Report of the Ohio Independent Evaluator

2009 and 2010 Ohio Efficiency Programs

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FINAL REPORT

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Table of Contents

Executive Summary

Introduction

In April 2010, the Public Utilities Commission of Ohio (PUCO) chose the Evergreen Economics team[1] to serve as the Independent Evaluator to assist in the review and monitoring of the Ohio electric utilities' energy efficiency program evaluation. The programs reviewed include those of American Electric Power Ohio (AEP Ohio), Dayton Power and Light Company (DP&L), Duke Energy Ohio (Duke Energy),[2] and FirstEnergy.[3]

As part of this process, the PUCO identified two primary objectives for the Independent Evaluator:

1. Develop independent savings estimates of program savings, cost effectiveness, and non-energy benefits for utility Demand Side Management (DSM) programs, transmission and distribution (T&D) measures, and projects undertaken by mercantile customers; and

2. Provide assurance that claimed measures are properly installed and utilized through due diligence audits and inspections for a sample of projects.

Additional objectives include the following:

3. Improve the design and implementation of existing and future DSM programs through limited and focused process evaluations and targeted research efforts;

4. Support the PUCO in developing a best-of-class evaluation infrastructure for utility efficiency programs; and

5. Develop and initiate long-term evaluation plans to understand issues such as persistence of savings, measure retention and market effects relating to market transformation.

This report is the first verification report produced by the Independent Evaluator and covers energy efficiency program years 2009 and 2010. This has been accomplished through a review of the Portfolio Status Update and related evaluation research reports filed by the utilities for both years. Beginning in 2010, these activities also involved verifying the reported savings by reviewing an extract of each utility's participant database and replicating the savings amounts included in the Portfolio Status Update report. In an effort to standardize reporting across utilities, the Independent Evaluator also developed templates for both the evaluation plan and evaluation reports submitted by the utilities

[1] The Independent Evaluator team consists of staff from the following companies: Evergreen Economics, Itron, Inc., Michaels Engineering, and Phil Willems/PWP. The original contract for the Independent Evaluator was awarded to ECONorthwest. Senior staff managing the Independent Evaluator contract left to form Evergreen Economics in January 2011. The Independent Evaluator contract was transferred from ECONorthwest to Evergreen Economics in March 2012.

[2] Although there are Duke Energy companies in other states, in this report, unless otherwise noted "Duke Energy" refers specifically to Duke Energy Ohio.

[3] FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (Ohio Edison), and The Toledo Edison Company (Toledo Edison). In this report, referred to collectively as FirstEnergy or Companies, where noted.

each year. In addition to the verification activities, the Independent Evaluator fielded both a participant and a non-participant baseline survey to collect information on utility customers throughout the state.

Key Findings

There are several overarching findings from the Independent Evaluator review of the 2009 and 2010 Portfolio Status Update reports and the related evaluation research. While we have several recommendations on how the evaluation process can be improved, it is important to discuss these within the overall context of the work that has been completed by the Ohio electric utilities with their efficiency programs. Specifically:

- **Evaluation reports are generally of high quality.** The evaluation reports we reviewed were generally of high quality and conformed to the standard practices of the evaluation industry.
- **Participants are generally satisfied with their program experience.** Those evaluations that had a process evaluation component found that participants were generally very satisfied with their program experience. This finding was confirmed by the participant phone survey fielded by the Independent Evaluator team.

Our review of the impact estimates and evaluation reports has resulted in identifying issues that will affect energy savings reported by the Ohio utilities. These issues are summarized below and addressed again in the discussions of the individual utility evaluation reports.

CFL installation rate. For programs that promote the adoption of CFLs, an installation adjustment factor should be applied when calculating first-year savings to account for the fact that not all of the CFLs will be installed (and remain installed) in the first year. The appropriateness of assuming an installation rate of less than 100 percent is generally accepted within the evaluation community and has become standard practice in most jurisdictions. The 2010 draft Ohio energy efficiency technical reference manual (TRM)[4] recommends an installation adjustment factor (or In Service Rate (ISR)) of 86 percent (for point-of-sale) and 81 percent (for direct install). Both DP&L and FirstEnergy adjusted their CFL impact estimates using an installation adjustment factor. Conversely, both AEP Ohio and Duke Energy assumed that 100 percent of the distributed CFLs were installed in the first year. While their findings and approaches were not always used in calculating program savings as reported in the Portfolio Status Updates, evaluation studies conducted by the Ohio electric utilities are consistent with this recommendation, with both Duke Energy[5] and DP&L[6] estimating installation rates well below 100 percent based on participant surveys.

[4]Vermont Energy Investment Corporation. *Draft State of Ohio Energy Efficiency Technical Reference Manual.* (Prepared for Public Utilities Commission of Ohio. August 6, 2010), 13, 18. amppartners.org/pdf/TRM_Appendix_E_2011.pdf

[5]TecMarket Works. *An Evaluation of the Smart $aver Program in Ohio.* (Prepared for Duke Energy Ohio, September 29, 2008), 17.

[6]The Cadmus Group. *2010 Evaluation Measurement and Verification Report.* (Prepared for the Dayton Power & Light Company. March 15, 2011), 14.

Audit and home energy comparison programs. Several of the utilities have energy audit programs that provide free energy audits to customers to identify energy saving measures and encourage them to participate in one of the utility rebate programs. Similarly, some of the utility programs offer home energy comparison reports that compare a customer's energy consumption with that of his or her peers and provide suggestions on how to reduce energy use. Since the rebate program will capture the savings associated with the installed measures promoted by these kinds of programs, utilities often will not attempt to claim savings from an audit-style program to avoid double counting savings. If savings are to be claimed from the audit program, they should be limited to those resulting from behavior changes directly attributable to the audit program.

Estimating energy savings attributable to an audit program is challenging at best, and requires a combination of multiple analysis methods, such as a billing regression model possibly combined with a participant survey confirming that customers took specific actions as a direct result of the audit. As discussed above, these savings estimates also need to remove savings that are attributable to participating in other rebate and upstream programs. While earlier drafts of the Ohio TRM include an audit savings value, the current version has eliminated such savings entirely. .

Mercantile customers – retrofit versus replacement baseline. The draft Ohio TRM specifies how savings are to be calculated for large non-residential custom projects and allows for either a retrofit or replacement baseline depending on the type of project. All projects that do not meet the requirements of a retrofit project must be defined as a replacement project and must follow the commercial and industrial (C&I) Equipment Replacement – Custom Measure Analysis Protocol described in the TRM.

In practice, there is sometimes disagreement among evaluators on what the appropriate baseline should be – either replacement or retrofit – and the effect on savings can be significant depending on which baseline is assumed. This issue arose with one mercantile project for AEP Ohio, where the AEP Ohio evaluator assumed the existing equipment baseline, while the Independent Evaluator believes that a new equipment baseline is appropriate. In this instance, the different baseline assumptions resulted in a 74 percent decrease is savings estimated by the Independent Evaluator relative to AEP Ohio's estimate for this one very large project. Similar differences in baseline assumptions may also occur with mercantile customers in other utilities.

Impact information sources. Our expectation at the start of this project was that the electric utility impact estimates would be a combination of *ex ante* values from the original program filings with the PUCO, savings values from the Ohio TRM, and *ex post* impact values derived from the utility evaluation research in the prior year. Instead, we found a host of additional impact sources, as illustrated in Table 3. This multitude of sources has made the savings claim review for each utility more challenging, as there are many more sources that needed to be vetted than originally anticipated.

Net impacts. For 2009, 2010 and 2011, the Ohio electric utilities are required to report only gross impacts. At some point in the future, however, the PUCO anticipates requiring the utilities to start reporting net impacts in the Portfolio Status Update reports. In preparation of this, some of the utilities have already begun to research net impact effects through the use of self-report phone survey question batteries exploring free ridership and spillover.

In 2010, the Independent Evaluator team began developing a free ridership battery of survey questions that will eventually be refined to become the standard approach for estimating net impacts for the Ohio electric utilities. A subset of the free ridership questions was tested as part of the participant phone survey fielded in 2010 and discussed in more detail later in this report. While

additional questions are needed to develop a more rigorous estimate of free ridership, these preliminary results suggest that there is some amount of free ridership for these programs. To facilitate increased and standardized research in this area, the Independent Evaluator team will finish developing the standard free ridership question battery and scoring algorithm in 2012.

Recommendations

Based on the findings summarized above, the Independent Evaluator makes the following over-arching recommendations. Additional utility-specific recommendations are discussed in the next chapter.

Apply a CFL installation adjustment factor. It is standard practice to assume an installation rate of less than 100 percent for CFLs to reflect the fact that not all CFLs will get installed. The draft Ohio TRM recommends using an installation rate of 81 to 86 percent depending the delivery mechanism (i.e., point-of-sale versus direct install). We recommend that all CFL savings be adjusted using an installation rate adjustment factor derived from either current evaluation research using primary data collection or taken from the Draft Ohio TRM.

Develop a complete list of sources for *ex ante* savings values. Origins of *ex ante* savings values are not clear in the 2009 and 2010 Portfolio Status Update and evaluation reports. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference.

Require a rigorous impact method to estimate impacts from audit and energy comparison programs. As discussed below in the review of the utility evaluation research, the impact method used to estimate savings for audit and home energy comparison results have generally resulted in unrealistically high estimates of savings. We recommend that more rigorous impact analysis methods be used if savings are going to be claimed for these types programs. Acceptable methods include a billing analysis possibly combined with a survey that clearly identifies which activities undertaken by the participant were a direct result of the audit or comparison report. A quasi-experimental design using a billing analysis of participants and a randomly selected sample of non-participants as a control group is also an acceptable approach. Savings resulting from installing rebated measures through other utility programs (including any upstream lighting programs for CFLs) must be subtracted from the savings calculations. If the impact evaluation does not include these components, we recommend that no savings be claimed for audit and home energy comparison report programs.

Adopt the process recommendations presented in the utility evaluation reports. Although the process findings from the utility evaluations are not discussed in this report, the Independent Evaluator did review the related analysis methods, conclusions, and recommendations. As we were also able to review the evaluation plans and the data collection activities as they occurred, we believe that the process evaluation conclusions are sound and, therefore, the recommendations presented in the utility evaluation reports should be adopted.

Introduction

In April 2010, the PUCO chose the Evergreen Economics team to serve as the Independent Evaluator to assist in the review and monitoring of the Ohio electric utilities' energy efficiency program evaluation. The Independent Evaluator team consists of staff from the following companies:

- Evergreen Economics[7]
- Itron, Inc.
- Michaels Engineering
- Phil Willems / PWP

The programs reviewed include those of the following Ohio utilities:

- American Electric Power Ohio (AEP Ohio)
- Dayton Power and Light Company (DP&L)
- Duke Energy Ohio (Duke Energy)[8]
- FirstEnergy[9]

As part of this process, the PUCO identified two primary objectives for the Independent Evaluator:

1. Develop independent savings estimates of program savings, cost effectiveness, and non-energy benefits for utility DSM programs, T&D measures, and projects undertaken by mercantile customers; and

2. Provide assurance that claimed measures are properly installed and utilized through due diligence audits and inspections for a sample of projects.

Additional objectives include the following:

3. Improve the design and implementation of existing and future DSM programs through limited and focused process evaluations and targeted research efforts;

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[9] FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (Ohio Edison), and The Toledo Edison Company (Toledo Edison). In this report, referred to collectively as FirstEnergy or Companies, where noted.

This report is the first verification report produced by the Independent Evaluator and covers energy efficiency program years 2009 and 2010. In addition to the verification activities, the Independent Evaluator fielded both a participant and a non-participant baseline survey to collect information on utility customers throughout the state. These results are included in the second half of this report.

Ohio Energy Efficiency Regulatory Background

Ohio Power Company, Columbus Southern Power Company, Duke Energy of Ohio, the Dayton Power and Light Company, Toledo Edison, Ohio Edison, and Cleveland Electric Illuminating Company (electric utilities)[10] are public utilities as defined in Section 4905.02, Revised Code.[11] As such, these companies are subject to the jurisdiction and general supervision of the PUCO in accordance with Sections 4905.04, 4905.05, and 4905.06, Revised Code. Key elements of these codes relating to the reporting and evaluation of the energy efficiency programs implemented by the Ohio electric utilities are summarized below.

On April 23, 2008, the Ohio legislature adopted Amended Substitute Senate Bill No. 221 (SB 221)[12], which became effective on July 31, 2008. Among the provisions of SB 221 was the requirement in Section 4928.66, Revised Code[13], for the PUCO to take certain actions related to the implementation of energy efficiency and peak-demand reduction programs by the electric utilities. Section 4928.66(B), Revised Code, requires the PUCO to verify the annual levels of energy efficiency and peak-demand reduction achieved by each electric utility. Further, Section 4928.66(A)(2)(c), Revised Code, specifically provides that mercantile customers of the electric utilities may be exempted from payment of a mechanism that recovers the cost of energy efficiency and peak-demand reduction programs, if the PUCO determines that such an exemption reasonably encourages those customers to commit their demand response or other customer-sited capabilities for integration into the electric utility's demand response, energy efficiency, or peak-demand reduction programs.

In order to assess the benefit of these activities, the PUCO must be in a position to be able to determine, with reasonable certainty, the energy savings and demand reductions attributable to the energy efficiency programs undertaken by the electric utilities and mercantile customers. Specifically, the PUCO needs the capability to: (a) verify each electric utility's achievement of energy and peak-demand reduction requirements, pursuant to Section 4928.66(B), Revised Code; (b) consider exempting mercantile customers from cost recovery mechanisms pursuant to Section 4928.66(A)(2)(c), Revised Code; and (c) review cost recovery mechanisms for energy efficiency and/or peak-demand reduction programs implemented by the electric utilities.

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[10] American Electric Power operates in Ohio as the Ohio Power Company in two rate zones, Columbus Southern Power and Ohio Power. These Companies are jointly managed under the name "AEP Ohio." FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company, Ohio Edison Company, and The Toledo Edison Company.

[11] Ohio General Assembly. Ohio Administrative Revised Code. (Ohio, Amended by 129th General Assembly Effective Date June 11, 2012). Chapter 4905.02. http://codes.ohio.gov/orc/4905.02

[12] Am. Sub. SB221 (Schuler, May 1, 2008). Amended Substitute Senate Bill Number 221. 127th General Assembly. 2007-2008. http://www.legislature.state.oh.us/bills.cfm?ID=127_SB_221

[13] Ohio General Assembly. Ohio Administrative Revised Code. (Ohio, Amended by 129th General Assembly Effective Date September 10, 2012). Chapter 4928.66. http://codes.ohio.gov/orc/4928.66

Through these rules, the electric utilities have been assigned responsibility for certain evaluation, measurement, and verification activities associated with their energy efficiency programs. In addition to the electric utility evaluation activities, the Independent Evaluator is responsible for monitoring, verifying, and reporting to the PUCO the electric savings and peak-demand reductions resulting from utility program and mercantile customer activities; determining program and portfolio cost-effectiveness; conducting program process evaluations; and performing due-diligence reviews of electric utility and mercantile customer programs and activities, including project and documentation inspections.

Other important information is contained in the "Green Rules" promulgated by the PUCO in Chapter 4901:1-39, Ohio Administrative Code (O.A.C.).[14] Key elements of these rules include the following:

- Within sixty days of the effective date of the rules, each electric utility shall file an initial benchmark report with the PUCO that identifies the energy and demand baselines for kilowatt-hour (kWh) sales and kilowatt (kW) demand for the reporting year, including a description of the method of calculating the baseline, with supporting data; and the applicable statutory benchmarks for energy savings and electric utility peak-demand reduction. (Rule 4901:1-39-05(A), O.A.C.)

- Prior to proposing its comprehensive energy efficiency and peak-demand reduction program portfolio plan, an electric utility shall conduct an assessment of potential energy savings and peak-demand reduction from adoption of energy efficiency and demand- response measures within its certified territory, which will be included in the electric utility's program portfolio plan. The assessment shall include an analysis of technical, economic, and achievable potential, and shall describe in detail program design criteria and promising measures not selected. (Rule 4901:1-39-03, O.A.C.)

- Each electric utility shall design and propose a comprehensive energy efficiency and peak-demand reduction program portfolio, including a range of programs that encourage innovation and market access for cost-effective energy efficiency and peak-demand reduction for all customer classes, which will achieve the statutory benchmarks for peak- demand reduction, and meet or exceed the statutory benchmarks for energy efficiency. An electric utility's first program portfolio plan filed pursuant to this rule shall be filed with supporting testimony prior to January 1, 2010. Each electric utility shall file an updated program portfolio plan by April 15, 2013, and by the fifteenth of April every third year thereafter, unless otherwise directed by the PUCO. (Rule 4901:1-39- 04(A), O.A.C.)

- An electric utility's program portfolio plan shall include, but not be limited to a "description of the plan for preparing reports that document the electric utility's evaluation, measurement, and verification of the energy savings and/or peak-demand reduction resulting from each program and the process evaluations conducted by the electric utility." (Rule 4901:1-39-04(C)(5)(l), O.A.C.)

[14] Ohio General Assembly. Ohio Administrative Code. (Ohio, Effective Date December 10, 2009). Chapter 4901: 1-39. http://codes.ohio.gov/oac/4901%3A1-39

- By May fifteenth of each year, each electric utility shall file a portfolio status report addressing the performance of all approved energy efficiency and peak-demand reduction programs in its program portfolio plan over the previous calendar year. Such report must include, at minimum, a compliance demonstration and a program performance assessment. (Rule 4901:1-39-05(C), O.A.C.)

- The portfolio status report must include an evaluation, measurement, and verification report that documents the energy savings and peak-demand reduction values and the cost-effectiveness of each energy efficiency and demand-side management program reported in the electric utility's portfolio status report. (Rule 4901:1-39-05(C)(2)(b), O.A.C.)

Independent Evaluator Research Activities

The primary focus of the Independent Evaluator activities to date has been verifying the Ohio utilities 2009 and 2010 reported savings. This has been accomplished through a review of the Portfolio Status Update and related evaluation research reports filed by the utilities for both years. Beginning in 2010, these activities also involved verifying the reported savings by reviewing an extract of each utility's participant database and replicating the savings amounts included in the Portfolio Status Update report. In an effort to standardize reporting across utilities, the Independent Evaluator also developed templates for both the evaluation plan and evaluation reports submitted by the utilities each year. More specifically, to produce this report, the Independent Evaluator has been engaged in the following activities in verifying the 2009 and 2010 reported savings from the Ohio utilities:

- Meeting with the Ohio utilities and their evaluation teams to discuss our evaluation activities and our expected role in the evaluation process;
- Developing templates for the utility evaluation plans and evaluation reports;
- Reviewing, commenting, and approving utility evaluation plans;
- Reviewing, commenting, and approving phone survey instruments provided by the utility evaluation teams;
- Conducting ride-alongs for site visits that were done as part of the utility evaluations;
- Reviewing the 2009 and 2010 Portfolio Status Update Reports and associated evaluation reports;
- Replicating the savings claimed in the 2010 Portfolio Status Update report using an extract of customer participation data provided by each utility;
- Fielding a phone survey of a sample of 2010 program participants;
- Fielding a statewide phone survey to collect baseline information; and
- Combining the baseline phone survey data garnered by AEP Ohio's evaluation team with that we gathered to report statewide findings.

To avoid duplication of evaluation research activities to the extent possible, the Independent Evaluator attempted to rely as much as possible on the evaluation activities being conducted by the utilities and their evaluation contractors. For example, by reviewing and approving customer phone surveys already being planned by the Ohio utilities, the Independent Evaluator was able to reduce the need to conduct separate customer surveys. This helps avoid possible customer dissatisfaction by being subject to multiple surveys addressing the same topics. By reviewing the evaluation plans, analysis methods, and data collections instruments prior to their implementation, we have more confidence in the results, as we are able to provide input as the methods are being developed. This is

in contrast to a less collaborative process by which we would only see results after they were completed and consequently only be able to recommend changes retroactively.

The remainder of this report is organized as follows. General findings that apply to all utilities are discussed in the following section. This is followed by a more detailed discussion of the individual utility savings claims. Following the utility discussions are two chapters presenting the results of the participant phone survey and the non-participant baseline surveys fielded by the Independent Evaluator in 2010.

A separate volume of this report contains appendices that provide tabulations of all survey results for both the participant and baseline phone surveys, as well as the templates developed by Independent Evaluator for the utility evaluation plans and evaluation reports.

Overarching Evaluation Findings

There are several overarching findings from the Independent Evaluator review of the 2009 and 2010 Portfolio Status Update reports and the related evaluation research. The general issues are discussed in this chapter, with additional discussion included in the sections relating to each of the individual utility assessments.

While we have several recommendations on how the evaluation process can be improved, it is important to discuss these within the overall context of the work that has been completed by the Ohio electric utilities with their efficiency programs. Specifically:

- **Evaluation reports are generally of high quality.** The evaluation reports we reviewed were generally of high quality and conformed to the standard practices of the evaluation industry. Comments we have on these evaluation reports are included in the utility findings sections in the next chapter.
- **Participants are generally satisfied with their program experience.** Those evaluations that had a process evaluation component found that participants were generally very satisfied with their program experience. This finding was confirmed by the participant phone survey fielded by the Independent Evaluator team.

Our review of the impact estimates and evaluation reports has resulted in identifying issues that will affect savings that can be counted toward Ohio utility requirements. These issues are summarized below and addressed again in the discussions of the individual utility evaluation reports.

1. CFL installation rate. For programs that promote the adoption of CFLs, an installation adjustment factor should be applied when calculating first-year savings to account for the fact that not all CFLs will be installed (and remain installed) in the first year. For program year 2010, both DP&L and FirstEnergy adjusted their CFL impact estimates using an installation rate factor. Conversely, both AEP Ohio and Duke Energy assumed that 100 percent of the distributed CFLs were installed in the first year. A comparison of 2010 rates along with claimed residential CFL savings is shown in Table 1. Note that, with the exception of FirstEnergy, all the utilities derive a significant amount of their 2010 portfolio savings from CFLs.

Table 1: Comparison of 2010 CFL Savings Calculations and Installation Rates

Measure	TRM	Duke Energy	DP&L	AEP Ohio	FirstEnergy
CFL Installation Rate Assumed	Direct Install: 81% Time of Sale: 86%	100%	86%	100%	89%
2010 Total Savings from Residential CFLs (kWh)		191,583,519	113,788,872	138,316,640	659,167
Share of 2010 Total Portfolio Savings		62%	63%	38%	1%

The appropriateness of assuming an installation rate of less than 100 percent is generally accepted within the evaluation community and has become standard practice in most jurisdictions. The installation adjustment is also supported by numerous evaluation research studies. The draft Ohio TRM[15] recommends an installation adjustment factor (or In Service Rate (ISR)) of 86 percent (for point-of-sale) and 81 percent (for direct install). While their findings and approaches were not always used in calculating program savings as reported in the Portfolio Status Updates, evaluation studies conducted by the Ohio electric utilities are consistent with this recommendation, with Duke Energy[16] and DP&L[17] both estimating installation rates well below 100 percent based on participant surveys.

We recommend that all CFL impacts be adjusted to account for the installation rate. The installation adjustment can be based on either the factor recommended in the draft Ohio TRM, or using the results of evaluation research (e.g., participant phone survey and/or on-site verification) for that particular utility.

2. Audit and home energy comparison programs. Several of the utilities have energy audit programs that provide free energy audits to customers to identify energy saving measures and encourage them to participate in one of the utility rebate programs. Similarly, some of the utility programs offer home energy comparison reports that compare a customer's energy consumption with that of his or her peers and provide suggestions on how to reduce energy use. Since the rebate program will capture the savings associated with the installed measures promoted by these kinds of programs, utilities often will not attempt to claim savings from an audit-style program to avoid double counting savings. If savings are to be claimed from the audit program, they should be limited to those resulting from behavior changes directly attributable to the audit program.

Estimating the energy savings attributable to an audit program is challenging at best, and requires a combination of multiple analysis methods, such as a billing regression model combined with a participant survey confirming that customers took specific actions as a direct result of the audit – and also need to remove savings that are attributable to participating in other rebate and upstream programs. In fact, while an earlier draft (from July 2010) of the Ohio TRM included a savings value for the audit as a measure (240 kWh), the current version eliminates savings for audits entirely. Separate impact studies of the residential energy audit program in California (Home Energy Efficiency Survey or HEES) have also estimated savings ranging from 31 to 276 kWh annually.[18]

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[15]Vermont Energy Investment Corporation. *Draft State of Ohio Energy Efficiency Technical Reference Manual.* (Prepared for Public Utilities Commission of Ohio. August 6, 2010): 13, 18.

[16]TecMarket Works. *An Evaluation of the Smart $aver Program in Ohio.* (Prepared for Duke Energy Ohio, September 29, 2008), 17.

[17]The Cadmus Group. *2010 Evaluation Measurement and Verification Report.* (Prepared for the Dayton Power & Light Company. March 15, 2011), 14.

[18] An impact evaluation of PG&E's Home Energy Efficiency Survey conducted by ECONorthwest resulted in an overall savings estimate of 241 kWh using a fixed price billing regression model (*Addendum to the Process Evaluation of the 2006-08 HEES Program: Estimating Energy Savings Associated with the HEES Program, Net of Savings Attributed to other PG&E Programs.* ECONorthwest, February 14, 2011) When a separate regression was run to isolate those impacts that were directly influenced by the audit recommendations, the impact fell to 31 kWh annually. A separate impact evaluation of the SCE HEES program by John Peterson of Athens Research,

As shown in the Table 2 comparison, in 2010 both FirstEnergy and Duke Energy used billing regression models to estimate impacts that were significantly higher than the now out-of-date TRM-recommended savings value and the values found in other studies such as the California HEES evaluation. (Note that the Duke Energy audit program, Home Energy House Call, also included the distribution of some measures such as CFLs and faucet aerators.) Based on our review of the Ohio evaluation reports, the evaluations did not adequately address the issue of participating in other programs or clearly link the reduction in savings to specific actions as a result of the audit. Given the high savings estimates, it also appears that the models were picking up other outside factors influencing lower energy use and attributing it to the audit program.

Table 2: Comparison of 2010 Home Energy Audit Calculations

Measure	TRM	Duke Energy	DP&L	AEP Ohio	FirstEnergy
Home Energy Audit	240 kWh*	856 kWh	N/A	N/A	300 kWh (2010 evaluation average = 416 kWh, with range of 233 to 1,032)
Total 2010 Savings from Home Energy Audits (kWh)		8,948,236	N/A	N/A	13,072,500
Share of 2010 Portfolio Savings		3%	N/A	N/A	13%

***Note:** Value from July 2010 draft Ohio TRM.

3. Mercantile customers – retrofit versus replacement baseline. The draft Ohio TRM specifies how savings are to be calculated for large non-residential custom projects and allows for either a retrofit or replacement baseline depending on the type of project:

impact estimates ranged from 188 to 276 kWh annually (*Memo on HEES 2004-05 Savings Analysis*. John Peterson, Athens Research, September 7, 2007).

> Energy efficiency retrofit projects involve the replacement of existing equipment prior to the end of its useful life in order to achieve energy savings. Therefore, the existing equipment may be used to establish the project baseline. The analysis must account for the remaining life of the existing equipment, and if the analysis period extends beyond the remaining life of the existing equipment, the analysis shall account for increases in efficiency that would have occurred through autonomous efficiency improvements or equipment replacement that would have occurred at the end of the existing equipment life in the absence of early retirement. The baseline description shall detail the baseline technology(ies) affected by the measure; including make, model number, nameplate information, and equipment rated capacity, condition, age, lifetime, usage, operating schedule, and controls. The baseline shall also account for upgrades to the equipment that would have occurred during the analysis period absent the early retirement of the equipment. (p. 316)

All projects that do not meet the requirements as a retrofit project must be defined as a replacement project and must, instead, follow the commercial and industrial (C&I) Equipment Replacement – Custom Measure Analysis Protocol described in the draft Ohio TRM, which states:

> An equipment replacement project is defined as equipment replaced at the end of its rated service life, or when it is replaced due to failure, obsolescence or a need for increased capacity (p. 297).
>
> Baseline for Equipment Replacement projects is the equipment meeting the level of efficiency required by State Code, applicable Federal product efficiency standard or standard practices, whichever is most stringent, in place at the time of installation. If there is no applicable State code or Federal Standard then the methodology for establishing standard practice shall be documented in the M&V plan as described in PJM Manual 18B Section 8. The baseline description shall detail information regarding the baseline technology(ies) including make, model number, nameplate data and rated capacity of the equipment, operating schedule, and controls and how the baseline was determined. (p. 301)

In practice, there is sometimes disagreement among evaluators on what the appropriate baseline should be – either replacement or retrofit – and the effect on savings can be significant, depending on which baseline is assumed. This issue arose with one mercantile project for AEP Ohio. In this case, the AEP Ohio evaluator assumed the existing equipment baseline, while the Independent Evaluator believes that a new equipment baseline is appropriate. In this instance, the different baseline assumptions resulted in a 74 percent decrease is savings estimated for this one very large project when the new equipment baseline was used.

In anticipation of future differences in interpretation for these types of projects, we propose that part of the Independent Evaluator role involve helping utilities and PUCO staff review the application savings calculations as they are being submitted for approval for those projects where there may be disagreement on determining the appropriate baseline. This would include mercantile customers and could also be extended to other large custom projects.

Finally, as a separate issue, it should be noted that many of the mercantile projects reviewed were completed before the program was being offered and therefore could not possibly have been influenced by the program. While we understand that this is the law in the State of Ohio and was

being correctly followed by the utilities, we would be remiss as independent evaluators if we did not note that claiming savings for actions taken before a program is offered is inconsistent with standard industry practice.

4. Impact information sources. Our expectation at the start of this project was that the electric utility impact estimates would be a combination of *ex ante* values from the original program filings with the PUCO, savings values from the draft Ohio TRM, and *ex post* impact values derived from the utility evaluation research in the prior year. Instead we found a host of additional impact sources, as illustrated in Table 3. This multitude of sources has made the savings claim review for each utility more challenging, as there are many more sources that needed to be vetted than originally anticipated.

Table 3: Sources for *Ex Ante* Savings Values

AEP Ohio Programs	2010 AEP Ohio Reported Savings (GWh)	*Ex Ante* Impact Source(s)					
		Draft Ohio TRM	Utility evaluation	Original PUCO Filing	Implementation Contractor	Utility TRM	Other
Residential Programs							
Efficient Products	137.70						x
Appliance Recycling	17.80		x				
Retrofit	0.07	x	x				
Conservation Kits (e^3Smart)	1.60		x				
Low Income	0.90	x	x				
Non-residential Programs							
Prescriptive	141.90		x		x		
Custom	34.20				x		
Self Direct	32.60		x		x		
Express Install	0.03				x		

DP&L Programs	2010 DP&L Reported Savings (GWh)	*Ex Ante* Impact Source(s)					
		Draft Ohio TRM	Utility evaluation	Original PUCO Filing	Implementation Contractor	Utility TRM	Other
Residential Programs							
Residential Lighting (CFL)	112.70	x					
Residential HVAC Rebates	9.47	x					x
Residential Appliance Recycling	3.83	x					
Education, School Programs	0.98	x					
Residential Low Income Affordability	0.38	x					
Residential HVAC Diagnostic & Tune Up	0.11	x					
Non-residential Programs							
Non-Residential Prescriptive Rebates	37.66	x					
Non-Residential Custom Rebates	9.12		x				
Mercantile Customer Commitments	4.96						x

Duke Energy Programs	2010 Duke Energy Reported Savings (GWh)	*Ex Ante* Impact Source(s)					
		Draft Ohio TRM	Utility evaluation	Original PUCO Filing	Implementation Contractor	Utility TRM	Other
Residential Programs							
SAW Smart $aver Residential	214.54		x		x		x
Home Energy Comparison Report	2.96			x			
Non-residential Programs							
SAW Smart $aver Non-Residential Prescriptive	84.30		x		x	x	x
SAW Smart $aver Custom	8.96				x		x

FirstEnergy Programs	2010 FirstEnergy Reported Savings (GWh)	*Ex Ante* Impact Source(s)					
		Draft Ohio TRM	Utility evaluation	Original PUCO Filing	Implementation Contractor	Utility TRM	Other
Residential Programs							
Home Energy Analyzer	13.89			x			
Community Connections (Low Income)	3.69				x		
Non-residential Programs							
Mercantile	80.11						x

5. Net impacts. For 2009, 2010 and 2011, Ohio electric utilities are required to report only gross impacts. At some point in the future, however, the PUCO anticipates requiring the utilities to start reporting net impacts, which can be defined as the incremental energy savings attributable to the utility efficiency program that exclude "free riders" who would have installed the energy efficient

measures even if utility rebates had not been available. In preparation of this, some of the utilities have already begun to research net impact effects through the use of self-report phone survey question batteries exploring free ridership and spillover.

In 2010, the Independent Evaluator team began developing a free ridership battery of survey questions that will eventually be refined to become the standard approach for estimating net impacts for the Ohio electric utilities. A subset of free ridership questions was tested as part of the participant phone survey fielded in 2010 and is discussed in more detail in later in this report.

While additional questions are needed to develop a more rigorous estimate of free ridership, these preliminary results suggest that there is some amount of free ridership for these programs. To facilitate increased and standardized research in this area, the Independent Evaluator team will finish developing the standard free ridership question battery and scoring algorithm in 2012.

Recommendations

Based on the findings summarized above, the Independent Evaluator makes the following over-arching recommendations. Additional utility-specific recommendations are discussed in the next chapter.

Apply a CFL installation adjustment factor. It is standard practice to assume an installation rate of less than 100 percent for CFLs to reflect the fact that not all CFLs will get (or remain) installed. The draft Ohio TRM recommends using an installation rate of 81 to 86 percent depending on the delivery mechanism (i.e., point-of-sale versus direct install). We recommend that all CFL savings be adjusted using an installation rate adjustment factor derived from either current evaluation research using primary data collection from Ohio utility customers, or taken from the current Ohio TRM.

Develop a complete list of sources for *ex ante* savings values. Origins of *ex ante* savings values are not clear in the 2009 and 2010 Portfolio Status Update and evaluation reports. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference.

Require a rigorous impact analysis method to estimate impacts from audit and energy comparison programs. As discussed in the review of the utility evaluation research, the impact analysis methods used to estimate savings for audit and home energy comparison results have generally resulted in unrealistically high estimates of savings. We recommend that more rigorous impact analysis methods be used if savings are going to be claimed for these programs. Acceptable methods include a billing analysis combined with a survey that clearly identifies which activities undertaken by the participant were a direct result of the audit or comparison report. A quasi-experimental design using a billing analysis of participants and a randomly selected sample of non-participants as a control group is also an acceptable approach. Savings resulting from installing measures through other utility programs where a rebate is provided (including any upstream lighting programs for CFLs) must be subtracted from the savings calculations. If the impact evaluation does not include these components, we recommend that no savings be claimed for audit and home energy comparison report programs.

Adopt the process recommendations presented in the utility evaluation reports. Although the process findings from the utility evaluations are not discussed in this report, the Independent Evaluator did review the analysis methods, conclusions, and recommendations. As we also were able to review the evaluation plans and the data collection activities as they occurred, we believe that the process evaluation conclusions are sound and therefore the recommendations presented in the utility evaluation reports should be adopted.

Review of Utility-Reported Savings

This chapter presents an overview of the review of the Portfolio Status Update reports and supporting evaluation reports for each utility. Key findings are included for each utility for both the 2009 and 2010 program years.

As discussed previously, a goal of the Independent Evaluator was to avoid duplicating as much as possible the evaluation activities being conducted by the utility evaluation contractors. By reviewing the evaluation plans, analysis methods, and data collections instruments prior to their implementation, the Independent Evaluator could have confidence in the results and not have to conduct a full-scale parallel evaluation. This also avoided possible dissatisfaction among customers who might be subject to multiple surveys or site visits addressing the same topics.

Separate review and verification activities were conducted by the Independent Evaluator in 2009 and 2010 and included:

2009 Independent Evaluator Activities. The first year of the Independent Evaluator verification involved reviewing the 2009 Portfolio Status Update report and supporting evaluation research. One of the objectives set by the PUCO for the Independent Evaluator is to assist with establishing a best-of-class evaluation framework for the state of Ohio. As part of working toward this goal, we reviewed all the 2009 evaluation reports and are providing comments where needed to improve report quality and create some consistency across utilities in the level of detail provided. Comments in the following sections are meant to be constructive in the hopes of working toward this ultimate goal.

The evaluation research reports were reviewed using several criteria focused on the quality and completeness of the reports.

Questions asked during this review include:

- Is there adequate background provided on the programs covered in the evaluation?
- Are research questions clearly identified?
- Are data collection tasks clearly linked to research questions?
- Are the data collection methods documented?
- Are the analysis methods clearly explained?
- Are the data collection and evaluation activities appropriate for addressing the research questions identified?
- Are the savings estimates credible?

The template used for the reviews of the 2009 reports is included as Appendix B.

2010 Independent Evaluator Activities. The 2010 verification activities were more extensive as the Independent Evaluator had the time to set expectations of evaluation requirements with the utilities prior to the Portfolio Status Update report being filed in 2010. For 2010, the utilities were provided with a template for both the evaluation plan and the evaluation report that they were

expected to follow.[19] These templates are provided as Appendix E to this report. Also in 2010, the Independent Evaluator verified the 2010 savings reported in the Portfolio Status Update report by analyzing an extract of the participant database provided by each utility. This participant database contained information on each customer who received a rebate from the utility (and therefore was counted as part of that year's energy savings and included in the Portfolio Status Update report). A brief process evaluation was also conducted via phone survey for a small sample of program participants for each utility.

Additional activities undertaken by the Independent Evaluator for 2010 included the following:

- Meeting with each utility and their evaluation teams to discuss our evaluation activities and our expected role in the utility evaluation process;
- Developing templates for the utility evaluation plans and evaluation reports;
- Reviewing, commenting, and approving the utility evaluation plans;
- Reviewing, commenting, and approving phone survey instruments provided by the utility evaluation teams;
- Conducting ride-alongs for site visits that were done as part of utility evaluations;
- Reviewing the 2010 Portfolio Status Report and associated evaluation reports;
- