2016 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

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1 Executive Summary

For 2016, 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, as well as multiple discussions with the FirstEnergy Collaborative group.

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; 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, Refrigerators, and HVAC.

For each measure, ADM employed two strategies to calculate ex-post savings:

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[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.

- A bottom-up approach utilizing primary data collected from the Companies' service territories via a Random Digit Dialing (RDD) telephone survey.

- A top-down approach utilizing macro-level data.

To ascertain information for the *bottom-up* approach about the energy efficient measures the Companies' residential customers purchased during 2016, 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.

The *top-down* approach utilized market data from U.S. Energy Information Administration, the Association of Home Appliance Manufactures, 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 2016.

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 refrigerator 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 refrigerators, the top-down approach utilized market data as an independent check on ex post savings. 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. 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	4,962,085	5,193.53	78,651,886
OE	HVAC	6,927,405	7,250.52	109,803,335
TE	HVAC	2,048,951	2,144.52	32,477,043
Total		**13,938,441**	**14,588.57**	**220,932,265**
CEI	Refrigerator	4,616,596	819.73	78,482,132
OE	Refrigerator	6,445,079	1,144.40	109,566,347
TE	Refrigerator	1,906,291	338.49	32,406,948
Total		**12,967,966**	**2,302.62**	**220,455,427**
CEI	Lighting	41,375,604	5,367.63	499,453,693
OE	Lighting	57,466,117	7,455.04	693,685,684
TE	Lighting	16,090,513	2,087.41	194,231,992
Total		**114,932,233**	**14,910.08**	**1,387,371,369**
Res Total		**141,838,640**	**31,801.27**	**1,828,759,061**

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 sample was generated by stratifying the population of businesses within the Companies' service territories based on average annual energy usage (kWh). For program year 2016, a total of 172,902 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 2016 and if they had plans to install energy efficient equipment prior to the end of 2017. Respondents who indicated installing equipment during 2016 were then asked detailed questions regarding the installed equipment. ADM completed decision maker surveys for 4,675 out of 28,050 program-eligible entities. Of those respondents, 482 claimed to have

installed energy efficient equipment during 2016. ADM performed a site visit to verify measure implementation for 186 of these respondents, of which ADM found that 120 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.

Equipment during 2016 were associated with 7,392,943 kWh of annual energy savings. The summer coincident peak savings for this sample of businesses is 1,229 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	4,339,191	856.06
OE	2,584,675	292.42
TE	469,077	80.78
2016 Total	7,392,943	1,229.25

Energy savings measures considered for CAP include Lighting, HVAC, motors, refrigeration, appliances, water heating, and process improvements. 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. The extrapolated annual energy savings for all operating companies is 59,035,351 kWh. 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	574,653	149	6,725,387
CE-GS	18,193,128	3,894	213,062,535
CE-GSU	1,447,025	215	16,189,772
CE-GT	2,334,029	273	24,915,760
CEI Total	**22,548,835**	**4,530**	**260,893,454**
OE-GP	2,460,834	377	29,493,569
OE-GS	21,585,439	2,041	253,417,530
OE-GSU	753,727	57	9,958,930
OE-GT	1,363,589	148	16,363,036
OE Total	**26,163,589**	**2,622**	**309,233,065**
TE-GP	1,996,020	327	22,770,358
TE-GS	8,254,281	1,310	97,537,696
TE-GSU	26,034	4	307,637
TE-GT	46,592	7	550,561
TE Total	**10,322,927**	**1,649**	**121,166,253**
Total	**59,035,351**	**8,801**	**691,292,772**

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 2016. 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 2016 by residential customers within the Companies' service territories.

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 2016.

- 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 2016?

2.1.1 Residential Market Data Acquisition

The sample frame for measurement and verification of residential CAP energy savings includes all 1,861,678 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 2016.

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. A summary of the residential survey is shown in Table 2-1.

Table 2.1: Survey Population

Sample	Month	Customers
Survey 1	August, 2016	1,500
Survey 2	September, 2016	1,500
Survey 3	December, 2016	600
2016 Total		**3,600**

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 2016. 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 the survey respondent to request participation in a site verification visit. If the respondent agreed, a site visit was scheduled to gather the information to facilitate calculation of energy savings. 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 2-2.

Table 2.2: Residential Market Data Collection Effort Statistics

Unit	Quantity
Population Size (Residential Households)	1,861,678
Customers Completing Survey	3,600
Residential Site Visits	200

2.2 Commercial & Industrial

The overall objective for the impact evaluation of the CAP C&I Programs was to verify the gross energy savings (kWh) and peak demand (kW) reduction resulting from energy efficiency measures installed during 2016 by businesses within the Companies' service territories.

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 calendar year 2016.

- 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. Monitoring was also conducted, when necessary, to obtain more accurate information on the hours of operation for lighting equipment.

- Program energy savings were estimated using the Ohio TRM:

  o 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.

  o 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 C&I CAP are presented below:

- 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 2016?

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 (4/30/2015 to 5/31/2016).
- Customers with non-current or expected non-current accounts.
- Customers with any months of zero or negative savings within the chosen 12-month period.[2]
- 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

For each EDC, the remaining population of C&I customers (183,743) were grouped into strata based on the customer level of annual energy usage. Six sampling strata were created for each EDC. 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. To achieve the desired number of survey respondents, a large number of 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 28,050.

Customers in each sample were divided into three groups: high energy users, national accounts, and low/medium energy users. For the high-energy users and national accounts, ADM contacted customers by referencing contact information provided by the Companies' account representatives. For low/medium energy users, ADM contacted customers by referencing phone contact information contained in data provided to ADM by the Companies. The samples are shown in Table 2-3.

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

Table 2.3:C&I Market Data Collection Effort Statistics

Survey	Time Period of Data Collection	Randomly selected segments of C&I population from which sampling was performed
Survey 1	September/October	25,000
Survey 2	January/February	3,050
2016 Total		**28,050**

The survey population was presented a survey to determine:

- Energy efficiency equipment installed in 2016
- Energy efficiency equipment planned to be installed in the remainder of 2016
- Which energy efficiency equipment was installed in 2016
- Which energy efficiency equipment was planned to be installed at a future date

To obtain businesses to participate in the survey, they were called up to 8 times over the course of 3 weeks. Call backs 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 2016. However, surveys were considered to have a response if a conversation was initiated. 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 and Process Improvements

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.

Upon completion of the survey, each respondent willing to participate was contacted by an ADM Associate through email and a follow-up phone call. The email template can be

seen in Appendix C. The intent of the email was to gather documentation and information not acquired during the survey. Documentation included:

- Letter of Attestation for equipment installed in 2016
- 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 an accurate energy savings. Site visits included the verification of each energy efficient measure installed within the business.

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

Table 2.4: Participation Statistic

Sample	Customers
Sample Size	28,050
Survey Respondents	4,675
Businesses with reported Installed Measures or planned to install in 2016	482
Site Visits	186
Sites with Verified Energy Savings	120

Of the businesses that claimed to have installed or plan to install measures in 2016, 455 of them were low/medium energy users. A summary of the businesses that claimed measures is shown in Table 2.5

Table 2.5: Claimed Measures by Business Type

Claimed Installed or planned to install Measures	Customers
Low/Medium Energy Users	455
National Accounts	15
High Energy Users	12
Total	**482**

Of the businesses who claimed measures in 2016, 186 were visited by ADM field technicians. ADM visited every business accepting a site visit. A breakdown of the business classifications where site visits were completed is shown in Table 2.6.

Table 2.6: Businesses Accepting Site Visits

Site Visits	Customers
Low/Medium Energy Users	159
National Accounts	15
High Energy Users	12
Total	**186**

3 Program Description

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 Code section, the 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.

The primary objective of CAP is to determine the energy savings from the Companies' customers without the influence of an energy 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 of businesses within the Companies' service territories.

This chapter presents a description of each of the sectors in the customer action program.

3.1 Residential

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 include: lighting, HVAC, and refrigeration. Primary data associated with the Companies' customers' energy efficiency actions and purchasing behaviors was collected via a RDD telephone survey as described in section 2.1, as well as through site visits.

3.2 Commercial & Industrial

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. All commercial and industrial businesses are eligible for the program but have the option to opt out or not participate. Business customers within the Companies were acquired through the process outlined in Section 2.2. Participants were chosen randomly into a stratified sample based on average annual energy usage (kWh). The population considered for CAP included 172,902 businesses. Energy savings were calculated for each business based on the number of energy efficient measures installed during 2016. 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 and process improvements. The category of other includes custom equipment, process equipment, and other measures that are quantifiable by EM&V best practices. The methodologies for calculating energy savings were consistent with high energy users and medium/low energy users.

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 2016. 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.

3.3   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 2013-2016 Mercantile and Community Connections and 2013-2015 C&I program data.[3] 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.

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[3] There were no other programs for 2016 that included measures counted under the CAP to verify dual participation.

4 Methodology

This chapter provides a description of the methodology applied by ADM in the evaluation of the CAP during 2016.

4.1 Residential Methodology

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.

4.1.1 Sampling Design and Extrapolation Methods

In order to ascertain information about the energy efficient measures purchased by the Companies' residential customers during 2016, 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 data base 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

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[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.

behavior. The following comparison uses the 3,600 survey responses collected for the Companies with gold-standard Census Bureau data for that state. The data used is the 2015 five-year household level Public Use Microdata Set (PUMS) of the American Community Survey (ACS). This data set 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 4-1 below illustrates how well the PUMAs (orange) were contained within the Companies' service territories (blue).

Figure 4-1: 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 4-1 below.

