROMPT TO GIVE [ANSWER TO RL3] TOTAL]

_____ Record number of CFLs

_____ Record number of LEDs

_____ Record number of halogens

_____ Record number of LED Fixtures

Don’t know 98

Refused 99

RL9. [SHOW IF any bulbs purchased] When did you last purchase each of the following type of bulbs. [USE 9998 FOR DK, 9999 FOR REFUSED]

CFLs Date: MMYYYY

LEDs Date: MMYYYY

Halogens Date: MMYYYY

LED Fixtures Date: MMYYYY

RL10. [SKIP IF RL4=02, 98, or 99 AND RL5=02, 98 or 99, AND RL6=02, 98, or 99, , AND RL7=02, 98, or 9] Were any of the CFLs, LEDs, halogen bulbs or LED fixtures you purchased in 2017 installed in a business or commercial building?

Yes 01 [READ RL11]

No 02

Don’t know 98

Refused 99

RL11. [ASK IF RL10 = 01] Approximately how many of the [Number of CFLs + LEDs + Halogen + LED Fixtures from RL8] CFLs, LEDs or Halogens you said you purchased were installed in a business or commercial building?

_____ CFLs [RECORD NUMBER, 0 – 97] [ask if RL8 CFLS>0]

_____ LEDs [RECORD NUMBER, 0 – 97] [ask if RL8LEDS>0]

_____ Halogens [RECORD NUMBER, 0 – 97] [ask if RL8Halogens>0]

_____ LED Fixtures [RECORD NUMBER, 0 – 97] [ask if RL8LEDS>0]

Don’t know 98

Refused	99

Prior Purchases/ Program Awareness/ Satisfaction

[ASK IF RL4 = 01]

PP1. Prior to 2017, had you ever purchased CFL light bulbs?

Yes	01
No	02
Don’t know	98
Refused	99

[ASK IF RL5 = 01]

PP2. Prior to 2017, had you ever purchased LED light bulbs?

Yes	01
No	02
Don’t know	98
Refused	99

PP3. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the LED bulbs you purchased? [Where 1-Extremly dissatisfied. 2- dissatisfied, 3-neutral, 4-satisfied, 5-extremely satisfied]

_____ [RECORD RESPONSE]

Have you noticed a difference on your electric bill?

Yes, I’ve noticed savings	01
No	02
Open Ended	[RECORD RESPONSE]

[ASK IF RL6 = 01]

PP4. Prior to 2017, had you ever purchased LED fixtures? LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in.

Yes	01
No	02
Don't know	98
Refused	99

[ASK IF RL7 = 01]

PP5. Prior to 2017, had you ever purchased halogen light bulbs?

Yes	01
No	02
Don't know	98
Refused	99

In-Service Rate

ISR1. [SKIP IF RL1<> 01 OR ([SKIP IF RL4=02, 98, or 99 AND RL5=02, 98, or 99 AND RL6=02, 98, or 99 AND RL7=02, 98, or 99] SKIP IF RL3 = 97, 98 or 99])] Again, you said you purchased [Number of CFLs + LEDs + LED Fixtures +Halogen from RL8] in 2017. How many of those CFLs, LEDs or halogens would you estimate you installed ***within one week of purchase***?

_____ [RECORD NUMBER, 0 – 97. IF RESPONDENT SAYS "100%" or "ALL", THEN SKIP TO RS1]

Don't know	98
Refused	99

ISR2. [SKIP IF RL1 != 01 [SKIP IF RL4=02, 98, or 99 AND RL5=02, 98, or 99 AND RL6=02, 98, or 99 AND RL7=02, 98, or 99] SKIP IF RL3 = 97, 98 or 99] How many of those CFLs, LEDs or Halogens purchased did you save to install at a later date?

_____ [RECORD NUMBER, 0 – 97. IF RESPONDENT SAYS "100%" or "ALL", THEN SKIP TO RS1]

Don’t know 98

Refused 99

ISR3. Approximately how many of the light bulbs you purchased have you not installed? [If respond is unsure, say “Your best estimate is okay.”]

_____ CFLs [RECORD NUMBER, 0 – 97.]

_____ LEDs [RECORD NUMBER, 0 – 97.]

_____ Halogens [RECORD NUMBER, 0 – 97.]

_____ LED Fixtures [RECORD NUMBER, 0 – 97.]

Don’t know 98

Refused 99

Purchase

Reasoning

RS1. [ASK IF RL4 = 01] You mentioned you have purchased CFL light bulbs in 2017. When you purchased these CFLs, why did you make the purchase?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. IF respondent says “I needed bulbs” or similar, PROMPT for more detailed explanation.]

Replaced burned out bulbs	01
Replace working bulbs, wanted to lower energy usage	02
Installed in a new light fixture or lamp socket	03
Improve lighting quality/brighten a room	04
Replaced burned out bulbs & working bulbs at same time	05
Stock up on bulbs	06
Good deal prompted purchase	07
Other (describe) _____	
Don’t know	98
Refused	99

RS2. [ASK IF RL5 = 01] You mentioned you have purchased LED light bulbs in 2017. When you purchased these LEDs, why did you make the purchase?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. IF respondent says “I needed bulbs” or similar, PROMPT for more detailed explanation.]

Replaced burned out bulbs	01
Replace working bulbs, wanted to lower energy usage	02
Installed in a new light fixture or lamp socket	03
Improve lighting quality/brighten a room	04
Replaced burned out bulbs & working bulbs at same time	05
Stock up on bulbs	06
Good deal prompted purchase	07
Promotion of LED bulbs changed my mind	08
Other (describe) _____	
Don’t know	98
Refused	99

RS3. Did you know [ANSWER U1] provides funds to reduce the price of LED bulbs purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW RS4 TO RS5 IF RS3 = 1]

RS4. How did you learn about the discounted price?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03

Friend/Family	04
TV/Radio/Internet Advertising	05
Other(Specify)	
Don’t Know	98

RS5. To the best of your knowledge, were the LED bulbs you purchased in 2017 discounted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

RS6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the LED light bulbs you purchased? [Where 1-Extremly dissatisfied. 2- dissatisfied, 3-neutral, 4-satisfied, 5-extremely satisfied]

_____ [RECORD RESPONSE]

RS7. Have you noticed a difference on your electric bill?

Yes, I’ve noticed savings	01
No	02
Open Ended [RECORD RESPONSE]	

RS8. [ASK IF RL6 = 01] You mentioned you have purchased LED fixtures in 2017. When you purchased these LED fixture, why did you make the purchase? LED fixtures are light fixtures that use LED technology and are wired directly instead of screwed in.

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. IF respondent says “I needed bulbs” or similar, PROMPT for more detailed explanation.]

Replaced burned out bulbs	01
Replace working bulbs, wanted to lower energy usage	02

Installed in a new light fixture or lamp socket	03
Improve lighting quality/brighten a room	04
Replaced burned out bulbs & working bulbs at same time	05
Stock up on bulbs	06
Good deal prompted purchase	07
Other (describe) _____	
Don’t know	98
Refused	99

RS9. Did you know [ANSWER U1] provides funds to reduce the price of LED fixtures purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW RS10 TO RS12 IF RS9 = 1]

RS10. How did you learn about the discounted price?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other (Specify)	
Don’t Know	98

RS11. To the best of your knowledge, were the LED fixtures you purchased in 2017 discounted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

RS12. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the LED fixtures you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

RS13. Have you noticed a difference on your electric bill?

Yes, I’ve noticed savings	01
No	02
Open Ended[RECORD RESPONSE]	

RS14. [ASK IF RL7 = 01] You mentioned you have purchased halogen light bulbs in 2017. When you purchased these halogens, why did you make the purchase?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. IF respondent says “I needed bulbs” or similar, PROMPT for more detailed explanation.]

Replaced burned out bulbs	01
Replace working bulbs, wanted to lower energy usage	02
Installed in a new light fixture or lamp socket	03
Improve lighting quality/brighten a room	04
Replaced burned out bulbs & working bulbs at same time	05
Stock up on bulbs	06
Good deal prompted purchase	07
Other (describe) _____	08
Don’t know	98
Refused	99

Bulb Types Replaced

RP1. [SKIP IF RL4=02, 98, or 99 AND RL5=02, 98, or 99 AND RL6=02, 98, or 99 AND RL7=02, 98, or 99] SKIP IF RL3 = 97, 98 or 99] Again, you said you purchased [Number of CFLs from RS4] CFLs in 2017. In which of the following locations did you install the CFLs? [Allow multiple answers]

Bedrooms	01
Bathrooms	02
Living Room	03
Kitchen	04
Entry Way	05
Dining Room	06
Garage	07
Basement	08
Den	09
Stairway	10
Office	11
Hallway	12
Outdoor	13
Other Room/Location	14
Store for later installation	15
Don’t know	98
Refused	99

RP2. Thinking about the new CFLs in your home, how many were installed?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP3. How many of the new CFLs replaced standard incandescent bulbs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP4. How many of the new CFLs replaced halogens?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP5. How many of the new CFLs replaced old CFLs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP6. How many of the new CFLs replaced LEDs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP7. [[SKIP IF RL5=02, 98] SKIP IF RL3 = 97, 98 or 99]] Again, you said you purchased [Number of LEDs from RL8] LEDs in 2017. In which of the following locations do you install the LEDs? [Allow multiple answers]

Bedrooms	01
Bathrooms	02
Living Room	03
Kitchen	04
Entry Way	05
Dining Room	06
Garage	07
Basement	08
Den	09
Stairway	10
Office	11
Hallway	12
Outdoors	13
Other Room/Location	14
Store for later installation	15
Don’t know	98
Refused	99

RP8. Thinking about the new LEDs in your home, how many were installed?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP9. How many of the new LEDs replaced standard incandescent bulbs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP10. How many of the new LEDs replaced halogens?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP11. How many of the new LEDs replaced CFLs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP12. How many of the new LEDs replaced old LEDs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP13. [ASK IF RL6 = 01] Again, you said you purchased [Number of LED Fixtures from RL8] LED Fixtures in 2017. In which of the following locations did you install the LEDs? [Allow multiple answers]

Bedrooms	01
Bathrooms	02
Living Room	03
Kitchen	04
Entry Way	05
Dining Room	06
Garage	07
Basement	08
Den	09
Stairway	10
Office	11
Hallway	12
Outdoors	13
Other Room/Location	14
Store for later installation	15
Don’t know	98
Refused	99

RP14. Thinking about the new LED fixtures in your home, how many were installed?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP15. How many of the new LED fixtures replaced standard incandescent bulbs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP16. How many of the LED fixtures replaced halogens?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP17. How many of the new LED fixtures replaced CFLs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP18. How many of the new LED fixtures replaced old LEDs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP19. [ASK IF RL7 = 01 AND RS8 != 98 AND RL8 !=99 ELSE SKIP TO AP] Again, you said you purchased [Number of Halogens from RL8] Halogens in 2017. In which of the following locations do you install the Halogens? [Allow multiple answers]

Bedrooms	01
Bathrooms	02
Living Room	03
Kitchen	04
Entry Way	05
Dining Room	06
Garage	07
Basement	08
Den	09
Stairway	10
Office	11
Hallway	12
Outdoors	13
Other Room/Location	14
Store for later installation	15
Don’t know	98
Refused	99

RP20. Thinking about the new Halogens in your home, how many were installed?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP21. How many of the new Halogens replaced standard incandescent bulbs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP22. How many of the new Halogens replaced old Halogens?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP23. How many of the new Halogens replaced CFLs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP24. How many of the new Halogens replaced LEDs?

_____ [RECORD NUMBER, 0 – 97]

Don’t know 98

Refused 99

RP25. [SKIP IF (RL4=02,98,99 AND RL5=02,98,99 AND RL6=02,98,99 AND RPL7=02,98,99)] Of the light bulbs you purchased in 2017, were any of them purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

The Home Depot	01
Lowes Home Improvement	02
Sam’s Club	03
Walmart	04
Costco	05
Sears	06
Hartville Hardware	07
Other(Specify)	08
Don’t know	98
Refused	99

Appliance Basics

AP. Since January 1, 2017, have you purchased or had installed ANY of the following items in your home/residence: Refrigerator, Freezer, Dehumidifier, Room Air Conditioner, High-Efficiency Central Air Conditioner, Heat Pump or Mini-Split Heat Pump?

Q.	Appliance	Yes	No	DK	REF
AP1	Refrigerator				
AP2	Freezer				
AP3	Dehumidifier				
AP4	Room Air Conditioner				
AP5	Central AC				
AP6	Heat Pump				
AP7	Mini-Split Heat Pump				

Refrigerator

[ASK RF1 – RF12 IF AP1 = Y]

RF1. What kind of Refrigerator model did you purchase? [READ ANSWERS]

Top-freezer refrigerator model	01
Bottom-freezer refrigerator model	02
Side-by-side refrigerator model	03
Don’t know	98
Refused	99

RF2. Was the refrigerator you purchased Energy Star certified?

Yes	01
No	02
Don’t know	98
Refused	99

RF3. Do you remember the month in 2017 when you purchased the refrigerator?

_____ [ENTER MONTH]

Don’t know	98
Refused	99

RF4. Was this refrigerator purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02
Not a replacement	03
Don’t know	98
Refused	99

RF5. [ASK IF RF4 = 02] Why didn’t you repair the broken unit?

Too costly	01
Too much time involved	02
Wanted to change style	03
Don’t know	98
Refused	99

RF6. What did you do with your old unit?

Still have it, not in use	01
Recycled the unit	02
Took it to the dump	03
Sold it for scrap metal	04
Sold for parts	05
Sold or gifted unit to an individual	06
Sold or donated to an organization/company.	07
Company name: _____	
Don't know	98
Refused	99

RF7. For the refrigerator you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

The Home Depot	01
Lowes Home Improvement	02
Sam's Club	03
Walmart	04
Costco	05
Sears	06
Hartville Hardware	07
Other(Specify)	
Don't know	98
Refused	99

RF8. Did you know [ANSWER U1] provides funds to reduce the price of refrigerators purchased at retail stores?

Yes	01
No	02
Don't know	98
Refused	99

[SHOW RF9 TO RF10 IF RF8 = 1]

RF9. How did you learn about the discounted price?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other(Specify)	
Don't Know	98

RF10. To the best of your knowledge, was the refrigerator you purchased in 2017 discounted through your utility?

Yes	01
No	02
Don't know	98
Refused	99

RF11. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the refrigerator you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

RF12. Have you noticed a difference on your electric bill?

Yes, I've noticed savings	01
No	02
Open Ended[RECORD RESPONSE]	
Don't know	98
Refused	99

Freezer

[ASK FZ1-FZ12 IF AP2 = Y]

FZ1. What kind of freezer model did you purchase? [READ ANSWERS]

Chest freezer, with the lid on top	01
Upright Freezer, with the door on the front	02
Don’t know	98
Refused	99

FZ2. Was the freezer you purchased Energy Star certified?

Yes	01
No	02
Don’t know	98
Refused	99

FZ3. Do you remember the month in 2017 when you purchased the freezer?

_____ [ENTER MONTH2

Don’t know	98
Refused	99

FZ4. Was this freezer purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02
Not a replacement	03
Don’t know	98
Refused	99

FZ5. [ASK IF FZ4 = 02] Why didn't you repair the broken unit?

Too costly	01
Too much time involved	02
Wanted to change style	03
Don't know	98
Refused	99

FZ6. What did you do with your old unit?

Still have it, not in use	01
Recycled the unit	02
Took it to the dump	03
Sold it for scrap metal	04
Sold for parts	05
Sold or gifted unit to an individual	06
Sold or donated to an organization/company.	07
Company name: _____	
Don't know	98
Refused	99

FZ7. For the freezer you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

The Home Depot	01
Lowes Home Improvement	02
Sam's Club	03
Walmart	04
Costco	05

Sears	06
Hartville Hardware	07
Other(Specify)	
Don’t know	98
Refused	99

FZ8. Did you know [ANSWER U1] provides funds to reduce the price of freezers purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW FZ9 TO FZ10 IF FZ8 = 1]

FZ9. How did you learn about the discounted price?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	03
TV/Radio/Internet Advertising	04
Other(Specify)	
Don’t Know	98

FZ10. To the best of your knowledge, was the freezer you purchased in 2017 discounted through your utility?

Yes	01
No	02
Don’t know	98

Refused	99

FZ11. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the freezer you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

FZ12. Have you noticed a difference on your electric bill?

Yes, I've noticed savings	01
No	02
Open Ended[RECORD RESPONSE]	
Don't know	98
Refused	99

Dehumidifier

[ASK DH1 – DH10 IF AP3 = Y]

DH1. Was the dehumidifier you purchased Energy Star certified?

Yes	01
No	02
Don’t know	98
Refused	99

DH2. Do you remember the month in 2017 when you purchased the dehumidifier?

_____ [ENTER MONTH]

Don’t know	98
Refused	99

DH3. Was this dehumidifier purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02
Not a replacement	03
Don’t know	98
Refused	99

DH4. [ASK IF DH3 = 02] Why didn’t you repair the broken unit?

Too costly	01
Too much time involved	02
Wanted to change style	03

Don’t know	98
Refused	99

DH5. For the dehumidifier you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

The Home Depot	01
Lowes Home Improvement	02
Sam’s Club	03
Walmart	04
Costco	05
Sears	06
Hartville Hardware	07
Other(Specify)	
Don’t know	98
Refused	99

DH6. Did you know [ANSWER U1] provides funds to reduce the price of dehumidifiers purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW DH7 TO DH8 IF DH6 = 1]

DH7. How did you learn about the discounted price?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	02
Friend/Family	03

TV/Radio/Internet Advertising	04
Other(Specify)	
Don’t Know	98

DH8. To the best of your knowledge, was the dehumidifier you purchased in 2017 discounted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

DH9. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the dehumidifier you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-Neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

DH10. Have you noticed a difference on your electric bill?

Yes, I’ve noticed savings	01
No	02
Open Ended	[RECORD RESPONSE]

Room Air Conditioner

[ASK RA1-RA7 IF AP4 = Y]

RA1. What was the make or manufacturer of the room air conditioner you purchased? The make or manufacturer should be listed on the unit.

_____ [RECORD ANSWER]

Don’t know	98 [PROMPT TO LOOK AT THE UNIT]
Refused	99

RA2. What is the capacity of the unit in BTUs?

_____ [RECORD ANSWER]

Don’t know	98 [PROMPT TO LOOK AT THE UNIT]
Refused	99

RA3. Was the room AC you purchased Energy Star certified?

Yes	01
No	02
Don’t know	98
Refused	99

RA4. Which month in 2017 was the air conditioner installed?

_____ [RECORD ANSWER]

Don’t know	98
Refused	99

RA5. Was this air conditioner purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01 [SKIP TO RA7]
To replace a broken unit	02
Not a replacement	03 [SKIP TO RA7]
Don’t know	98 [SKIP TO RA7]
Refused	99 [SKIP TO RA7]

RA6. [ASK IF RA5 = 02] Why didn’t you repair the broken unit?

Too costly	01

Too much time involved	02
Wanted to change style	03
Don’t know	98
Refused	99

RA7. What did you do with your old unit?

Still have it, not in use	01
Recycled the unit	02
Took it to the dump	03
Sold it for scrap metal	04
Sold for parts	05
Sold or gifted unit to an individual	06
Sold or donated to an organization/company.	07
Company name: _____	
Don’t know	98
Refused	99

High-Efficiency Central Air Conditioner

[ASK CAC1 THROUGH CAC11 IF AP5 = Y]

CAC1. Which month in 2017 did you purchase the central air conditioning system?

_____ [ENTER MONTH PRODUCT WAS PURCHASED]

Don’t know	98
Refused	99

CAC2. Can you tell me the make or manufacturer of the central air conditioning system you purchased? The make or manufacturer should be listed on the outdoor unit.

_____ [ENTER MANUFACTURER OF UNIT]

Don't know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

CAC3. Was the central air conditioning system you purchased Energy Star certified?

Yes 01

No 02

Don't know 98

Refused 99

CAC4. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

Don't know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

CAC5. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

Don't know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

CAC6. Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don't know 98

Refused 99

[ASK CAC7 IF CAC6 = 98 OR CAC6=99]
CAC7. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don’t know	98
Refused	99

CAC8. Can you tell me the name of the contractor who installed the new unit?

_____ [RECORD CONTRACTOR NAME]

Did not use contractor	01
Don’t know	98
Refused	99

CAC9. Was this air conditioner purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02
Not a replacement	03
Don’t know	98
Refused	99

CAC10. [ASK IF CAC9 = 02] Why didn't you repair the broken unit?

Too costly	01
Too much time involved	02
Wanted to change style	03
Don't know	98
Refused	99

CAC11. What did you do with your old unit?

Still have it, not in use	01
Recycled the Unit	02
Took it to the dump	03
Sold it for scrap metal	04
Sold for parts	05
Sold or gifted unit to an individual	06
Sold or donated to an organization/company.	07
Company name: _____	
Don't know	98
Refused	99

Heat Pump

[ASK HP1 – HP9 IF AP6 = Y]

HP1. Which month in 2017 did you purchase the heat pump?

_____ [ENTER MONTH PRODUCT WAS PURCHASED]

Don't know 98

Refused 99

HP2. Can you tell me the make or manufacturer of the heat pump you purchased?

_____ [ENTER MANUFACTURER OF UNIT]

Don't know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

HP3. Was the Heat Pump you purchased Energy Star certified?

Yes 01

No 02

Don't know 98

Refused 99

HP4. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

Don't know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

HP5. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

Don’t know	98 [PROMPT TO LOOK AT THE UNIT]
Refused	99

HP6. Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don’t know	98
Refused	99

[ASK HP7 IF HP6 = 98 OR HP6=99]

HP7. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don’t know	98
Refused	99

HP8. Can you tell me the name of the contractor who installed the new unit?

_____ [RECORD CONTRACTOR NAME]

Did not use contractor	01
Don’t know	98
Refused	99

HP9. Was this Heat Pump purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02

Not a replacement	03
Don't know	98
Refused	99

Mini-Split Heat Pump

[ASK MSP1 – MSP9 IF AP7 = Y]

MSP1. Which month in 2017 did you purchase the mini-split heat pump?

_____ [ENTER MONTH PRODUCT WAS PURCHASED]

Don't know	98
Refused	99

MSP2. Can you tell me the make or manufacturer of the mini-split heat pump you purchased?

_____ [ENTER MANUFACTURER OF UNIT]

Don't know	98 [PROMPT TO LOOK AT THE UNIT]
Refused	99

MSP3. Was the Heat Pump you purchased Energy Star certified?

Yes	01
No	02
Don't know	98
Refused	99

MSP4. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

Don't know	98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

MSP5. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

Don’t know 98 [PROMPT TO LOOK AT THE UNIT]

Refused 99

MSP6. Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don’t know 98

Refused 99

[ASK MSP7 IF MSP6 = 98 OR MSP6 =99]

MSP7. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don’t know 98

Refused 99

MSP8. Can you tell me the name of the contractor who installed the new unit?

_____ [RECORD CONTRACTOR NAME]

Did not use contractor 01

Don’t know 98

Refused 99

MSP9. Was this Heat Pump purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01
To replace a broken unit	02
Not a replacement	03
Don't know	98
Refused	99

Household Electronics

HE. Since January 1, 2017, have you purchased or had installed ANY of the following items in your home/residence: Computer, Digital Imaging or Printers, Computer Monitor, a TV less than 40 inches, or a TV that is 40 inches or larger?

Q.	Appliance	Yes	No	DK	REF
HE1	Computer				
HE2	Computer Monitor				
HE3	Imaging or printers				
HE4	TV, less than 40 inches				
HE5	TV, 40 inches or larger				

[ASK CMP1 – CMP7 IF HE1 = Y]

Computers

CMP1. Are you currently using the computer you purchased?

Yes	01
No	02
Don't know	98
Refused	99

CMP2. For the computer you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

Sam’s Club	03
Walmart	04
Costco	05
Sears	06
Best Buy	07
Other (Specify)	
Don’t know	98
Refused	99

CMP3. Did you know [ANSWER U1] provides funds to promote energy efficient computers purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW CMP4 to CMP5 if CMP3 = 1]

CMP4. How did you learn about the promotion?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other(Specify)	
Don’t Know	98

CMP5. To the best of your knowledge, was the computer you purchased in 2017 promoted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

CMP6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the computer you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

[ASK CM1 – CM6 IF HE2 = Y]

Computer Monitors

CM1.Are you currently using the computer monitor you purchased?

Yes	01
No	02
Don’t know	98
Refused	99

CM2. For the computer monitor you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

Sam’s Club	03
Walmart	04
Costco	05
Sears	06
Best Buy	07

Other (Specify)	08
Don’t know	98
Refused	99

CM3. Did you know [ANSWER U1] provides funds to promote energy efficient computer monitors purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW CM4 to CM5 if CM3 = 1]

CM4. How did you learn about the promotion?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other (Specify)	
Don’t Know	98

CM5. To the best of your knowledge, was the computer monitor you purchased in 2017 promoted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

CM6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the computer monitor you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4- Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

[ASK IPS1 – IPS6 IF HE3 = Y]

Imaging, printers and scanners

IPS1. Are you still using the printer or other imaging device you purchased?

Yes	01
No	02
Don't know	98
Refused	99

IPS2. For the printer or other imaging device you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

Sam's Club	01
Walmart	02
Costco	03
Sears	04
Best Buy	05
Other (Specify)	06
Don't know	98
Refused	99

IPS3. Did you know [ANSWER U1] provides funds to promote energy efficient imaging devices purchased at retail stores?

Yes	01
No	02
Don’t know	98
Refused	99

[SHOW IPS4 to IPS5 if IPS3 = 1]

IPS4. How did you learn about the promotion?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other(Specify)	
Don’t Know	98

IPS5. To the best of your knowledge, was the printer or imaging device you purchased in 2017 promoted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

IPS6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the printer or imaging device you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4- Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

[ASK STV1 – STV6 IF HE4 = Y]

TV's less than 40"

STV1. Did you install the TV smaller than 40 inches you purchased?

Yes	01
No	02
Don't know	98
Refused	99

STV2. For the TV smaller than 40 inches you bought, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

Sam's Club	01
Walmart	02
Costco	04
Sears	05
Best Buy	06
Other(Specify)	07
Don't know	98
Refused	99

STV3. Did you know [ANSWER U1] provides funds to promote energy efficient TVs purchased at retail stores?

Yes	01
No	02
Don't know	98
Refused	99

[SHOW STV4 to STV5 if STV3 = 1]

STV4. How did you become aware of the promotion?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05
Other(Specify)	
Don’t Know	98

STV5. To the best of your knowledge, was the TV you purchased in 2017 promoted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

STV6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the TV fixtures you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

[ASK LTV1 – LTV6 IF HE5 = Y]

TV’s 40” or greater

LTV1. Did you install the TV 40 inches or greater you purchased?

Yes	01
No	02
Don’t know	98
Refused	99

LTV2. For the TV 40 inches or greater, was it purchased through any of the following retail stores: [READ LIST, CHECK ALL THAT APPLY]

Sam's Club	01
Walmart	02
Costco	03
Sears	04
Best Buy	05
Other(Specify)_____	06
Don't know	98
Refused	99

LTV3. Did you know [ANSWER U1] provides funds to promote energy efficient TVs purchased at retail stores?

Yes	01
No	02
Don't know	98
Refused	99

[SHOW LTV4 TO LTV5 IF LTV3 = 1]

LTV4. How did you learn about the promotion?

Retail Store Signage	01
Retail Store Employee	02
Utility Marketing	03
Friend/Family	04
TV/Radio/Internet Advertising	05

Other(Specify)	
Don’t Know	98

LTV5. To the best of your knowledge, was the TV you purchased in 2017 promoted through your utility?

Yes	01
No	02
Don’t know	98
Refused	99

LTV6. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the TV you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4- Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

Smart Thermostat

ST1. Did you purchase a Smart Thermostat in 2017? Smart thermostat models include Nest, ecobee, Honeywell, LUX, and Emerson models.

Yes	01
No	02
Don’t know	98
Refused	99

[ASK ST2 – ST9 IF ST1 = 01]

ST2. Did you install the Smart Thermostat you purchased?

Yes	01
No	02

Don’t know	98
Refused	99

.

ST3. Please rate, on a scale of 1-5, how satisfied or dissatisfied you are with the smart thermostat you purchased, where 1-Extremly Dissatisfied. 2- Dissatisfied, 3-neutral, 4-Satisfied, 5-Extremely Satisfied.

_____ [RECORD RESPONSE]

ST4. Have you noticed a difference on your electric bill?

Yes, I’ve noticed savings 01

No

Open Ended[RECORD RESPONSE]

ST5. What kind of AC unit do you have?

Room Air Conditioner	01
Central AC	02
Heat Pump	03
Mini-Split Heat Pump	04
Don’t know	98
Refused	99

ST6. What kind of heating unit do you have?

Electric Furnace	01
Gas Furnace	02
Heat Pump	03
Don’t know	98
Refused	99

ST7. Do you recall the SEER rating of the unit?

_____ [RECORD SEER]

Don’t know	98
Refused	99

ST8. Do you recall the age of the unit?

_____ [RECORD AGE]

Don’t know	98
Refused	99

ST9. What type of thermostat is your Smart Thermostat replacing?

Manual	01
Programmable	02
Don’t know	98
Refused	99

Household Characteristics / Demographics

Please answer the following questions about the house, apartment, or mobile home you reside in.

HC1. Which best describes this building? Include all apartments, flats, etc., even if vacant.

A mobile home	01
A one-family house detached from any other house	02
A one-family house attached to one or more houses	03
A building with 2 apartments	04

A building with 3 or 4 apartments	05
A building with 5 to 9 apartments	06
A building with 10 to 19 apartments	07
A building with 20 to 49 apartments	08
A building with 50 or more apartments	09
Boat, RV, van, etc.	10
Don’t know	98
Refused	99

HC2. Please select one of the following. Is this house, apartment, or mobile home-

Owned by you or someone in this household with a mortgage or loan? Include home equity loans.	01
Owned by you or someone in this household free and clear (without a mortgage or loan)?	02
Rented	03
Occupied without payment of rent?	04
Don’t know	98
Refused	99

HC3. About when was this building first built?[DO NOT READ]

2000 or later -Specify year XXXX	01
1990 to 1999	02
1980 to 1989	03
1970 to 1979	04
1960 to 1969	05
1950 to 1959	06
1940 to 1949	07
1939 or Earlier	08
Don’t know	98
Refused	99

HC4. Approximately how many square feet is your home?

_____ Record Number [100-99999]

Don’t know	98
Refused	99

HC5. How many separate rooms are there in this house, apartment or mobile home?

Include bedrooms, kitchens, etc.

Exclude bathrooms, porches, foyers, halls or unfinished basements.

_____ Record Number [1-97]

Don’t know	98
Refused	99

HC6. How many of those rooms are bedrooms?

Count as bedrooms those rooms you would list if this house, apartment, or mobile home were for sale or rent. If this is an efficiency/studio apartment, print "0".

_____ Record Number [1-97]

Don’t know	98
Refused	99

HC7. How many people are living or staying at this address?

Include everyone who is living or staying here for more than 2 months.

Include yourself if you are living or staying here for more than 2 months.

Include anyone else staying here who does not have another place to stay, even if they are here for less than two months.

Do not include anyone who is living somewhere else for more than two months, such as a college student living away or someone in the Armed Forces on deployment.

_____ Record Number [1-97]

Don’t know	98
Refused	99

HC7. When did the person who owns or leases this house, apartment or mobile home move in? Please provide a month and year

Month XX Year XXXX

Don’t know	98
Refused	99

HC8. Which FUEL is used MOST for heating this house, apartment, or mobile home?

Gas: from underground pipes serving the neighborhood	01
Gas: stored liquid petroleum gas (propane/butane)	02
Electricity	03
Fuel oil, kerosene, etc.	04
Coal	05
Wood	06
Solar energy	07
Other fuel	08
No fuel used	09
Don’t know	98
Refused	99

HC9. In the past 12 months, what was the cost in dollars of oil, coal, kerosene, wood, etc., for this house, apartment, or mobile home? If you have lived here less than 12 months, estimate the cost.

$_____ Record Number [100-99999]	
Don’t know	98
Refused	99

HC10. What is your approximate total household income? [READ CATEGORIES]

Less than $10,000	01
$10,000 to $29,999	02
$30,000 to $49,999	03
$50,000 to $69,999	04
$70,000 to $89,999	05
$90,000 to $99,999	06
$100,000 to $149,999	07
$150,000 or more	08
Don’t know	98
Refused	99

Customer Information:

CI1. Thank you for your time in answering questions regarding lighting and appliance purchases in Ohio. We have finished with the questions for this survey. Upon verification that you are a customer of FirstEnergy’s Ohio utilities, we would like to mail you a $5 Walmart gift card for your participation. To do that I’ll need your mailing information at this time. You can expect to receive the gift card in 4-6 weeks.

Are you willing to provide your name and the address so we can mail the gift card?

Name:

Address:

CI2. Would you allow us to contact you again to schedule a household visit to document the energy saving measures you described? You would receive an additional $20 Walmart gift card for participating in this part of the study.

Yes	01
No	02
Don’t know	98
Refused	99

[IF CI2 = Yes, SHOW CI3]

CI3. What day of the week and time would work best for you?

Day

Time

Don’t Know/Refused.

If you have any questions regarding this survey or would like to check on the status of your $5 gift card, please call 775-345-3031. Once again thank you for participating in this survey regarding household lighting and appliance purchases in Ohio. Have a great day.

FirstEnergy Ohio CAP C&I Participant Survey 2017

Pre-fill values

1) Stratum

2) ID

3) Utility name

4) Address

5) NAICS Group

6) Interviewer name

Telephone Introduction

[Please correct as necessary.]

7) Company name [FOR REFERENCE]

8**) [GREETING] Hello, my name is [Q6 Interviewer name] and I am calling from ADM Associates. This is not a sales call. We are conducting energy research on behalf of [Q3 Utility Name]. Your business will be compensated for full participation in this study. May I speak with someone who is familiar with equipment purchases made for the facility at [Q7 Company Name]?**

(IF NEEDED: ADM Associates is a professional service corporation providing comprehensive energy program evaluations, evaluations of emerging technologies, market assessments, and energy program portfolio development support.)

(IF NEEDED: This is not a sales call. This study is being conducted for research purposes and your responses will not be connected with your firm.)

[SEE TEXT INSTRUCTIONS BELOW COMMENT BOX]

Yes, you are speaking with the correct person.

Yes. [WHEN REFERRED TO A NEW CONTACT, RECORD CONTACT INFO IN COMMENT BOX, THEN REPEAT THIS QUESTION WITH NEW CONTACT. REPEAT THIS PROCESS UNTIL APPROPRIATE CONTACT HAS BEEN REACHED]

No [MARK AS REFUSAL]

Comments:

[IF NO, GO TO END]

[Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "1"]

[RESPONDENT IDENTIFICATION OPTIONS; SUPERVISOR, OPERATIONS MANAGER, MAINTENANCE MANAGER]
[MEASURE TYPE IDENTIFICATION OPTIONS; MOTORS, PUMPS, LIGHTING (SUCH AS LED FIXTURES)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "2"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, OPERATIONS MANAGER, BUSINESS MANAGER, ENGINEERING MANAGER, MAINTENANCE MANAGER]
[MEASURE TYPE IDENTIFICATION OPTIONS; MOTORS, PUMPS, LIGHTING (SUCH AS LED FIXTURES), HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "3"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, OPERATIONS MANAGER, BUSINESS MANAGER, ENGINEERING MANAGER, MAINTENANCE MANAGER]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "4"

[RESPONDENT IDENTIFICATION OPTIONS; STORE MANAGER, MANAGER ON DUTY]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS

(SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES), REFRIGERATION]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "5"

[RESPONDENT IDENTIFICATION OPTIONS; SUPERVISOR, OPERATIONS MANAGER, MAINTENANCE MANAGER]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES), REFRIGERATION]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "6"

[RESPONDENT IDENTIFICATION OPTIONS; BUSINESS MANAGER, MAINTENANCE MANAGER, SUPERVISOR]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "7"

[RESPONDENT IDENTIFICATION OPTIONS; BUILDING MANAGER, MAINTENANCE MANAGER, FACILITIES SUPERVISOR]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES)]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "8"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, ENGINEERING MANAGER, PURCHASER]

[MEASURE TYPE IDENTIFICATION OPTIONS; HEATING OR COOLING SYSTEMS

(SUCH AS NEW ROOFTOP UNITS), LIGHTING (SUCH AS LED FIXTURES), BOILERS]

Logic: Hidden unless: Question "NAICS Group" #5 is exactly equal to "9"

[RESPONDENT IDENTIFICATION OPTIONS; FACILITIES SUPERVISOR, ENGINEERING MANAGER, MAINTENANCE MANAGER]

[MEASURE TYPE IDENTIFICATION OPTIONS; LIGHTING (SUCH AS LED FIXTURES), HEATING OR COOLING SYSTEMS (SUCH AS NEW ROOFTOP UNITS), MOTORS]

9) Contact name

I would like to start by asking if your company has installed any of the following energy measures in 2017: lighting, refrigeration unit (including ice makers and freezers), HVAC systems or components, boilers, hot water heaters, electric motors, or clothes washers. [Select all that apply]

Yes, have installed

No, have not installed [GO TO Thank You]

No, I don't want to take the survey [GO TO Thank You]

Measures

Purchase and/or Installation of New Equipment

10) Great, would you be willing to answer a few questions about your company's experience purchasing or installing new equipment? This survey should take approximately 10 minutes of your time and we would like to provide compensation in exchange for short visit to your business to gather information, documentation, and proof of purchase in regards to the equipment you have installed. By completing a W-9, your business will be paid based on energy savings calculations from industry experts using information and documentation provided by your business. Your business will receive a check from $100 to a maximum of $1,000 for a completed survey and visit.

Yes

No **[SKIP TO END]**

11) What is the approximate area of your building or buildings?

Text:

Units

Sqft

Acres

Other [SPECIFY IN COMMENTS]

Comments:

12) What percentage of that space are you responsible for?

13) What are your normal operating hours? [Check all that apply]
Select days of operation and note operating hours in the comment boxes.

[Read only as needed]

Monday:

Tuesday:

Wednesday:

Thursday:

Friday:

Saturday:

Sunday:

Don't know:

Refused:

14) Are there any holidays when your facility is closed? [Check all that apply]

[Read only as needed]

New Year's Day

Martin Luther King Jr. Birthday

President's Day

Memorial Day

Independence Day

Labor Day

Columbus Day

Veterans' Day

Thanksgiving Day

Rosa Parks Day

Christmas Day

Other 1 - Write In (Required):

Other 2 - Write In (Required):

Don't know

Refused

15) **Are there any months when your business is closed? [Check all that apply] Note any seasonal closures in the comments boxes. [IF NONE, MARK "0" IN NONE BOX]**

[Read only as needed]

January:

February:

March:

April:

May:

June:

July:

August:

September:

October:

November:

December:

None:

Don't know:

Refused:

16) Please classify your facility type as one of the following

[Read only as needed]

Food Sales

Food Service

Health Care

Hotel/Motel

Office

Public Assembly

Public Services (non-food)

Retail

Warehouse

School

College

Industrial

Garage

Other (Specify):

Installed Measures

17) What is/are the measures that you have installed in 2017? [IF RESPONSE IS GENERAL, E.G., “LIGHTING EQUIPMENT”, PROBE FOR SPECIFIC MEASURES FROM LIST. IF NECESSARY, LIST THE POSSIBLE CATEGORIES BELOW] [Select all that apply]

Lighting

HVAC: Packaged air conditioners, heat pumps, or heaters

Refrigeration and Freezers

Boiler & Water Heater

Clothes washers or refrigerated vending machines

Motors

Other:

Didn't implement any measures

Don't know

Refused

Lighting Verification

[IF No response to Q17 = “Lighting”, SKIP TO HVAC Verification]

The next few questions will be about the LIGHTING that you installed or replaced.

18) What types of lighting upgrades did you implement? (Read options)
[ALLOW UP TO 5 RESPONSES]

Linear fluorescent light fixtures (for example T8 or T12 fluorescent lamps)

Compact fluorescent lamps (CFLs)

LED light fixtures

Metal Halide Lamps

Ceiling Fan Light Kits

High Intensity Discharge Lamps

LED exit signs

Incandescent Reflector Lamps

Occupancy sensors

Other, specify:

Didn't install any lighting equipment

Don't know

Refused

[IF "Linear fluorescent light fixtures" IS NOT AN ANSWER TO Q18, SKIP TO CFLS]

Linear Fluorescents

19A) How many linear fluorescents, for example T5s or T8s, did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

19B) When did you install the linear fluorescents?

If more than one piece of equipment will be installed, enter earliest date only.

20) What is the wattage of the linear fluorescents you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

21) And are these linear fluorescents installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q21 = “Inside”]

22) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

23) Did the linear fluorescents replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q23 = “No”, “Don’t know”, OR “Refused”, SKIP TO CFLS]

24) What equipment did the linear fluorescents replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q24 = "Linear fluorescent light T12"]

25) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Linear fluorescent light T12"]

26) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Linear fluorescent light T8"]

27) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Linear fluorescent light T8"]

28) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Incandescent"]

29) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Incandescent"]

30) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "CFL"]

31) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "CFL"]

32) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Metal Halide"]

33) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Metal Halide"]

34) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

Linear Fluorescent Replace Other

[SHOW IF Q24 = "Other, specify"]

35) How many [Q24 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q24 = "Other, specify"]

36) What is the wattage of the [[Q24 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF "Compact Fluorescent Lamps (CFLs)" IS NOT AN ANSWER TO Q18, SKIP TO LED light fixtures]

Compact Fluorescent Lamps (CFLs)

37A) How many compact fluorescent lamps, also known as CFLs, did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

37B) When did you install the CFLs?

If more than one piece of equipment will be installed, enter earliest date only.

38) What is the wattage of the CFLs you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

39) And are these CFLs installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q39 = "Inside"]

40) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

41) Did the CFLs replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q41 = “No”, “Don’t know”, OR “Refused”, SKIP TO LEDS]

42) What equipment did the CFLs replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q42 = “Linear fluorescent light T12”]

43) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Linear fluorescent light T12"]

44) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Linear fluorescent light T8"]

45) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Linear fluorescent light T8"]

46) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Incandescent"]

47) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Incandescent"]

48) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "CFLs"]

49) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "CFLs"]

50) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Metal Halide"]

51) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Metal Halide"]

52) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Other"]

CFLs Replace Other

53) How many [Q42 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Other"]

54) What is the wattage of the [Q42 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF "LED light fixtures (CFLs)" IS NOT AN ANSWER TO Q18, SKIP TO Metal Halide Lamps]

LED light fixtures

55A) How many light emitting diode fixtures, also known as LEDs, did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

55B) When did you install the LEDs?

If more than one piece of equipment will be installed, enter earliest date only.

56A) What is the wattage of the LEDs you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

56B) What type of LEDs did you install? [EAD CATEGORIES IF NESCESSARY]

General Purpose

Reflector

Tube LEDs that replace linear fluorescent bulbs

LED Metal Halide replacements

Fixtures

Other

57) And are these LEDs installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q57 = “Inside”]

58) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

59) Did the LEDs replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q59 = “No”, “Don’t know”, OR “Refused”, SKIP TO Metal Halide Lamps]

60) What equipment did the LEDs replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q60 = “Linear fluorescent light T12”]

61) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Linear fluorescent light T12”]

62) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Linear fluorescent light T8”]

63) How many T8s did you remove?
NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Linear fluorescent light T8”]

64) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Incandescent”]

65) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Incandescent”]

66) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “CFL”]

67) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “CFL”]

68) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Metal Halide”]

69) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Metal Halide”]

70) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q60 = “Other”]

LEDs Replace Other

71) How many [Q60 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

72) What is the wattage of the [Q60 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[IF “Metal Halide Lamps” IS NOT AN ANSWER TO Q18, SKIP TO Incandescent Reflector Lamps]

Metal Halide Lamps

73A) How many metal halide(s) did you install? [NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

73B) When did you install the metal halides?

If more than one piece of equipment will be installed, enter earliest date only.

74) What is the wattage of the metal halide(s) you installed? [NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

75) And are these metal halide(s) installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q75 = “Inside”]

76) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

77) Did the metal halide(s) replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q77 = “No”, “Don’t know”, OR “Refused”, SKIP TO Incandescent Reflector Lamps]

78) What equipment did the metal halide(s) replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q78 = “Linear fluorescent light T12”]

79) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Linear fluorescent light T12"]

80) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Linear fluorescent light T8"]

81) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Linear fluorescent light T8"]

82) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Incandescent"]

83) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Incandescent"]

84) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "CFL"]

85) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "CFL"]

86) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Metal Halide"]

87) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Metal Halide"]

88) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q78 = "Other"]

Metal Halide Replace Other

89) How many [Q78 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

90) What is the wattage of the [Q78 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF "Incandescent Reflector Lamps" IS NOT AN ANSWER TO Q18, SKIP TO Ceiling Fan Lights]

Incandescent Reflector Lamps

91A) How many incandescent reflector lamps did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

91B) When did you install the incandescent reflector lamps?

If more than one piece of equipment will be installed, enter earliest date only.

92) What is the wattage of the incandescent reflector lamps you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

93) And are these incandescent reflector lamps installed inside, outside, or in a refrigerated space like a walk-in refrigerator or freezer?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q93 = “Inside”]

94) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

95) Did the incandescent reflector lamps replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q95 = “No”, “Don’t know”, OR “Refused”, SKIP TO Ceiling Fan Lights]

96) What equipment did the incandescent reflector lamps replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q96 = “Linear fluorescent light T12”]

97) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q96 = “Linear fluorescent light T12”]

98) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q96 = “Linear fluorescent light T8”]

99) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q96 = “Linear fluorescent light T8”]

100) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q96 = “Incandescent”]

101) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q96 = "Incandescent"]

102) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q96 = "CFL"]

103) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q96 = "CFL"]

104) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q96 = "Metal Halide"]

105) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q96 = "Metal Halide"]

106) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

Incandescent Reflector Lamps Other

107) How many [Q96 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

108) What is the wattage of the [Q96 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF "Ceiling Fan Lights" IS NOT AN ANSWER TO Q18, SKIP TO High Intensity Discharge Lamps]

Ceiling Fan Lights

109A) How many ceiling fan lights did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

109B) When did you install the ceiling fan lights?

If more than one piece of equipment will be installed, enter earliest date only.

110) What is the wattage of the ceiling fan lights you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

111) Did the ceiling fan lights replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q111 = "No", "Don't know", OR "Refused", SKIP TO High Intensity Discharge Lamps]

112) What equipment did the ceiling fan lights replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q112 = “Linear fluorescent light T12”]

113) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q112 = “Linear fluorescent light T12”]

114) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q112 = “Linear fluorescent light T8”]

115) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q112 = “Linear fluorescent light T8”]

116) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "Incandescent"]

117) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "Incandescent"]

118) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "CFL"]

119) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "CFL"]

120) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "Metal Halide"]

121) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "Metal Halide"]

122) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q112 = "Other"]

Ceiling Fan Replace Other

123) How many [Q112 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

124) What is the wattage of the [Q112 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF "High Intensity Discharge Lamps" IS NOT AN ANSWER TO Q18, SKIP TO LED Exit Signs]

High Intensity Discharge Lamps

125A) How many high intensity discharge lamps, also known as HID, did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

125B) When did you install the high intensity discharge lamps?

If more than one piece of equipment will be installed, enter earliest date only.

126) What is the wattage of the HID you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

127) Did the HID replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q127 = “No”, “Don’t know”, OR “Refused”, SKIP TO LED Exit Signs]

128) What equipment did the HID replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q128 = “Linear fluorescent light T12”]

129 How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q128 = “Linear fluorescent light T12”]

130) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q128 = “Linear fluorescent light T8”]

131) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q128 = “Linear fluorescent light T8”]

132) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "Incandescent"]

133) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "Incandescent"]

134) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "CFL"]

135) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "CFL"]

136) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "Metal Halide"]

137) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = "Metal Halide"]

138) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q128 = “Other”]

HID Replace Other

139) How many [Q128 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

140) What is the wattage of the [Q128 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[IF “LED Exit Signs” IS NOT AN ANSWER TO Q18, SKIP TO Other Energy Saving Lighting Measures]

LED Exit Signs

141A) When did you install the LED exit signs?

If more than one piece of equipment will be installed, enter earliest date only.

141B) Were the LED exit signs single sided, double sided, or a combination of the two sign types?

Single sided

Double sided

Some single and some double sided

Electroluminescent

Other (Specify):

Don't know

Refused

[IF "Other Energy Saving Lighting Measures" IS NOT AN ANSWER TO Q18, SKIP TO HVAC Verification]

Other Energy Saving Lighting Measures

142A) How many [Q18 Other: Specify] did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

142B) When did you install the [Q18 Other: Specify]?

If more than one piece of equipment will be installed, enter earliest date only.

143) What is the wattage of the [Q18 Other: Specify] you installed? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

144) And are these [Q18 Other: Specify] installed inside, outside, or in a refrigerated space?

Inside

Outside

Refrigerated space

(Other, specify):

(Don't know)

(Refused)

[SHOW IF Q144 = "Inside"]

145) Is the inside space heated, cooled, or both?

Heated

Cooled

Both

(Don't know)

(Refused)

146) Did the [Q18 Other: Specify] replace existing equipment?

Yes

No

(Don't know)

(Refused)

[IF Q146 = “No”, “Don’t know”, OR “Refused”, SKIP TO HVAC verification]

147) What equipment did the [Q18 Other: Specify] replace?

Linear fluorescent light T12

Linear fluorescent light T8

Incandescent

CFL

Metal Halide

Other, specify:

Don't know

Refused

[SHOW IF Q147 = “Linear fluorescent light T12”]

148) How many T12s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON’T KNOW; 9999=REFUSED]

[SHOW IF Q147 = “Linear fluorescent light T12”]

149) What is the wattage of the T12s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Linear fluorescent light T8"]

150) How many T8s did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Linear fluorescent light T8"]

151) What is the wattage of the T8s that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Incandescent"]

152) How many incandescent bulbs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Incandescent"]

153) What is the wattage of the incandescent bulbs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "CFL"]

154) How many CFLs did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "CFL"]

155) What is the wattage of the CFLs that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Metal Halide"]

156) How many metal halides did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Metal Halide"]

157) What is the wattage of the metal halides that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q147 = "Other"]

Other Lighting Measures Replace Other

158) How many [Q147 Other: Specify] did you remove?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

159) What is the wattage of the [Q147 Other: Specify] that you removed?
[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[IF No response to Q17 = "HVAC: Packaged air conditioners, heat pumps, or heaters" SKIP TO Refrigeration Verification]

HVAC Verification

The next few questions will be about the HVAC equipment that you installed or replaced.

160) What types of equipment did you install as part of the HVAC project? [Check all that apply]

SPLIT Air Conditioning System

PACKAGED Air Conditioning System

Air Source Heat Pump

AIR Cooled Chiller

WATER Cooled Chiller

Ground Source Heat Pump

Unit Heater

Ductless Mini Split [counts as Other]

Other (Specify)

Didn't install any HVAC equipment

Don't know

Refused

[SHOW IF Q160 = "SPLIT Air Conditioning System"]

Split Air Conditioning System

161A) When did you install the split air conditioning system?

If more than one piece of equipment will be installed, enter earliest date only.

161B) What is the capacity of the split air conditioning system? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q161B = “Tons” OR Q161 = “Btu/hr” SKIP TO 163)

162) How many square feet does the split air conditioning system serve?

Note any units or comments in the Comments Box.

Comments:

163) What is the SEER of the split air conditioning system?

SEER:

Not applicable

Don't know

Refused

[IF Q163= “SEER” SKIP TO 165)

164) What is the EER of the split air conditioning system?

SEER:

Not applicable

Don't know

Refused

165) Did the split air conditioning system replace old equipment?

Yes

No

Don't know

Refused

[IF Q165 = “No”, “Don’t know”, OR “Refused”, SKIP TO 167)

166) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

167) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

168) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = “PACKAGED Air Conditioning System”]

Packaged Air Conditioning System

169A) When did you install the packaged air conditioning system?

If more than one piece of equipment will be installed, enter earliest date only.

169B) What is the capacity of the packaged air conditioning system? (Capture either in tons or in Btu/hr)

Tons:

Btu/hr:

Not applicable

Don't know

Refused

[IF Q169B = “Tons” OR Q169 = “Btu/hr” SKIP TO 171)

170) How many square feet does the packaged air conditioning system serve?

171) What is the SEER of the packaged air conditioning system?

SEER:

Not applicable

Don't know

Refused

[IF Q171= “SEER” SKIP TO 173)

172) What is the EER of the packaged air conditioning system?

EER:

Not applicable

Don't know

Refused

173) Did the packaged air conditioning system replace old equipment?

Yes

No

Don't know

Refused

[IF Q173 = "No", "Don't know", OR "Refused", SKIP TO 175]

174) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

175) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

176) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = "Air Source Heat Pump"]

Air Source Heat Pump

177A) When did you install the air source heat pump?

If more than one piece of equipment will be installed, enter earliest date only.

177B) What is the capacity of the air source heat pump? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q177B = “Tons” OR Q177 = “Btu/hr” SKIP TO 179)

178) How many square feet does the air source heat pump serve?

Note any units or comments in the Comments Box.

Comments:

179) What is the SEER of the air source heat pump?

SEER:

Not applicable

Don't know

Refused

[IF Q179= “SEER” SKIP TO 181]

180) What is the EER of the air source heat pump?

SEER:

Not applicable

Don't know

Refused

181) Did the air source heat pump replace old equipment?

Yes

No

Don't know

Refused

[IF Q181 = “No”, “Don’t know”, OR “Refused”, SKIP TO 183]

182) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

183) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

184) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = “AIR Cooled Chiller”]

Air Cooled Chiller

185A) When did you install the air cooled chiller?

If more than one piece of equipment will be installed, enter earliest date only.

185B) What is the capacity of the air cooled chiller? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

IF Q185B = “Tons” OR Q185 = “Btu/hr” SKIP TO 187)

186) How many square feet does the air cooled chiller serve?

Note any units or comments in the Comments Box.

Comments:

187) What is the efficiency of the new air cooled chiller, in kilowatts per ton?

Note any units or comments in the Comments Box.

Efficiency in kilowatts per ton:

Not applicable

Don't know

Refused

Comments:

188) Did the air cooled chiller replace old equipment?

Yes

No

Don't know

Refused

[IF Q188 = “No”, “Don’t know”, OR “Refused”, SKIP TO 190]

189) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

190) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

191) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = "WATER Cooled Chiller"]

Water Cooled Chiller

192A) When did you install the water cooled chiller?

If more than one piece of equipment will be installed, enter earliest date only.

192B) What is the capacity of the water cooled chiller? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q192B = “Tons” OR Q192 = “Btu/hr” SKIP TO 194)

193) How many square feet does the water cooled chiller serve?

Note any units or comments in the Comments Box.

Comments:

194) What is the efficiency of the new water cooled chiller, in kilowatts per ton?

Note any units or comments in the Comments Box.

Efficiency in kilowatts per ton:

Not applicable

Don't know

Refused

Comments:

195) Did the water cooled chiller replace old equipment?

Yes

No

Don't know

Refused

[IF Q195 = "No", "Don't know", OR "Refused", SKIP TO 197]

196) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

197) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

198) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = “Ground Source Heat Pump”]

Ground Source Heat Pump

199A) When did you install the ground source heat pump?

If more than one piece of equipment will be installed, enter earliest date only.

199B) What is the capacity of the ground source heat pump? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q199B = “Tons” OR Q199 = “Btu/hr” SKIP TO 201)

200) How many square feet does the ground source heat pump serve?

Note any units or comments in the Comments Box.

Comments:

201) What is the SEER of the ground source heat pump?

SEER:

Not applicable

Don't know

Refused

[IF Q201= “SEER” SKIP TO 203)

202) What is the EER of the ground source heat pump?

SEER:

Not applicable

Don't know

Refused

203) Did the ground source heat pump replace old equipment?

Yes

No

Don't know

Refused

[IF Q203 = “No”, “Don’t know”, OR “Refused”, SKIP TO 205]

204) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

205) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

206) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = "Unit Heater"]

Unit Heater

207A) When did you install the unit heater?

If more than one piece of equipment will be installed, enter earliest date only.

207B) What is the capacity of the unit heater? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Watts:

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q207B = “Tons” OR Q207 = “Btu/hr” SKIP TO 213]

208) How many square feet does the unit heater serve?

Note any units or comments in the Comments Box.

Comments:

209) Did the unit heater replace old equipment?

Yes

No

Don't know

Refused

[IF Q209 = “No”, “Don’t know”, OR “Refused”, SKIP TO 211]

210) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

211) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

212) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

[SHOW IF Q160 = "Other (Specify)"]

Other HVAC

213A) When did you install the [Q160 Other (Specify)]?

If more than one piece of equipment will be installed, enter earliest date only.

213B) What is the capacity of the [Q160 Other (Specify)]? (Capture either in tons or in Btu/hr)

Note any units or comments in the Comments Box.

Tons:

Btu/hr:

Not applicable

Don't know

Refused

Comments:

[IF Q213B = "Tons" OR Q213 = "Btu/hr" SKIP TO 215]

214) How many square feet does the [Q160 Other (Specify)]? serve?

215) What is the SEER of the [Q160 Other (Specify)]?

SEER:

Not applicable

Don't know

Refused

[IF Q215= “SEER” SKIP TO 217]

216) What is the EER of the [Q160 Other (Specify)]?

SEER:

Not applicable

Don't know

Refused

217) Did the [Q160 Other (Specify)] replace old equipment?

Yes

No

Don't know

Refused

[IF Q217 = “No”, “Don’t know”, OR “Refused”, SKIP TO 219]

218) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

219) What is the primary fuel source for heating? [Do not read list]

Electric

Gas

Oil

Purchased steam

Don't know

Refused

220) What is the temperature set-point of the conditioned space?

Fahrenheit:

Celsius:

Don't know

Refused

221) What is the temperature set-point of the conditioned space for cooling and heating?

Record response in units indicated by the respondent.

Heating set-point Fahrenheit:

Heating set-point Celsius:

Cooling set-point Fahrenheit:

Cooling set-point Celsius:

Don't know

Refused

Refrigeration Verification

[IF No response to Q17 = "Refrigeration and Freezers", SKIP TO Boiler & Water Heater Verification]

The next few questions will be about the refrigeration equipment that you installed or replaced.

222) What types of equipment did you install as part of the refrigeration project. [Check all that apply]

ENERGY STAR certified Refrigerator

ENERGY STAR certified Freezer

Walk-in Cooler or Freezer

Display Case

ENERGY STAR certified Refrigerated Beverage Vending Machine

Automatic Commercial Ice Maker

Other (Specify):

Don't know

Refused

[SHOW IF Q222 = "ENERGY STAR certified Refrigerator"]

ENERGY STAR certified Refrigerator

223A) How many ENERGY STAR certified refrigerator(s) did you install?

223B) When did you install the ENERGY STAR certified refrigerator(s)?

If more than one piece of equipment will be installed, enter earliest date only.

224) Would you please describe the new equipment, using as much detail as possible, such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

225) Did the ENERGY STAR certified refrigerator(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q225 = "No", "Don't know", OR "Refused", SKIP TO ENERGY STAR certified Freezer]

226) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "ENERGY STAR certified Freezer"]

ENERGY STAR certified Freezer

227A) How many ENERGY STAR certified freezer(s) did you install?

227B) When did you install the ENERGY STAR certified freezer(s)?

If more than one piece of equipment will be installed, enter earliest date only.

228) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

229) Did the ENERGY STAR certified freezer(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q229 = "No", "Don't know", OR "Refused", SKIP TO Walk-in Cooler or Freezer]

230) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Walk-in Cooler or Freezer"]

Walk-in Cooler or Freezer

231A) How many walk-in cooler(s) or freezer(s) did you install?

231B) When did you install the walk-in cooler(s) or freezer(s)?

If more than one piece of equipment will be installed, enter earliest date only.

232) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

233) Did the walk-in cooler(s) or freezer(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q233 = “No”, “Don’t know”, OR “Refused”, SKIP TO Display Case]

238) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = “Display Case”]

Display Case

235A) How many display case(s) did you install?

235B) When did you install the display case(s)?

If more than one piece of equipment will be installed, enter earliest date only.

236) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

237) Did the display case(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q237 = “No”, “Don’t know”, OR “Refused”, SKIP TO ENERGY STAR certified Refrigerated Beverage Vending Machine]

238) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "ENERGY STAR certified Refrigerated Beverage Vending Machine"]

ENERGY STAR certified Refrigerated Beverage Vending Machine

239A) How many ENERGY STAR certified refrigerated beverage vending machine(s) did you install?

239B) When did you install the ENERGY STAR certified refrigerated vending machine(s)?

If more than one piece of equipment will be installed, enter earliest date only.

240) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

241) Did the refrigerated beverage vending machine(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q241 = “No”, “Don’t know”, OR “Refused”, SKIP TO Automatic Commercial Ice Maker]

242) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Automatic Commercial Ice Maker"]

Automatic Commercial Ice Maker

243A) How many automatic commercial ice maker(s) did you install?

243B) When did you install the automatic ice maker(s)?

If more than one piece of equipment will be installed, enter earliest date only.

244) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

245) Did the automatic commercial ice maker(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q245 = “No”, “Don’t know”, OR “Refused”, SKIP TO Other Refrigeration Measure]

246) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Other (Specify)"]

Other Refrigeration Measure

247A) How many [Q222 Other (Specify)] did you install?

247B) When did you install the [Q222 Other (Specify)]?

If more than one piece of equipment will be installed, enter earliest date only.

248) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

249) Did the [Q222 Other (Specify)] replace old equipment?

Yes

No

Don't know

Refused

[IF Q249 = “No”, “Don’t know”, OR “Refused”, SKIP TO Boiler and Water Heater Verification]

250) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR certified vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR certified or other energy-efficient option

Standard efficiency

Additional information:

Don't know

Refused

[IF No response to Q17 = "Boiler & Water Heater" SKIP TO Other Appliance Verification]

Boiler and Water Heater Verification

The next few questions will be about the BOILER and WATER HEATING measures that you installed or replaced.

251) What types of boiler or water heating upgrades did you install?

Storage water heater

Low flow faucet aerators

Hot Water Pre-Rinse Spray Valves

Low flow showerheads

Tankless water heater

Boiler

Other (Specify):

Didn't install any boiler or water heating equipment

Don't know

Refused

[SHOW IF Q251 = "Storage water heater"]

Storage Water Heater

252A) How many storage water heater(s) did you install?

252B) When did you install the storage water heater(s)?

If more than one piece of equipment will be installed, enter earliest date only.

253) What is the fuel source for the storage water heater(s)?

Gas

Electric

Multiple Units, some gas, some electric

Don't know

Refused

[SHOW IF Q253 = “Multiple Units, some gas, some electric”]

254) How many of the storage water heaters are gas units, and how many are electric?

Gas:

Electric:

Don't know

Refused

[SHOW IF Q257 = “Multiple Units, some gas, some electric”]

255) What is the heating capacity and thermal efficiency of the gas storage water heater(s) you installed?

Note any units or comments in the Comments Box.

Heating capacity:

Thermal efficiency:

Don't know

Refused

Comments:

[SHOW IF Q257 = “Multiple Units, some gas, some electric” OR Q257 = “Electric”]

256) What is the heating capacity and thermal efficiency of the electric storage water heater(s) you installed?

Note any units or comments in the Comments Box.

Heating capacity:

Thermal efficiency:

Don't know

Refused

Comments:

[SHOW IF Q253 = “Multiple Units, some gas, some electric” OR Q253 = “Electric”]

257) Are the electric storage water heaters GAMA/AHRI efficiency rating certified?

Yes

No

Don't know

Refused

258) Did the storage water heater(s) replace existing equipment?

Yes

No

Don't know

Refused

[SHOW IF Q253 = (“Multiple Units, some gas, some electric” OR Q253 = “Gas”) AND Q258 = YES]

259) What was the heating capacity and thermal efficiency of the old gas fueled storage water heater?

Note any units or comments in the Comments Box.

Heating capacity:

Thermal efficiency:

Don't know

Refused

Comments:

[SHOW IF Q253 = (“Multiple Units, some gas, some electric” OR Q253 = “Electric”) AND Q258 = YES]

260) What was the heating capacity and thermal efficiency of the old electric fueled storage water heater?

Note any units or comments in the Comments Box.

Heating capacity:

Thermal efficiency:

Don't know

Refused

Comments:

[SHOW IF Q253 = (“Multiple Units, some gas, some electric”) AND Q258 = YES]

261) What was the gallon capacity of the old storage water heater?

Gallon capacity:

Don't know

Refused

[SHOW IF Q251 = “Low flow faucet aerators”]

Low Flow Faucet Aerators

262A) How many low flow faucet aerator(s) did you install?

262B) When did you install the low flow faucet aerator(s)?

If more than one piece of equipment will be installed, enter earliest date only.

263) Are the faucet aerators connected to fixtures that use electric or gas water heating?

Gas

Electric

Multiple units, some gas, some electric

Don't know

Refused

[SHOW IF Q263 = "Multiple Units, some gas, some electric"]

264) How many faucet aerators are connected to fixtures that use gas water heaters and how many are connected to electric water heaters?

Gas:

Electric:

Don't know

Refused

[SHOW IF Q251 = "Hot Water Pre-Rinse Spray Valves"]

Hot Water Pre-Rinse Spray Valves

265A) How many hot water pre-rinse spray valves(s) did you install?

265B) When did you install the how water pre-rinse spray value(s)?

If more than one piece of equipment will be installed, enter earliest date only.

266) Are the pre-rinse spray valves(s) connected to fixtures that use electric or gas water heating?

Gas

Electric

Multiple Units, some gas, some electric

Don't know

Refused

[SHOW IF Q266 = “Multiple Units, some gas, some electric”]

267) How many pre-rinse spray valves are connected to fixtures that use gas water heaters and electric water heaters?

Gas:

Electric:

Don't know

Refused

268) What is the reduction in daily water consumption through the pre-rinse spray valves(s)?

Quantity (Specify Units)

Don't know

Refused

[SHOW IF Q251 = “Low flow showerheads”]

Low-Flow Shower Heads

269A) How many low-flow shower head(s) did you install?

269B) When did you install the low-flow shower head(s)?

If more than one piece of equipment will be installed, enter earliest date only.

270) Are the low-flow shower heads connected to fixtures that use electric or gas water heating?

Gas

Electric

Multiple Units, some gas, some electric

Don't know

Refused

[SHOW IF Q274 = "Multiple Units, some gas, some electric"]

271) How many low-flow shower heads are connected to fixtures that use gas water heaters and electric water heaters?

Gas:

Electric:

Don't know

Refused

272) On average, how many showers are taken per day using one of the low flow showerheads you installed?

Quantity (Specify Units)

Don't know

Refused

[SHOW IF Q251 = "Tankless water heater"]

Tank-less Water Heater

273A) How many tank-less water heater(s) did you install?

273B) When did you install the tank-less water heater(s)?

If more than one piece of equipment will be installed, enter earliest date only.

274) What is the fuel source for the tank-less water heater(s) you installed?

Gas

Electric

Multiple Units, some gas, some electric

Don't know

Refused

[SHOW IF Q274 = "Multiple Units, some gas, some electric"]

275) How many of the tank-less water heaters are gas units, and how many are electric?

Gas:

Electric:

Don't know

Refused

276) What is the size of the tank-less water heater(s) you installed, in Btu/hr?

Less than 75,000 Btu/hr

Greater than 75,000 Btu/hr but less than or equal to 155,000 Btu/hr

Greater than 155,000 Btu/hr

Don't know

Refused

277) What is the output capacity of the tankless water heater(s) you installed, in gallons per minute (GPM)?

Output Capacity (GPM):

Don't know

Refused

278) Did the tank-less water heater(s) replace existing units?

Yes

No

Don't know

Refused

[IF Q278 = “No”, “Don’t know”, or “Refused”, SKIP TO Boiler]

279) What was the energy factor of the existing water heater(s) that you replaced?

Note any units or comments in the Comments Box.

Energy Factor:

Don't know

Refused

Comments:

280) What was the size of the water heater(s) you REPLACED, in BTU/hr?

Less than 75,000 Btu/hr

Greater than 75,000 Btu/hr but less than or equal to 155,000 Btu/hr

Greater than 155,000 Btu/hr

Don't know

Refused

281) What was the capacity of the water heater(s) you REPLACED, in gallons (Gal)?

Capacity (Gal):

Don't know

Refused

[SHOW IF Q251 = “Boiler”]

Boiler

282A) How many boiler(s) did you install?

282B) When did you install the boiler(s)?

If more than one piece of equipment will be installed, enter earliest date only.

283) What is the capacity of the new boiler(s)?

Note any units or comments in the Comments Box.

Capacity (Btu/hr):

Don't know

Refused

Comments:

284) How many fire rates do you have for your boiler?

One

Two

Three

Four

Don't know

Refused

[IF Q288 = “Don’t Know” or Q288 = “Refused” SKIP TO Q293]

Now, I'm going to ask you about the percentage of oxygen in the exhaust gas and the flue gas temperature for each of the fire rate(s) that you just indicated.

285) What is the percentage of oxygen in the exhaust gas and the flue gas temperature at the first fire rate.

Note any units or comments in the Comments Box.

Percentage of oxygen at fire rate:

Flue gas temperature at fire rate Fahrenheit:

Flue gas temperature at fire rate Celsius:

Don't know

Refused

Comments:

[IF Q284 = “One” SKIP TO Q293]

286) What is the percentage of oxygen in the exhaust gas and the flue gas temperature at the second fire rate.

Note any units or comments in the Comments Box.

Percentage of oxygen at fire rate:

Flue gas temperature at fire rate Fahrenheit:

Flue gas temperature at fire rate Celsius

Don't know

Refused

Comments:

[IF Q284 = “Two” SKIP TO Q293]

287) What is the percentage of oxygen in the exhaust gas and the flue gas temperature at the third fire rate.

Note any units or comments in the Comments Box.

Percentage of oxygen at fire rate:

Flue gas temperature at fire rate Fahrenheit:

Flue gas temperature at fire rate Celsius:

Don't know

Refused

Comments:

[IF Q284 = “Three” SKIP TO Q293]

288) What is the percentage of oxygen in the exhaust gas and the flue gas temperature at the fourth fire rate.

Note any units or comments in the Comments Box.

Percentage of oxygen at fire rate:

Flue gas temperature at fire rate Fahrenheit:

Flue gas temperature at fire rate Celsius:

Don't know

Refused

Comments:

289) What is the fuel source of the boiler(s)?

Electricity

Gas

Oil

Don't know

Refused

290) Did the boiler(s) replace existing units?

Yes

No

Don't know

Refused

[IF Q290 = "No", "Don't know", OR "Refused", SKIP TO Clothes Washer and Other Appliance Verification]

291) What was the fuel source of the boiler(s) that you REPLACED?

Electricity

Gas

Oil

Don't know

Refused

292) What was the capacity of the boiler(s) that you REPLACED?

Note any units or comments in the Comments Box.

Capacity (Btu/hr):

Don't know

Refused

Comments:

Clothes Washer and Other Appliance Verification

[IF No response to Q17 = "Clothes washers or refrigerated vending machines" SKIP TO Motor Verification]

The next few questions will be about the CLOTHES WASHING and other APPLIANCES that you installed or replaced.

293) Indicate which of the following clothes washers, or other appliances that you have installed? [Check all that apply]

Clothes Washer:

Other Appliance 1 (Specify):

Other Appliance 2 (Specify):

Don't know

Refused

[IF Q293 = "Other Appliance 1", or "Other Appliance 2", , SKIP toOther Appliances 1]

[IF Q293 = "Don't know", or "Refused", SKIP to Motor Verification]

294A) How many clothes washer(s) did you install?

Clothes Washer:

Refused

Other - Write In

294B) When did you install the clothes washer(s)?

If more than one piece of equipment will be installed, enter earliest date only.

295) Did the new clothes washer replace an old clothes washer?

Yes

No

Don't know

Refused

[IF Q295 = “No”, “Don’t know”, OR “Refused”, SKIP TO Other Appliances 1]

296) How old was the existing clothes washer?

0-4 years

5-9 years

10-14 years

15-19 years

20 years or older

Don't know

Refused

297) Was the existing clothes washer rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

Yes

No

Don't know

Refused

Other Appliances 1

[SHOW IF Q293 = "Other Appliance 1 (Specify)"]

298A) How many [Q293 Other Appliance 1 (Specify)] did you install?

[Q293 Other Appliance 1 (Specify)]:

Refused

Other - Write In

298B) When did you install the [Q293 Other Appliance 1 (Specify)]?

If more than one piece of equipment will be installed, enter earliest date only.

299) Did the new [Q293 Other Appliance 1 (Specify)] replace an old [Q293 Other Appliance 1 (Specify)]?

Yes

No

Don't know

Refused

[IF Q299 = "No", "Don't know", OR "Refused", SKIP TO Other Appliances 2]

300) How old was the existing [Q293 Other Appliance 1 (Specify)]?

0-4 years

5-9 years

10-14 years

15-19 years

20 years or older

Don't know

Refused

301) Was the existing [Q293 Other Appliance 1 (Specify)] rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

Yes

No

Don't know

Refused

Other Appliances 2

[IF No response to Q17 = “Other Appliance 2 (Specify)”, SKIP TO Motor Verification]

302A) How many [Q293 Other Appliance 2 (Specify)] did you install?

[Q293 Other Appliance 2 (Specify)]:

Refused

Other - Write In

302B) When did you install the [Q293 Other Appliance 2 (Specify)]?

If more than one piece of equipment will be installed, enter earliest date only.

303) Did the new [Q293 Other Appliance 2 (Specify)] replace an old [Q293 Other Appliance 2 (Specify)] ?

Yes

No

Don't know

Refused

[IF Q303 = “No”, “Don’t know”, OR “Refused”, SKIP TO Motor Verification]

304) How old was the existing [Q293 Other Appliance 2 (Specify)] ?

0-4 years

5-9 years

10-14 years

15-19 years

20 years or older

Don't know

Refused

305) Was the existing [Q293 Other Appliance 2 (Specify)] rated as energy efficient (e.g. was it ENERGY STAR certified equipment)?

Yes

No

Don't know

Refused

Motor Verification

[IF No response to Q17 = "Motors", SKIP TO Contact Information]

The next few questions will be about the MOTORS that you installed or replaced.

306) What changes did you make to your electric motors? Did you…
[ALLOW MULTIPLE RESPONSES, UP TO 3]

Install or replace a motor

Install VFDs [Variable Frequency Drives] on existing motors

Do something else (Specify):

Don't know

Refused

[IF "Install or replace a motor" IS NOT AN ANSWER TO Q306, SKIP TO Q315]

307A) How many motor(s) did you install?
[NUMERIC OPEN END, 1 TO 500; 998=DON'T KNOW, 999=REFUSED]

307B) When did you install the motor(s)?

If more than one piece of equipment will be installed, enter earliest date only.

308) What is the approximate average horsepower of the new motors? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name]”)
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

309) On average, how many hours per day do the motors operate? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name])
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

310) Did the motors replace existing motors? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name]
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

Yes

No

Don't know

Refused

[IF Q310 = “No”, “Don’t know”, OR “Refused”, SKIP TO Q314]

311) Approximately how old were the motors that were REPLACED? (IF NEEDED: “We are interested in the average across all of the motors you installed [Q3:Utility Name] or replaced without receiving an incentive from [Q3:Utility Name]
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

0-4 years

5-9 years

10-14 years

15-19 years

20 years or older

Don't know

Refused

312) What is the approximate average horsepower of the motors that were REPLACED? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name]”)
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

313) What is the approximate average efficiency of the motors that were REPLACED? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name]”)
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

314) What is the approximate average efficiency of the new motors? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name])

[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

[IF “Install VFDs on existing motors” IS NOT AN ANSWER TO Q306, SKIP TO Contact Information]

315A) How many motors did you install VFDs on?
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

315B) When did you install the VFDs?

If more than one piece of equipment will be installed, enter earliest date only.

316) What is the approximate average horsepower of the motors you installed VFDs on? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name]”)
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

317) On average, how many hours per day do the motors with VFDs operate? (IF NEEDED: “We are interested in the average across all of the motors you installed or replaced without receiving an incentive from [Q3:Utility Name])
[NUMERIC OPEN END, 1 TO 500; 998=DON’T KNOW, 999=REFUSED]

318) What application are these VFD motors used for?

Heating or cooling

Some other process

Don’t know

Refuse

Contact Information

Installed Measures Contact Information

You will receive an email from ADM Associates that includes a list of the information, documents, and proof of purchase that are necessary in order for ADM to calculate annual energy savings. The email will also review the compensation structure for participating in this market research study ADM Associates will contact you by phone and/or email to arrange a site visit.

319) Lastly, would you please provide us with an email address and phone number to follow-up?

Email address:

Telephone number:

320) If you have any questions regarding this market study you can reach us at 775-229-4430.

Thank You!

Thank you for your time today and have a wonderful day.

7 Appendix C: Additional Documentation

Residential RDD thank you letter

[Date]

Dear [contact("full name")],

You recently completed a phone survey for ADM Associates regarding the energy saving equipment you purchased during 2017.

We've enclosed a $5 gift card as a token of appreciation for your time.

Thank you for your participation,

Sarah Vernon

ADM Associates, Inc.

Sarah@admenergy.com

Residential Site Visit thank you letter

XXXXX XX, 2018

Dear XXXXXXX,

You recently completed an in-home verification visit for ADM Associates regarding the energy saving equipment you purchased during 2017.

We've enclosed a $30 gift card as a token of appreciation for your time.

Thank you for your participation,

Sarah Vernon

ADM Associates, Inc.

Sarah@admenergy.com

C&I Commitment Payment letter

[DATE]

Dear [NAME],

Thank you for participating in the Customer Action Program, a market research study conducted by ADM Associates, Inc. on behalf of FirstEnergy's Ohio utilities. We appreciate you taking the time to provide us with information about the energy-efficient measures you installed in 2017. Enclosed is the payment that was promised based on annual kWh savings from installations you made in 2017.

If you have any questions or concerns, please feel free to contact me.

Sincerely,

Cody Dawson

ADM Associates

330-239-8677

cody.dawson@admenergy.com