Table 4.1: 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%

[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

EDC	Population	Sample n	Sample %	Weighted n	Weighted %	Change in %
The Illuminating Company	35.60%	1,311	36.42%	1,282	35.60%	-0.82%
Ohio Edison	49.70%	1,773	49.25%	1,789	49.70%	0.45%
Toledo Edison	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 4-2 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 seven measures, only the count for side-by-side refrigerators changed enough to be 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 4.2: Measure counts, percentages and differences by weight

Measure	Weighting	Lower C.I.	Total	Upper C.I.	Difference	Difference %
Top-Freezer Refrigerator	Adjusted	163	197	231	14	7.65%
	Not adjusted	161	183	204		
Bottom-Freezer Refrigerator	Adjusted	98	124	149	15	13.76%
	Not adjusted	92	109	125		
Side-by- Side Refrigerator	Adjusted	118	149	179	28	23.14%
	Not adjusted	103	121	138		
HVAC	Adjusted	198	234	270	2	0.86%
	Not adjusted	208	232	256		
LED	Adjusted	14302	16128	17954	2	0.01%
	Not adjusted	14586	16126	17667		
CFL	Adjusted	10517	12335	14154	-102	-0.82%
	Not adjusted	10995	12437	13878		
Halogen	Adjusted	8029	9740	11450	-283	-2.82%
	Not adjusted	8588	10023	11458		

Table 4-3 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 4.3: Comparison of telephone survey sample and the Companies' service territories building type frequency distributions

Building Type	Service Territory	Telephone Survey
Single-Family	83%	84%
Mobile Home	3%	3%
Apartment	13%	11%
Condominium	1%	0%
Other	0%	2%

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

4.1.2 Residential Impact Analysis Methods

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

4.1.2.1 Lighting

ADM calculated the energy savings and demand reductions produced by the Companies' customers installing energy efficient lighting during 2016. 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 a 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 2016 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

$$kWhSavingsLighting = \sum kWhSavings_t$$

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]

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];

[6] This value is 1,861,678 and was provided by the Companies.

[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.

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

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

ISR = In Service Rate[9].

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

Equation 4

$$kWSavingsLighting = \sum kWSavings_t$$

Equation 5

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.

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[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.

[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.

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

Equation 6

Where:

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

$\sum Survey_{Participants}$ = 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 2016 calendar year kWh savings from energy efficient lighting by the Companies' residential households is represented by $kWhSavingsLighting^{2016}$.

To calculate $kWhSavingsLighting^{2016}$, ADM examined the difference between the Companies' residential households' total calendar year 2016 lighting consumption (kWh) (the baseline year) and the Companies' residential households' total calendar year 2016 lighting consumption (kWh). This is illustrated in Equation 7 below:

$$kWhSavingsLighting^{2016} = ConsumptionLighting^{2015} - ConsumptionLighting^{2016}$$

Equation 7

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

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[13] This value was derived from a question that asked survey participants how many of each bulb type they purchased during 2016. 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.

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

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 8 below.

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

Equation 8

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 9

The bulb count at 12/31/2015 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 10 below:

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

Equation 10

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 11 below:

[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 1,861,678 and was provided by the Companies.

[18] http://www.eia.gov/todayinenergy/detail.cfm?id=415

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

$$\textbf{\textit{Equation 11}}$$

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 12 below.

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

$$\textbf{\textit{Equation 12}}$$

The bulb count at 12/31/2016 in the Companies' residential households begins with the bulb type *t* count at 12/31/2015 in the Companies' residential households calculated in Equation 10 and the subtracts the number of bulb type *t* that burnout during 2016 and then adds back the number of bulb type *t* that would be replaced in 2016. This is illustrated in Equation 13 below:

$$n_{Bulb_t}^{2016} = n_{Bulb_t}^{2015} - nBurn_{Bulb_t}^{2016} + nReplace_{Bulb_t}^{2016}$$

$$\textbf{\textit{Equation 13}}$$

The count of bulb type *t* that will burn out in 2016 is calculated by multiplying the bulb count at 12/31/2015 by the rate at which bulb type *t* burns out (Equation 14).

$$nBurn_{2016} = n_{Bulb_t}^{2015} * BurnRate_t$$

$$\textbf{\textit{Equation 14}}$$

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[19] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

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 15

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 2016 by the rate at which each bulb type t is likely to replace a burned-out bulb[22].

$$nReplace_{Bulb_t}^{2016} = nBurn_{2016} * ReplaceRate_{Bulb_t}$$

Equation 16

4.1.2.2 HVAC

ADM calculated energy savings and demand reductions produced by the Companies' residential customers purchasing energy efficient HVAC equipment during 2016. 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[24], the Energy Information Administration[25] (EIA), and the Air-Conditioning, Heating, & Refrigeration Institute (AHRI).

The total annual energy (kWh) savings for each HVAC type t was calculated using Equation 17 below.

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[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 2016 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 24-26 in the RDD telephone survey and question 16 in the April 2015 FE OH Market Potential survey.

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

Equation 17

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 2016

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

$$kWSavingsHVAC = \sum kWSavingsHVAC_t$$

Equation 18

The number of type t HVAC units (n_t) purchased in 2016, 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 2016 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 2016.

The above steps are summarized in Equation 19 below:

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

Equation 19

Where:

z	= Zip Codes in the Companies' service territories[23]
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 2016[25]
CF_z	= Climate Factor for Zip Code z
	= Region rate which effects usage and sales of units[26]
V	= Verification Rate
	$= \dfrac{Number\ of\ Sites\ Visited\ with\ Verfied\ Measure\ Installed}{Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed}$
	= 64.86% for Room AC; 90% for Central AC; 100% for Heat Pump

Where:

$Number\ of\ Sites\ Visited\ with\ Verfied\ Measure\ Installed$ [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 20:

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[23] Provided by the Companies.

[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

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

Equation 20

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

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

Equation 21

Where,

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

The tables below (Table 4-4, Table 4-5, Table 4-6) detail the percentage of residences per income bracket who purchased HVAC measures of type t $(R_i).$

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[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

Table 4.4: Percent of Residences with an AC Purchase in 2016[32]

% of Residences that purchased an AC in 2016 (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 2016	0.32	0.54	0.57	0.56	0.59
% Sold 2016	3.670%	4.140%	5.000%	4.459%	5.639%

Table 4.5: Percent of Residences with a Heat Pump Purchase in 2016[33]

% of Residences that purchased a HP in 2016 (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 2016	0.08	0.11	0.13	0.14	0.16
% Sold 2016	3.670%	4.140%	5.000%	4.459%	5.639%

Table 4.6: Percent of Residences with a Room AC Purchase in 2016[34]

% of Residences that purchased a Room AC in 2016 (From Energy Information Administration)					
	<20	**20-40**	**40-60**	**60-100**	**>100**
Total	7.60	6.80	4.30	4.40	2.60
Number < 2 Yrs.	1.20	0.90	0.60	0.50	0.50
Number in 2016	0.60	0.45	0.30	0.25	0.25
% Sold 2016	7.895%	6.618%	6.977%	5.682%	9.615%

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[32] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption   Residential Energy Consumption Survey (RECS)-b1 Air conditioning (HC7.5)

[33] Ibid.

[34] Ibid.

Climate Factors (CF_z) represent 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 Table 4-6 a-c below.

Table 4-6a: 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 4-6b: 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

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[35] Energy Information Administration - http://www.eia.gov/consumption/residential/data/2009/#sf?src=‹ Consumption   Residential Energy Consumption Survey (RECS)-b1 Air conditioning (HC7.6)

Table 4-6c: 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

Energy savings per CAC/RAC unit was calculated via Equation 22:

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

Equation 22

Where,

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

= 438.73

Cap = Capacity (kBTU)

= Size of the equipment installed

= 34.30[38]

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

= 10

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[36] Ibid.

[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/2016/December_2016.pdf

$SEER_{Installed}$ = SEER efficiency of installed unit
= 13

ADM calculated energy savings per Heat Pump unit with the following Equation 23[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 23

Where,

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

= 438.73

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

= 1549.01[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

4.1.2.3 Refrigerators

ADM calculated the energy savings and demand reductions produced by the Companies' residential customers installing energy efficient Refrigerators during

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

[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.

2016. ADM developed two analysis approaches to calculate the quantity of residences who purchased refrigerators in 2016.

- A top-down approach utilizing data market research data from U.S. Energy Information Administration and the Association of Home Appliance Manufactures. The quantities estimated from this method were used to calculate the quantity of refrigerators utilized in the ex post savings calculation.
- A bottom-up approach utilizing primary data collected from the Companies' service territories via a RDD telephone survey. This method was used to corroborate the quantity of refrigerators utilized in the ex post savings calculation via the top-down approach.

Top-Down Approach

ADM performed an analysis with data provided by FE OH, the United States Census Bureau[24], the Energy Information Administration[25] (EIA), and the Air-Conditioning, Heating, & Refrigeration Institute[26] (AHRI).

The total annual energy (kWh) savings for Refrigerator type *t* using Equation 24 below.

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

Equation 24

Where:

t = the types of Refrigerators

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

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

n_{Ref_t} = Number of type *t* Refrigeration units purchased in 2016

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

$$kWSavingsRef = \sum kWSavingsRef_t$$

Equation 25

The number of type *t* Refrigerator units (n_{Ref_t}) purchased in 2016, 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 2016 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 26 below:

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

Equation 26

Where:

z	= Zip Codes in the Companies' service territories[27]
i	= Income Bracket Levels[28]
	= 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} *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 2016[29]
V	= Verification Rate = 66.67%
	$= \dfrac{Number\ of\ Sites\ Visited\ with\ Verfied\ Measure\ Installed}{Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed}$

Where:

$Number\ of\ Sites\ Visited\ with\ Verfied\ Measure\ Installed$ [42]= 12

$Number\ of\ Sites\ Visited\ Claiming\ to\ have\ Measure\ Installed$ [43]= 18

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[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

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 20:

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

Equation 27

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]

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

In Equation 28 below, the percentage of Ohio residential households in zip code *z* with income bracket *i* is multiplied by number of the Companies residential households in zip code *z*.

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

Equation 28

Where,

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

Table 4-7 below detail the percentage of residential households per income bracket who purchased Refrigeration measures (R_i).

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

[45] Ibid.

[46] Provided by the Companies.

Table 4.7: Percent of Residences that purchased a Refrigerator in 2016

% of Residences that purchased a Refrigerator in 2016 (From Energy Information Administration)					
	<20	**20-40**	**40-60**	**60-100**	**>100**
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 2016	1.44	1.49	1.34	1.54	1.39
% Sold 2016	6.052%	5.425%	6.309%	6.540%	7.803%

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 4-8 below:

Table 4.8: Annual Savings for Refrigerators

Refrigerator Type	kWh
Bottom Freezer	119
Top Freezer	100
Side by Side	142

The demand savings was calculated using the following formula:

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

Equation 29

n_{Ref_t} was calculated according to Equation 26 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 4-9 below:

Table 4.9: Refrigerators Summer Coincidence Peak Savings

Refrigerator Type	kW
Bottom Freezer	.021
Top Freezer	.018
Side by Side	.025

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 2016. This was via Equation 30 below.

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

Equation 30

4.2 Commercial & Industrial Methodology

ADM'S evaluation of the 2016 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 95% confidence level. The sample was drawn randomly to create six 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 four 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 email and phone. The documentation requested is described in Section 3.2. 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 and Process Improvements

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 is utilized first and if additional calculations are necessary, EM&V best practices are used. Typical EM&V methods employed are summarized in Table 4-10.

Table 4.10 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
Process Improvements	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 from 2012 until the present 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 in-house data on standard wattages of lighting fixtures and ballasts to determine demand values for lighting fixtures. These data provide information on wattages for 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 31

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

1) Results from the on-site visit are used to calculate the average operating hours of the metered lights for every unique building type/usage area. 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 were calculated using DEER prototypical models and Typical Meteorological Year 3 (TMY3) weather data.

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. 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, including process improvements involve custom engineering algorithms from industry standard procedures.

4.2.5 Summer Coincident Peak Savings

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. For lighting analysis, this specific peak period is used in the energy savings calculations. For non-lighting analysis in which calculations from the Ohio TRM were used, the provided coincidence factor in the TRM was used.

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 32

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, then percent reduction in annual energy usage is multiplied by the average annual 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) is 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 33

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 95% confidence level to be applied to a 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).

5 Detailed Evaluation Findings

This chapter provides the findings of the impact evaluation component of this report.

5.1 Detailed Evaluation Findings: Residential

During the 2016 residential CAP evaluation ADM surveyed 3,600 residential customers across all zip codes in the Companies and performed 200 on-site visual verification visits.

5.1.1 Verification of Residential Lighting

Out of the 3,600 RDD sample respondents, 67% indicated that they purchased energy efficient light bulbs during 2016. 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 5-1.

Table 5.1:Residential Light Bulb Installations

Bulb Type	Count
Halogen	312,754
CFL	999,101
LED	2,182,726

Table 5-2 below details which rooms survey respondents installed the energy efficient bulbs they purchased in 2016.

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[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 2016 or obtained through a utility program were not counted.

Table 5.2:Residential Light Bulb Installations

Location	CFL	LED	Halogen
Basement	6.91%	6.25%	4.81%
Bathroom	12.20%	11.64%	8.65%
Bedroom	13.48%	12.83%	8.65%
Den	2.55%	2.78%	0.00%
Dining Room	5.87%	5.53%	4.81%
Entryway	3.97%	4.30%	2.88%
Garage	4.40%	5.39%	7.05%
Hallway	5.49%	5.17%	0.32%
Kitchen	12.68%	14.21%	20.51%
Living Room	16.56%	13.02%	12.82%
Office	2.37%	2.28%	1.28%
Other Room/Location	3.07%	4.16%	5.77%
Outdoor	5.06%	7.34%	20.19%
Stairway	2.46%	2.68%	0.32%
Store for later installation	2.93%	2.42%	1.92%

Table 5-3 below details which kind of bulbs respondents indicated they replaced with the energy efficient bulbs they purchased in 2016.

Table 5.3:Bulb Replacement Type

Pre-existing bulb	CFL	LED	Halogen
Incandescent	55.73%	55.72%	45.12%
Halogen	7.32%	7.92%	39.93%
CFL	32.48%	25.80%	11.58%
LED	4.48%	10.57%	3.37%

Table 5-4 below shows the kWh savings calculated during the impact evaluation of residential lighting. Table 5-5 shows the kW reduction.

Table 5.4:Residential Lighting annual energy kWh Savings

Measure	CEI	OE	TE	Total
Halogen	435,177	604,413	169,236	**1,208,826**
CFL	13,013,387	18,074,148	5,060,761	**36,148,296**
LED	27,927,040	38,787,555	10,860,516	**77,575,111**
Total	41,375,604	57,466,117	16,090,513	**114,932,233**

Table 5.5:Residential Lighting Summer Peak Coincidence kW Savings

Measure	CEI	OE	TE	Total
Halogen	54.12	75.17	21.05	**150.33**
CFL	1,661.31	2,307.37	646.06	**4,614.74**
LED	3,652.20	5,072.50	1,420.30	**10,145.01**
Total	5,367.63	7,455.04	2,087.41	**14,910.08**

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.

5.1.2 Verification of Residential Refrigerators

Out of the 3,600 RDD sample respondents ADM identified 319 respondents who completed all survey questions relevant to refrigerator purchase and installation. 9.08% of sample respondents reported purchasing and installing a refrigerator during the 2016 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 above concluded that 6.4% of residences purchased a refrigerator during the 2016 calendar year. The savings calculation was performed for a quantity of 112,735 refrigerators determined by the primary data collection effort. The breakout by refrigerator type is shown in Table 5-6.

Table 5.6: Refrigerator installations by unit type

Refrigerator Type	Energy Star Quantity Installed	Percent
Bottom-freezer	93	29.2%
Side-by-side	94	29.5%
Top-freezer	132	41.4%
Total	319	100.0%

Table 5-7shows the kWh savings calculated during the impact evaluation of refrigerators. Table 5-8 shows the kW reduction.

Table 5.7:Residential Refrigerators kWh Savings

Measure	CEI	OE	TE	Total
Bottom-freezer	1,358,284	1,896,256	560,865	3,815,406
Side-by-side	1,638,238	2,287,091	676,463	4,601,792
Top-freezer	1,620,074	2,261,732	668,963	4,550,768
Total	4,616,596	6,445,079	1,906,291	12,967,966

Table 5.8:Residential Refrigerators kW Reduction

Measure	CEI	OE	TE	Total
Bottom-freezer	239.70	334.63	98.98	673.31
Side-by-side	288.42	402.66	119.10	810.17
Top-freezer	291.61	407.11	120.41	819.14
Total	819.73	1,144.40	338.49	2,302.62

5.1.3 Verification of Residential HVAC

ADM calculated 2.1% of the Companies' residential households purchased a central Air Conditioner or Heat Pump during the 2016 calendar year and an additional 1.4% purchased a Room Air Conditioner. The savings calculation was performed for a quantity of 34,788 Air Conditioners, 2,839 Heat Pumps, and 26,288 Room Air Conditioners. Table 5-9 shows the kWh savings calculated during the impact evaluation of refrigerators. Table 5-10 shows the kW reduction.

Table 5.9:Residential HVAC Savings (kWh) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	4,294,249	5,995,061	1,773,187	12,062,497
Room Air Conditioners	87,504	122,161	36,132	245,797
Heat Pumps	580,332	810,183	239,632	1,630,147
Total	4,962,085	6,927,405	2,048,951	13,938,441

Table 5.10:Residential HVAC demand (kW) Summary

Measure	CEI	OE	TE	Total
Central Air Conditioners	4,893.91	6,832.22	2,020.80	13,746.93
Room Air Conditioners	112.30	156.78	46.37	315.46
Heat Pumps	187.32	261.51	77.35	526.18
Total	5,193.53	7,250.52	2,144.52	14,589.57

5.2 Detailed Evaluation Findings: Commercial & Industrial

5.2.1 Impact Evaluation Findings

This section provides the results of energy savings for the C&I CAP. Upon completion of the interview process, 186 business locations opted to participate in a site visit performed by an ADM field technician or engineer. Of these 186 sites, 120 sites provided all the required documentation to verify installation.

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, there were 210 low/medium energy user sample respondents who completed the survey but opted out after claiming measures were installed or planned to be installed. Of these, 39 businesses later claimed to have not installed any measures in 2016. Another 103 and businesses that claimed measures in the survey were not able to be reached for further information. Of the sites that could be visited, 14 provided enough information to estimate savings but not enough to provide substantial proof the measures were installed in 2016. ADM estimates the savings from these sample points would account for 189,554 kWh in annual energy savings within the sample.

At a confidence interval of 95%, a relative precision of 3.91% was calculated for the sample of 4,675 businesses. Table 5-11 shows the distribution of businesses in each stratum.

Table 5.11:CAP C&I Sample Precision

Strata	Population Count of businesses	Sample Count of businesses	Population	Sample Average Annual kWh usage
CE01 1	60,771	1,275	4,084,698,086	83,319,176
CE01 2	858	163	2,448,479,030	445,542,300
CE01 3	119	28	1,486,111,850	325,968,637
CE01 4	17	17	661,931,039	661,931,039
CE01 5	6	6	716,429,497	716,429,497
CE01 6	2	2	1,034,814,137	1,034,814,137
OE01 1	83,946	1,859	5,375,255,378	110,477,291
OE01 2	690	154	2,409,248,607	550,818,517
OE01 3	107	30	1,548,666,487	437,943,662
OE01 4	20	20	872,752,581	872,752,581
OE01 5	6	6	677,036,197	677,036,197
OE01 6	2	2	618,078,059	618,078,059
TE01 1	26,196	1,082	2,072,350,696	85,806,102
TE01 2	139	26	875,127,980	135,035,221
TE01 3	17	1	568,880,543	57,393,986
TE01 4	2	0	172,340,738	0
TE01 5	3	3	480,591,001	480,591,001
TE01 6	1	1	518,009,918	518,009,918
Total	**172,902**	**4,675**	**26,620,801,824**	**7,811,947,321**
Relative Precision				3.91%

[1] Average Annual kWh usage: Average daily usage per customer for the 5-2015 to 5-2016 timespan, multiplied by 365 days.

The breakdown of savings in the sample by operating company and measure are shown in Table 5-12. The overall sample annual energy savings are 7,392,943 kWh.

Table 5.12:CAP C&I Sample Savings (kWh) Summary

Measure	CEI	OE	TE
Lighting	4,056,767	2,268,460	442,117
HVAC	5,647	145,055	23,910
Appliances	1,083	1,904	542
Water Heating	0	0	0
Motors	0	0	0
Refrigeration	14246	2465	2,508
Others	261,448	166,791	0
Total	**4,339,191**	**2,584,675**	**469,077**

Sample savings are broken down by percentage operating company savings in Table 5-13. Significant portions of the savings in the sample came from lighting projects as well as process improvements within CEI and OE.

Table 5.13:CAP C&I Sample Savings (kWh) Measure Breakdown

Measure	CEI	OE	TE
Lighting	93.49%	87.77%	94.25%
HVAC	0.13%	5.61%	5.10%
Appliances	0.02%	0.07%	0.12%
Water heating	0.00%	0.00%	0.00%
Motors	0.00%	0.00%	0.00%
Refrigeration	0.33%	0.10%	0.53%
Other	6.03%	6.45%	0.00%

5.2.1.1 Verification of Commercial & Industrial Lighting

Out of the 120 sites with calculated energy savings in the sample, 100 included lighting measures. Lighting measures included retrofits, new construction, exterior, interior, and controls. Savings values ranged from 32 kWh per year to over 2,000,000 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 5-14.

Table 5.14: CAP C&I Sample Lighting Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	31	4,056,767	578.63
OE	41	2,268,460	240.85
TE	28	442,117	72.04
Total	**100**	**6,767,344**	**891.52**

Out of the 120 sites with calculated energy savings in the sample, 22 included HVAC measures. HVAC measures included small packaged AC units, unitary rooftop units, electric chillers, split units, and wall mounted units. Savings values ranged from 97 kWh per year to over 53,835 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 5-15.

Table 5.15: CAP C&I Sample HVAC Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	4	145,054	4.33
OE	10	23,910	51.13
TE	8	5,647	8.4
Total	**22**	**174,612**	**63.86**

5.2.1.2 Verification of Commercial & Industrial Refrigeration

Out of the 120 sites with calculated energy savings in the sample, 7 included refrigeration measures. Refrigeration measures consisted of various types of food storage refrigerators including solid door commercial refrigerators and glass door display refrigeration units. Savings values ranged from 388 kWh per year to 12,995 kWh per year. Annual energy savings and summer coincident peak savings by operating company are shown in Table 5-16.

Table 5.16: CAP C&I Sample Refrigeration Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	2	14,246	1.67
OE	3	2,465	0.29
TE	2	2,508	0.33
Total	**7**	**19,219**	**2.29**

5.2.1.3 Verification of Commercial & Industrial Water Heating

Out of the 120 sites with calculated energy savings in the sample, zero included electric water heating measures that resulted in energy savings. For this measure, savings were only applied to units that replaced old units (over 15 years old) with low energy factors.

5.2.1.4 Verification of Commercial & Industrial Motors

Out of the 120 sites with calculated energy savings in the sample, none included high efficiency motor installation. This measure consists of low HP motors as small as 1 HP.

5.2.1.5 Verification of Energy Star Appliances

Out of the 120 sites with calculated energy savings in the sample, 5 included the installation of Energy Star appliances. Energy Star appliances resulting in energy savings in the sample included washing machines, and ice machines. Energy Savings calculations were based on algorithms from the Ohio TRM. Annual energy savings and summer coincident peak savings by operating company are shown in Table 5.17.

Table 5.17: CAP C&I Sample Appliances Savings

Operating Company	Count (Sites with Savings)	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)
CEI	1	1,083	0
OE	3	2,022	0.15
TE	1	542	0
Total	**5**	**3,647**	**0.15**

5.2.1.6 Verification of Commercial & Industrial Process and other Measures

Out of the 120 sites with calculated energy savings in the sample, 2 included industrial process improvements or other custom energy efficiency equipment. These measures included a kinetic controller for a large existing motor generator, and controls for a blast motor that allows the unit to power down instead of idling during periods of no production.

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 5-19.

Table 5.18: 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	261,448	271.43
OE	1	166,673	0.01
TE	0	0	0
Total	**2**	**428,121**	**271.44**

5.2.1.7 Total Energy Savings

The total 2016 annual energy savings from the sampled sites are 7,392,943 kWh. The total peak demand reduction from the sampled sites are 1,229 kW. Most the energy savings came from lighting projects, representing 92% of the sample energy savings. Industrial process improvements, falling into the category of "other", represented 6% of the sample 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 0.00495. The highest reductions occurred for the stratum with the lowest average annual energy usage for each Company. Locations considered as high energy users were all considered in the sample, and even though not all had successful communications, extrapolation was not performed for these locations.

Extrapolation to the population of 172,902 business locations resulted in annual energy savings of 59,035,351 kWh. Summer coincident peak savings resulted in 8,801.22 kW. A summary of extrapolated energy savings, summer coincident peak savings, and lifetime energy savings is shown in Table 5-20.

Table 5.19: Energy Savings Extrapolation Summary

Strata	Annual Energy Savings (kWh)	Summer coincident peak savings (kW)	Lifetime Savings (kWh)
CE-GP	574,653	148.71	6,725,387
CE-GS	18,193,128	3,893.76	213,062,535
CE-GSU	1,447,025	214.64	16,189,772
CE-GT	2,334,029	272.60	24,915,760
CEI Total	**22,548,835**	**4,529.71**	**260,893,454**
OE-GP	2,460,834	377.00	29,493,569
OE-GS	21,585,439	2,041.29	253,417,530
OE-GSU	753,727	56.53	9,958,930
OE-GT	1,363,589	147.55	16,363,036
OE Total	**26,163,589**	**2,622.38**	**309,233,065**
TE-GP	1,996,020	327.30	22,770,358
TE-GS	8,254,281	1,310.27	97,537,696
TE-GSU	26,034	4.14	307,637
TE-GT	46,592	7.42	550,561
TE Total	**10,322,927**	**1,649.13**	**121,166,253**
Total	**59,035,351**	**8,801.22**	**691,292,772**

6 Conclusions

This chapter reports the conclusions resulting from the impact evaluation of the 2016 CAP. The savings by EDC, sector, and rate class, are presented in Table 6-1.

Table 6.1: kWh by Operating Company

	CEI	OE	TE	Total
Res Lighting	41,375,604	57,466,117	16,090,513	114,932,233
Res Refrigerator	4,616,596	6,445,079	1,906,291	12,967,966
Res HVAC	4,962,085	6,927,405	2,048,951	13,383,441
C&I	4,339,191	2,584,675	469,077	7,392,943
Total	**55,293,476**	**73,423,276**	**20,514,832**	**148,676,583**

Table 6.2: kW by Operating Company

	CEI	OE	TE	Total
Res Lighting	5,368.63	7,455.04	2,087.41	14,910.08
Res Refrigerator	819.73	1,144.40	338.49	2,302.62
Res HVAC	5,193.53	7,250.52	2,144.52	14,588.57
C&I	856.06	292.42	80.78	1,229.25
Total	**25,061.62**	**16,142.38**	**4,651.20**	**33,030.52**

The residential portion of the CAP resulted in finding 141,283,640 kWh of annual energy savings and 31,802 kW reduction across the three operating Companies.

The C&I portion of the CAP resulted in finding 59,035,351 kWh of annual energy savings across the three operating companies. The summer coincident peak savings resulted in 8,801kW reduction across the three operating Companies.

7 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 31: Calculation of Lifetime Savings.

Lifetime Savings = Measure Life x Annualized Savings

The annual energy savings from CAP 2016 for both residential and C&I is shown in Table 7-1. The lifetime energy savings from CAP 2016 for both residential and C&I is shown in Table 7-2.

Table 7.1: Annual kWh & KW Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants[48]	Annual kWh Savings	Annual kW Savings
CAP C&I	CEI	GP	100	574,653	148.71
	CEI	GS	61,191	18,193,128	3,893.76
	CEI	GSU	469	1,447,025	214.64
	CEI	GT	13	2,334,029	272.60
	CEI Total		**61,773**	**22,548,835**	**4,529.71**
	OE	GP	1,078	2,460,834	377.00
	OE	GS	83,466	21,585,439	2,041.29
	OE	GSU	84	753,727	56.53
	OE	GT	143	1,363,589	147.55
	OE Total		**84,771**	**26,163,589**	**2,622.38**
	TE	GP	484	1,996,020	327.30
	TE	GS	25,832	8,254,281	1,310.27
	TE	GSU	6	26,034	4.14
	TE	GT	36	46,592	7.42
	TE Total		**26,358**	**10,322,927**	**1,649.13**
C&I Total	**Total**		**172,902**	**59,035,351**	**8,801.22**
CAP Residential	CEI	RS	31,690	4,962,085	5,193.53
HVAC	OE	RS	44,242	6,927,405	7,250.52
	TE	RS	13,086	2,048,951	2,144.52
	Total		**89,018**	**13,938,441**	**14,588.57**
CAP Residential	CEI	RS	40,134	4,616,596	819.73
Refrigerator	OE	RS	56,029	6,445,079	1,144.40
	TE	RS	16,572	1,906,291	338.49
	Total		**112,735**	**12,967,966**	**2,302.62**
CAP Residential	CEI	RS	1,244,071	41,375,604	5,367.63
Lighting	OE	RS	1,736,806	57,466,117	7,455.04
	TE	RS	513,703	16,090,513	2,087.41
	Total		**3,494,580**	**114,932,234**	**14,910.08**
CAP Residential & C/I	**Total**		**3,869,235**	**200,873,992**	**40,602.27**

[48] C&I premises associated with program level savings.

Table 7.2: Lifetime kWh and kW Savings by Measure and Operating Company

Program	Company Code	Rate Code	Number of Participants	Lifetime kWh Savings
CAP C&I	CEI	GP	100	6,725,387
	CEI	GS	61,191	213,062,535
	CEI	GSU	469	16,189,772
	CEI	GT	13	24,915,760
	CEI Total		**61,773**	**260,893,454**
	OE	GP	1,078	29,493,569
	OE	GS	83,466	253,417,530
	OE	GSU	84	9,958,930
	OE	GT	143	16,363,036
	OE Total		**84,771**	**309,233,065**
	TE	GP	484	22,770,358
	TE	GS	25,832	97,537,696
	TE	GSU	6	307,637
	TE	GT	36	550,561
	TE Total		**26,358**	**121,166,253**
C&I Total	**Total**		**172,902**	**691,292,772**
CAP Residential	CEI	RS	31,690	78,651,886
HVAC	OE	RS	44,242	109,803,335
	TE	RS	13,086	32,477,043
	Total		**89,018**	**220,932,265**
CAP Residential	CEI	RS	40,134	78,482,132
Refrigerator	OE	RS	56,029	109,566,347
	TE	RS	16,572	32,406,948
	Total		**112,735**	**220,455,427**
CAP Residential	CEI	RS	1,244,071	499,453,693
Lighting	OE	RS	1,736,806	639,685,685
	TE	RS	513,703	194,231,992
	Total		**3,494,580**	**1,333,371,370**
Customer Action Program (CAP) Residential & C/I	**Total**		**3,869,235**	**2,487,130,996**

8 Appendix B: Survey Instruments

1. Residential Survey Instruments

2016 FirstEnergy's Ohio utilities' Customer Action Program

Random Digit Dial Telephone Survey

[START]

Q1. Hello, my name is _____, and I'm calling from ADM Associates, an independent research firm, conducting a survey regarding household lighting and appliance purchases in Ohio on behalf of the FirstEnergy Ohio Electric Utility Companies. 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 2016. 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 for your home?

Yes, I purchase lights   01 [GO TO Q2]

Someone else does it   02 [ASK TO SPEAK WITH PERSON, REPEAT INTRODUCTION THEN GO TO Q2]

No   03 [TRY TO RESCHEDULE AND THEN TERMINATE]

Q1REF.   01 Person available [CONTINUES]

02 Person not available [SETUP CALL-BACK]

03Refused to transfer to correct person. [TERMINATE]

Electric Utility and Location Information

Q2. First of all, to ensure your eligibility to participate, we need to determine that you are a customer of the FirstEnergy Electric Utility Companies. What is the name of your electric utility? [DO NOT READ, LET PARTICIPANT ANSWER]

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

Q3. [SKIP IF Q2 != 04] 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]

Q4. For our research purposes we need your approximate locale. Would you mind providing me with your zip code?

      _____ [RECORD 5 DIGIT ZIP]

    Don't know   98

    Refused   99

Awareness of Bulb Types

Q5. I'd like to ask you a few questions about your awareness of different types of light bulbs. Before this call today, had you ever heard of compact fluorescent light bulbs, or CFLs?

    Yes   01

    No   02 [READ E1]

    Don't know   98 [READ E1]

    Refused   99 [READ E1]

> E1. Here is a quick description: 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.

Q6. Before this call today, had you ever heard of light emitting diode light bulbs, or LEDs?

    Yes   01

    No   02 [READ E2]

    Don't know   98 [READ E2]

    Refused   99 [READ E2]

> E2. Here is a quick description: LED light bulbs are a newer light bulb technology that fit in regular light bulb sockets, but have various different appearances. LED bulbs are typically a lot heavier than incandescent bulbs. They use less energy and last much longer than typical incandescent light bulbs.

Q7. Before this call today, had you ever heard of increased efficiency incandescent bulbs, or halogens?

Yes	01
No	02 [READ E3]
Don't know	98 [READ E3]
Refused	99 [READ E3]

E3. Here is a quick description: 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.

Q8. Conventional light bulbs are known as incandescent light bulbs. Do you feel you could correctly identify 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	01
No	02
Don't know	98
Refused	99

Q9. Would you say you are very familiar, somewhat familiar, not too familiar, or not at all familiar with these currently available household light bulb technologies?

Very familiar	01
Somewhat familiar	02
Not too familiar	03
Not at all familiar	04
Don't know	98
Refused	99

Recent Light Bulb Purchases

Q10. I'd like to ask you a few questions about your prior light bulb purchases. In 2016, have you purchased any light bulbs?

Yes	01
No	02
Don't know	98
Refused	99

Q10A. Do you plan on purchasing any light bulbs this year? If so what type do you plan on purchasing?

Halogen	01

CFL	02
LED	03
Incandescent	04
Other	98
No plans to purchase	99

[IF Q10 != 1 SKIP TO Q28]

Q11. During 2016, how many light bulbs would you say you have purchased? [READ ANSWERS] [If respondent unsure, say "Your best estimate is OK."]

1-5	01
6-10	02
11-15	03
16-20	04
21-25	05
25-30	06
More than 30	Record exact respondent estimate
None	997
Don't know	998
Refused	999

Q12. Have you purchased any compact fluorescent light bulbs, also known as CFLs, during 2016?

Yes	01
No	02
Don't know	98
Refused	99

Q13. Have you purchased any light emitting diode bulbs, also known as LEDs, during 2016?

Yes	01
No	02
Don't know	98
Refused	99

Q14. Have you purchased any increased efficiency incandescent bulbs, also known as halogens, during 2016?

Yes	01
No	02
Don't know	98
Refused	99

Q15. [SKIP IF Q12=02, 98, or 99 AND Q13=02, 98, or 99 AND Q14=02, 98, or 99] SKIP IF Q11 = 997 OR Q11 = 998 OR Q11 = 999] I'd like to ask you about the number of different bulb types you have purchased in 2016. You mentioned earlier that you have purchased [ANSWER FROM Q11] light bulbs in 2016. How many of those bulbs were CFLs, LEDs, 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 Q11] TOTAL, PROMPT TO GIVE [ANSWER TO Q11] TOTAL]

_____ Record number of CFLs

_____ Record number of LEDs

_____ Record number of halogens

Don't know	98
Refused	99

Q16. [SKIP IF Q12=02, 98, or 99 AND Q13=02, 98 or 99, AND Q14=02, 98, or 99] Were any of the CFLs, LEDs or halogen bulbs you purchased in 2016 installed in a business or commercial building?

Yes	01 [READ Q16A]
No	02
Don't know	98
Refused	99

Q16A. [ASK IF Q16 = 01] Approximately how many of the [Number of CFLs + LEDs + Halogen from Q15] CFLs, LEDs or Halogens you said you purchased were installed in a business or commercial building?

_____ CFLs [RECORD NUMBER, 0 – 97] (ask if Q15CFLS>0)

_____ LEDs [RECORD NUMBER, 0 – 97] (ask if Q15LEDS>0)

_____ Halogens [RECORD NUMBER, 0 – 97] (ask if Q15HalogenS>0)

| Don't recall | 98 |
| Refused | 99 |

Prior Purchases

Q17. Prior to 2016, had you ever purchased CFL light bulbs?

Yes	01
No	02
Don't know	98
Refused	99

Q18. Prior to 2016, had you ever purchased LED light bulbs?

Yes	01
No	02
Don't know	98
Refused	99

Q19. Prior to 2016, had you ever purchased halogen light bulbs?

Yes   01

No   02

Don't know   98

Refused   99

In-Service Rate

Q20. [SKIP IF Q10 <> 01 OR (Q12=02,98,99 AND Q13=02,98,99 AND Q14=02,98,99)] Again, you said you purchased [Number of CFLs + LEDs + Halogen from Q15] in 2016. 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 Q21]

Don't recall   98

Refused   99

Q20A. [SKIP IF Q10 <> 01 OR (Q12=02,98,99 AND Q13=02,98,99 AND Q14=02,98,99)] 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 Q21]

Don't recall   98

Refused   99

Q20B. 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.]

    Don't recall   98

    Refused   99

Purchase

#4 Reasoning

Q21. [ASK IF Q12 = 01] You mentioned you have purchased CFL light bulbs in 2016. 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 usage02

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 recall   98

Refused   99

Q22. [ASK IF Q13 = 01] You mentioned you have purchased LED light bulbs in 2016. 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 usage02

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 recall	98
Refused	99

Q23. [ASK IF Q14 = 01] You mentioned you have purchased halogen light bulbs in 2016. 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) _____	
Don't recall	98
Refused	99

Bulb Types Replaced

Q24. [ASK IF Q12 = 01 AND Q15 != 998 AND Q15 !=999 AND Q11 != 998 AND Q11 !=999 AND Q11 != 997 ELSE SKIP TO Q25] Again, you said you purchased [Number of CFLs from Q15] CFLs in 2016. In which of the following locations do you install the CFLs?

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

Q24A. Thinking about the new CFLs in your home, how many were installed?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q24B. How many of the new CFLs replaced standard incandescent bulbs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q24C. How many of the new CFLs replaced halogens?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q24D. How many of the new CFLs replaced old CFLs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q24E. How many of the new CFLs replaced LEDs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q25. [ASK IF Q13 = 01 AND Q15 != 998 AND Q15 !=999 AND Q11 != 998 AND Q11 !=999 AND Q11 != 997 ELSE SKIP TO Q26] Again, you said you purchased [Number of LEDs from Q15] LEDs in 2016. In which of the following locations do you install the LEDs?

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	

Q25A. Thinking about the new LEDs in your home, how many were installed?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q25B. How many of the new LEDs replaced standard incandescent bulbs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q25C. How many of the new LEDs replaced halogens?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q25D. How many of the new LEDs replaced CFLs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q25E. How many of the new LEDs replaced old LEDs?

    _____   [RECORD NUMBER, 0 – 97]

Don't recall   98

Refused   99

Q26. [ASK IF Q14 = 01 AND Q15 != 998 AND Q15 !=999 AND Q11 != 998 AND Q11 !=999 AND Q11 != 997 ELSE SKIP TO Q27] Again, you said you purchased [Number of Halogens from Q15] Halogens in 2016. In which of the following locations do you install the Halogens?

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

Q26A. Thinking about the new Halogens in your home, how many were installed?

_____ [RECORD NUMBER, 0 – 97]

Don't recall 98

Refused 99

Q26B. How many of the new Halogens replaced standard incandescent bulbs?

_____ [RECORD NUMBER, 0 – 97]

Don't recall 98

Refused 99

Q26C. How many of the new Halogens replaced old Halogens?

_____ [RECORD NUMBER, 0 – 97]

Don't recall 98

Refused 99

Q26D. How many of the new Halogens replaced CFLs?

_____ [RECORD NUMBER, 0 – 97]

Don't recall 98

Refused 99

Q26E. How many of the new Halogens replaced LEDs?

_____ [RECORD NUMBER, 0 – 97]

Don't recall 98

Refused 99

Q27. [SKIP IF (Q12=02,98,99 AND Q13=02,98,99 AND Q14=02,98,99)] Of the light bulbs you purchased in 2016, 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
Big Lots	06
Hartville Hardware	07
None of these retailers	08
Don't know	98
Refused	99

Appliance Basics

Q28. Since January 1, 2016, have you purchased or had installed ANY of the following items in your home/residence: Refrigerator, Room Air Conditioner, High-Efficiency Central Air Conditioner, Heat Pump or Mini-Split Heat Pump?

Q.	Appliance	Yes	No	DK	REF
28.A	Refrigerator				
28.B	Room Air Conditioner				
28.C	Central AC				
28.D	Heat Pump				
28.E	Mini-Split Heat Pump				

Refrigerator

[ASK Q29-Q33 IF Q25.A = Y]

Q29. 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

Q29.A. Was the refrigerator you purchased Energy Star certified?

Yes	01
No	02
Don't know	98
Refused	99

Q30. Do you remember the month in 2016 when you purchased the refrigerator?

_____   [ENTER MONTH]

Don't recall   98

Refused   99

Q31. Was this refrigerator purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit   01   [SKIP TO Q34]

To replace a broken unit   02

Not a replacement   03   [SKIP TO Q34]

Don't recall   98   [SKIP TO Q34]

Refused   99   [SKIP TO Q34]

Q32. [ASK IF Q29 = 02] Why didn't you repair the broken unit?

Too costly   01

Too much time involved   02

Wanted to change style   03

Don't recall   98

Refused   99

Q33. 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

Room Air Conditioner

[ASK Q34-Q40 IF Q28B = Y]

Q34. 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

Q35. What is the capacity of the unit in BTUs?

_____ [RECORD ANSWER]

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

Q36. Was the room AC you purchased Energy Star certified?

Yes	01
No	02
Don't know	98
Refused	99

Q37. Which month in 2016 was the air conditioner installed?

_____ [RECORD ANSWER]

Don't know   98

Refused   99

Q38. Was this air conditioner purchased: [READ ANSWERS AND RECORD RESPONSE]

To replace a functioning unit	01 [SKIP TO Q41]
To replace a broken unit	02
Not a replacement	03 [SKIP TO Q41]
Don't recall	98 [SKIP TO Q41]
Refused	99 [SKIP TO Q41]

Q39. [ASK IF Q38 = 02] Why didn't you repair the broken unit?

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

Q40. 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 Q41 THROUGH Q50 IF Q28C = Y]

Q41. Which month in 2016 did you purchase the central air conditioning system?

_____   [ENTER MONTH PRODUCT WAS PURCHASED]

Don't recall   98

Refused   99

Q42. 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

Q42.A. Was the central air conditioning system you purchased Energy Star certified?

Yes   01

No   02

Don't know   98

Refused   99

Q43. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

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

Refused   99

Q44. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

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

Refused   99

Q45. Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don't know   98

Refused   99

[ASK Q46 IF Q45 = 98 OR Q45=99]

Q46. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don't know   98

Refused   99

Q47. 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

Q48. Was this air conditioner purchased: [READ ANSWERS AND RECORD

RESPONSE]

To replace a functioning unit   01   [GO TO Q51]

To replace a broken unit   02

Not a replacement   03   [GO TO Q51]

Don't recall   98   [GO TO Q51]

Refused   99   [GO TO Q51]

Q49. [ASK IF Q49 = 02] Why didn't you repair the broken unit?

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

Q50. 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 Q51 - Q58 IF Q28.D = Y]

Q51. Which month in 2016 did you purchase the heat pump?

_____   [ENTER MONTH PRODUCT WAS PURCHASED]

Don't recall   98

Refused   99

Q52. 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

Q52.A. Was the Heat Pump you purchased Energy Star certified?

Yes   01

No   02

Don't know   98

Refused   99

Q53. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

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

Refused   99

Q54. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

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

Refused   99

Q55. Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don't know   98

Refused   99

[ASK Q56 IF Q55 = 98 OR Q55=99]

Q56. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don't know   98

Refused   99

Q57. 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

Q58. 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 recall   98

Refused   99

Mini-Split Heat Pump

[ASK Q59 – Q66 IF Q28.E = Y]

Q59. Which month in 2016 did you purchase the mini-split heat pump?

_____   [ENTER MONTH PRODUCT WAS PURCHASED]

Don't recall   98

Refused   99

Q60. 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

Q60A... Was the Heat Pump you purchased Energy Star certified?

Yes   01

No   02

Don't know   98

Refused   99

Q61. What is the capacity of the unit in BTU/hr.?

_____ [RECORD CAPACITY]

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

Refused   99

Q62. What is the SEER rating of the NEW unit?

_____ [RECORD SEER]

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

Refused   99

Q63Do you recall the SEER rating of the OLD unit?

_____ [RECORD SEER]

Don't know   98

Refused   99

[ASK Q64 IF Q63 = 98 OR Q65=99]

Q64. Do you recall the age of the OLD unit?

_____ [RECORD AGE]

Don't know   98

Refused   99

Q65. 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

Q66. 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 recall	98
Refused	99

Household Characteristics / Demographics

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

Q67. 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

Q68. 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

Q69. 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

Q70. Approximately how many square feet is your home?

      _____ Record Number [100-99999]

      Don't know   98

      Refused   99

Q71. 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

Q72. 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

Q73. 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

Q74. 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 9888

Refused   99 9999

Q75. Which FUEL is used MOST for heating this house, apartment, or mobile home?

Gas: from underground pipes serving the neighborhood	01
Gas: bottled, tank, or LP	02
Electricity	03
Fuel oil, kerosene, etc.	04
Coal or coke	05
Wood	06
Solar energy	07
Other fuel	08
No fuel used	09
Don't know	98
Refused	99

Q76. 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

Q77. What is your approximate total household income? [PROVIDE BINS]

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:

Q78. 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 FirstEnergy's verification that you are a customer, 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:

Q79. 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 Q79 = Yes, SHOW Q80]

Q80. 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.

2. Commercial & Industrial Survey Instruments

FirstEnergy Ohio CAP C&I Participant Survey 2016

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 for 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]?

[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 GOTO 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 2016: 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

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 with regard to 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 and documentation in regards to the equipment you have installed. Your business will be paid on energy savings industry experts will calculate 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

[IF Q9 = "No, have not installed" SKIP TO Q315]

17) What is/are the measures that you have installed in 2016? [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

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

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

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!= YES 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 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 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)

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

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 != YES 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 incandescents that you removed?

[NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

[SHOW IF Q42 = "Incandescent"]

48) How many incandescents 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 q [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

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

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

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 != YES 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 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 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

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

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 != YES 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 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 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

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

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 != YES 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 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 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

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

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 != YES 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 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 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

125) How many high intensity discharge lamps, also known as HID, did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

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 != YES 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 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 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

141) 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

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

142) How many [Q18 Other: Specify] did you install? [NUMERIC OPEN END: 1-5000; 9998=DON'T KNOW; 9999=REFUSED]

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 != YES 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 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 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

Other (Specify)

Didn't install any HVAC equipment

Don't know

Refused

[SHOW IF Q160 = "SPLIT Air Conditioning System"]

Split Air Conditioning System

161) 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 Q161= "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 != "Yes" 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

169) 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 Q169= "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 != "Yes" 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

177) 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 Q177= "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 != "Yes" 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

185) 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 Q185= "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 != "Yes" 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]
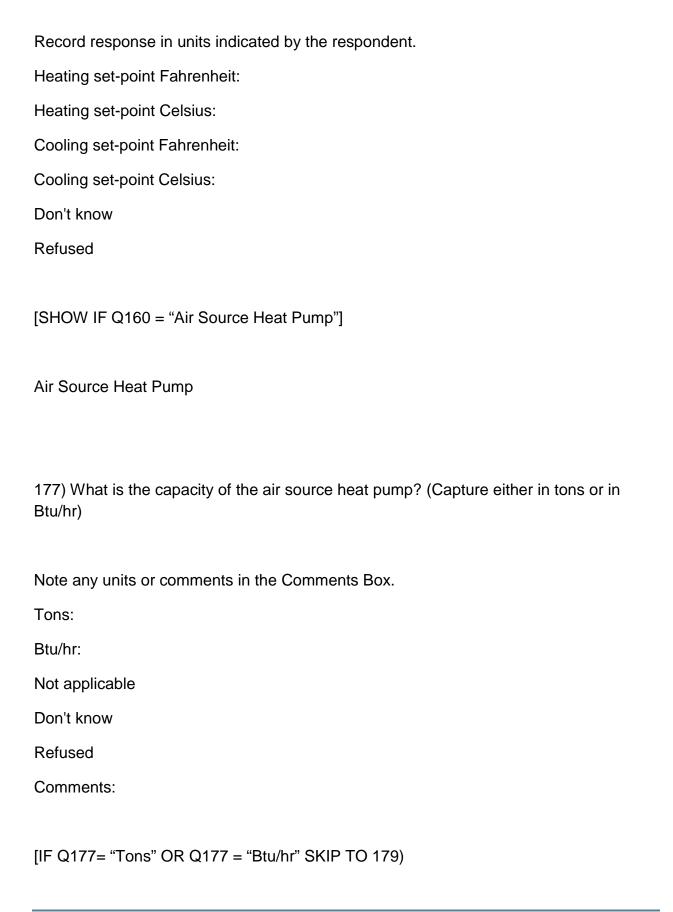

Electric

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

192) 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 Q192= "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?
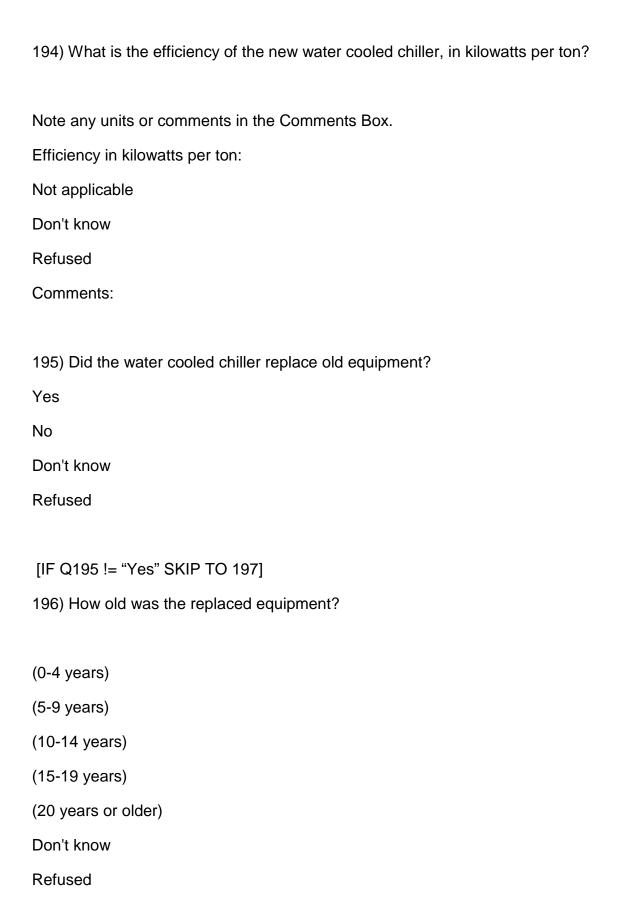
Yes

No

Don't know

Refused

 [IF Q195 != "Yes" 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

199) 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 Q199= "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 != "Yes" 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

207) 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 Q207= "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 != "Yes" SKIP TO 211]

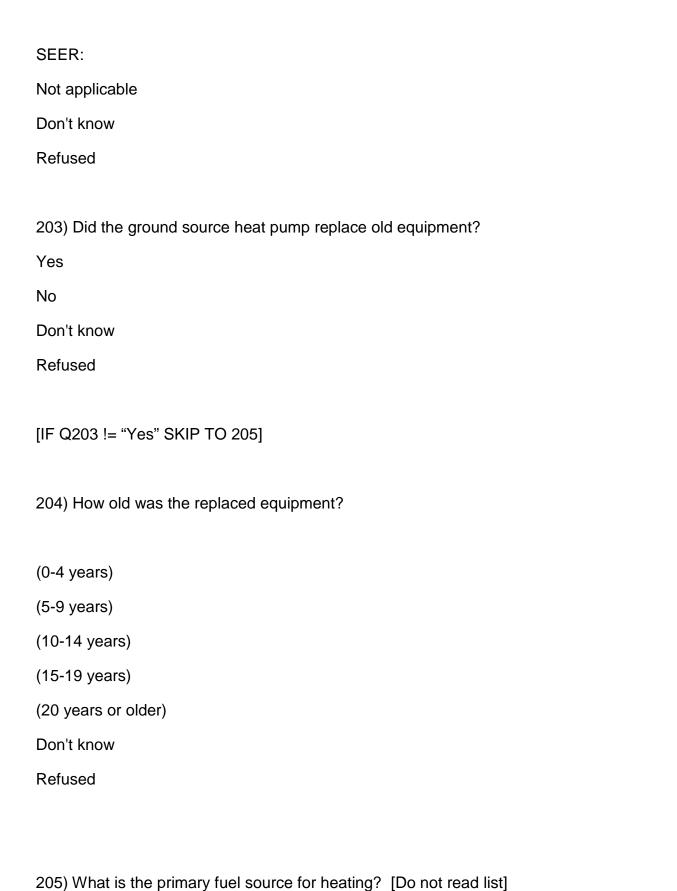210) How old was the replaced equipment?

(0-4 years)

(5-9 years)

(10-14 years)

(15-19 years)

(20 years or older)

Don't know

Refused

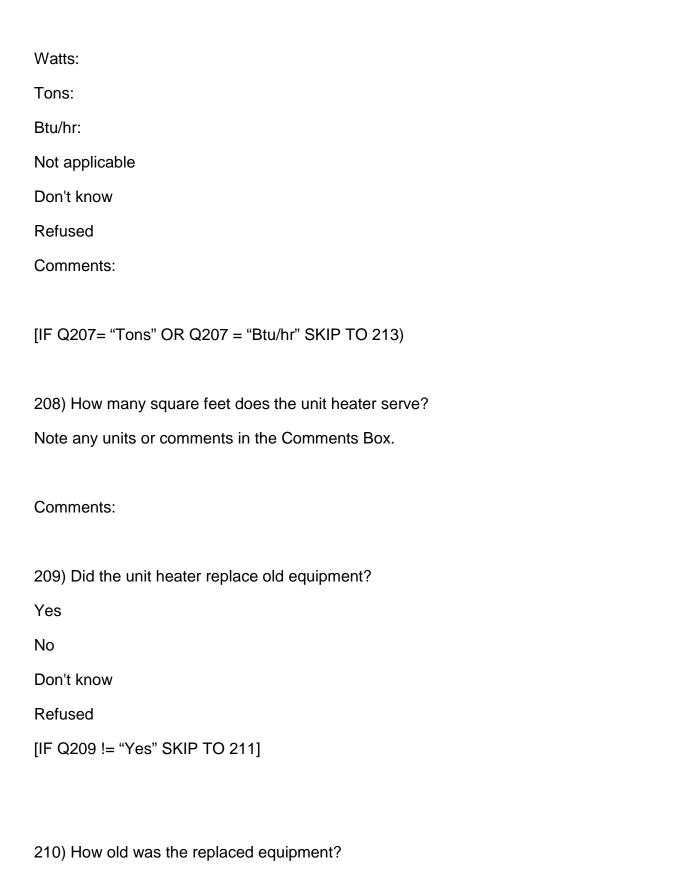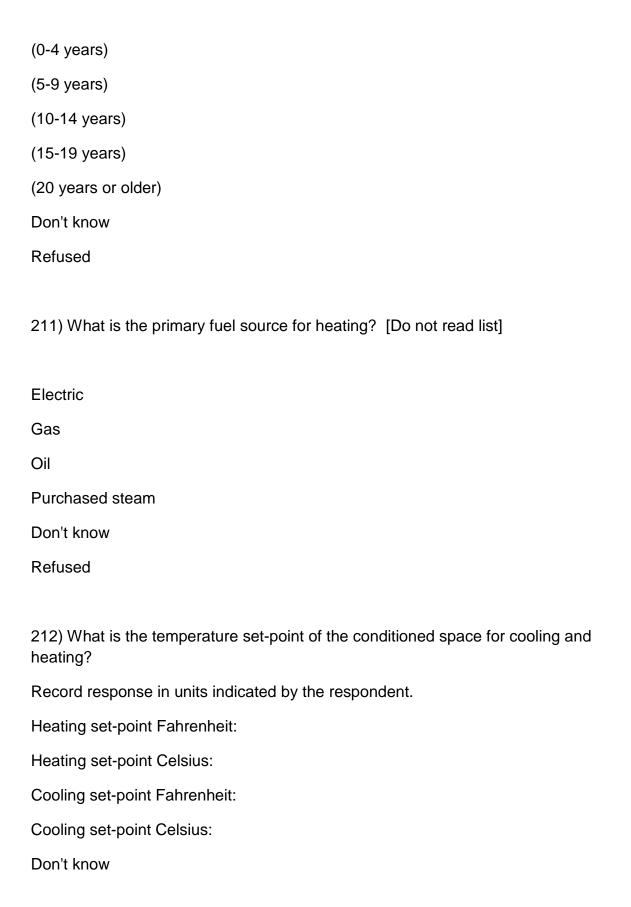211) What is the primary fuel source for heating? [Do not read list]

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

213) 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 Q213= "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 != "Yes" 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 Refrigerator

Energy Star Freezer

Walk-in Cooler or Freezer

Display Case

Energy Star Refrigerated Beverage Vending Machine

Automatic Commercial Ice Maker

Other (Specify):

Don't know

Refused

[SHOW IF Q222 = "Energy Star Refrigerator"]

ENERGY STAR Refrigerator

223) How many ENERGY STAR refrigerator(s) did you install?

224) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

225) Did the ENERGY STAR refrigerator(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q225 != "Yes" SKIP TO Energy Star Freezer]

226) Would you please describe the old equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Energy Star Freezer"]

ENERGY STAR Freezer

227) How many ENERGY STAR freezer(s) did you install?

228) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

229) Did the ENERGY STAR freezer(s) replace old equipment?

Yes

No

Don't know

Refused

[IF Q229 != "Yes" 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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

231) How many walk-in cooler(s) or freezer(s) did you install?

232) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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 != "Yes" 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Display Case"]

Display Case

235) How many display case(s) did you install?

236) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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 != "Yes" SKIP TO ENERGY STAR 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Energy Star Refrigerated Beverage Vending Machine"]

ENERGY STAR Refrigerated Beverage Vending Machine

239) How many ENERGY STAR refrigerated beverage vending machine(s) did you install?

240) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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 != "Yes" 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Automatic Commercial Ice Maker"]

Automatic Commercial Ice Maker

243) How many automatic commercial ice maker(s) did you install?

244) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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 != "Yes" 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR or other energy efficient option

Standard efficiency

Additional information:

Don't know

Refused

[SHOW IF Q222 = "Other (Specify)"]

Other Refrigeration Measure

247) How many [Q222 Other: Specify] did you install?

248) Would you please describe the new equipment, using as much detail as possible such as make, model, (e.g. ENERGY STAR vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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 != "Yes" 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 vs. standard efficiency), set-point, etc.?

Make:

Model:

Set-point Fahrenheit:

Set-point Celsius:

ENERGY STAR 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

252) How many storage water heater(s) did you install?

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

262) How many low flow faucet aerator(s) did you install?

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

265) How many hot water pre-rinse spray valves(s) did you install?

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

269) How many low-flow shower heads did you install?

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

273) How many tank-less water heater(s) did you install?

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 Q78 != "Yes" 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

282) How many boiler(s) did you install?

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 != "Yes" 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

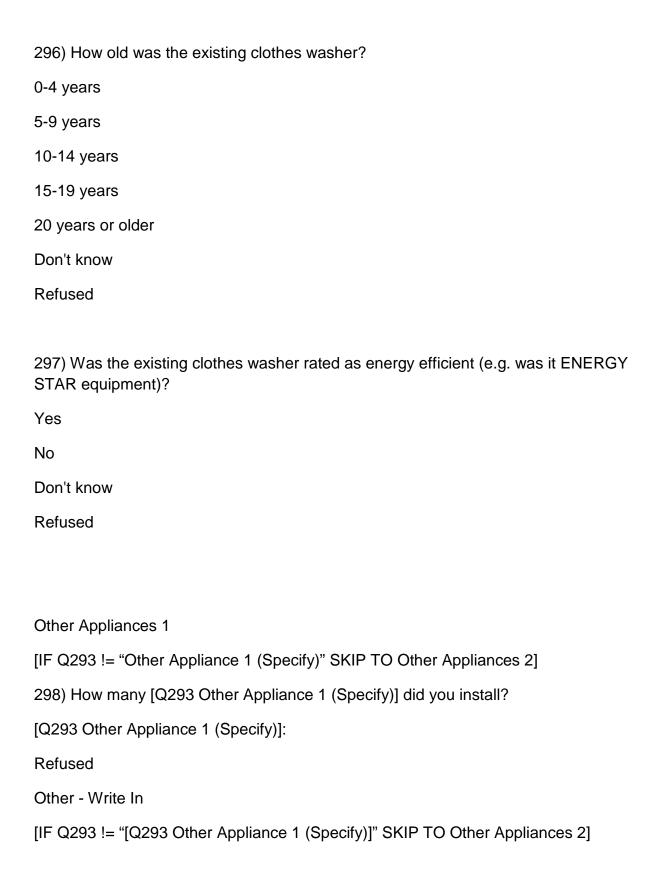Comments:

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 != "Clothes Washer" SKIP TO Other Appliances 1]

294) How many clothes washers did you install?

Clothes Washer:

Refused

Other - Write In

295) Did the new clothes washer replace an old clothes washer?

Yes

No

Don't know

Refused

[IF Q295 != "Yes" 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 equipment)?

Yes

No

Don't know

Refused

Other Appliances 1

[IF Q293 != "Other Appliance 1 (Specify)" SKIP TO Other Appliances 2]

298) How many [Q293 Other Appliance 1 (Specify)] did you install?

[Q293 Other Appliance 1 (Specify)]:

Refused

Other - Write In

[IF Q293 != "[Q293 Other Appliance 1 (Specify)]" SKIP TO Other Appliances 2]

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 != ["Yes"] 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 equipment)?

Yes

No

Don't know

Refused

Other Appliances 2

[IF Q293 != "Other Appliance 2 (Specify)" SKIP TO Motor Verification]

302) How many [Q293 Other Appliance 2 (Specify)] did you install?

[Q293 Other Appliance 2 (Specify)]:

Refused

Other - Write In

[IF Q306 != [Q293 Other Appliance 2 (Specify)] SKIP TO Motor Verification]

303) Did the new [Q293 Other Appliance 2 (Specify)] replace an old [Q293 Other Appliance 2 (Specify)] ?

Yes

No

Don't know

Refused

[IF Q307 != ["Yes"] 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 equipment)?

Yes

No

Don't know

Refused

Motor Verification

[IF No response to Q17 = "Clothes washers or refrigerated vending machines" SKIP TO Motor Verification]

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 2]

Install or replace a motor

Do something else (Specify):

Don't know

Refused

[IF Q306 != "Install or replace a motor" SKIP TO 315]

307) How many motors did you install?

[NUMERIC OPEN END, 1 TO 500; 998=DON'T KNOW, 999=REFUSED]

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]

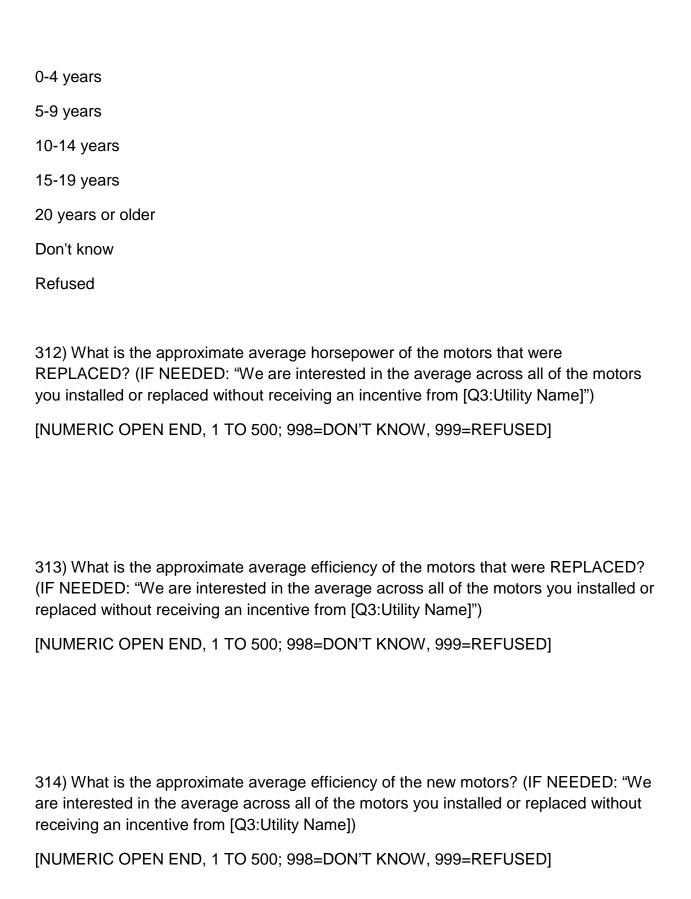[NUMERIC OPEN END, 1 TO 500; 998=DON'T KNOW, 999=REFUSED]

Yes

No

Don't know

Refused

[IF Q169 != "Yes" SKIP TO 171]

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]

Planned Measure Installation

315) Does your company plan to install any of the following energy measures in 2016: 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, plan to install

No, I'm not planning on installing any equipment

Refused

[IF Q315 != "Yes, plan to install" SKIP TO Contact information]

316) What are the measures that you plan to install in 2016? [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 - Write In (Required):

Doesn't plan to install any measures

Don't know

Refused

317) When are you planning to install the equipment?

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

Contact Information

Installed Measures Contact Information

[IF Q315 != "Yes, plan to install" SKIP TO Installed Measures Contact Information]

Thank you for participating in this survey. You should expect to receive the payment for your time in 6-8 weeks.

 You will receive an email from ADM Associates that includes a list of the information and documents 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.

[SKIP TO Q318]

Plan to Install Measures Contact Information

Thank you for participating in this survey.

You will receive an email or phone call from ADM Associates that follows up on the planned equipment upgrades.

At the time of the follow up contact, ADM will review the compensation structure available to you for providing information and documents related to the installation of equipment upgrades.

318) Lastly, would you please provide us with an email address and phone number to follow-up?

Email address:

Telephone number:

319) If you have any questions regarding this market study you can reach us at 775-345-3031.

Thank You!

Thank you for your time today and have a wonderful day.

9 Appendix C: Ancillary Documentation

Email Subject Line: ADM Associates Market Research Survey Follow-up

Dear Participant

Thank you for participating in the market research study being conducted by ADM Associates on behalf of FirstEnergy Ohio. We would like to follow up with you at this time to gather the necessary information required for our engineers to perform an annual energy savings calculation which will be used to determine compensation for your participation in this study.

Equipment installations that are eligible for this market research study include lighting, refrigeration units, Heating, Ventilation, and Air Conditioning (HVAC) systems, boilers, hot water heaters, electric motors, and clothes washers. Installations had to have occurred in the 2016 calendar year, and must be completed before an engineering analysis can be performed.

In order to perform verified energy savings calculations, the following documents are required by ADM Associates:

1. All invoices for installations
2. Fill out project information form
3. The attached form with signature, verifying measure installation.
4. A filled-out W-9 form (attached with this email)

Please submit these documents to ADM Associates via email to curtis.robbins@admenergy.com. If information cannot be obtained then we will gather the necessary information during the site visit. Once the information is received we will call to set up a site visit. You will receive payment based on annual energy savings calculations performed by ADM Associates Inc. The check will be mailed from ADM Associates corporate office in approximately 6-8 weeks after the analysis is complete.

On behalf of the entire team working on this market research study, we would like to once again thank you for your participation. If you have any questions in regard to this process, please feel free to reach out to me.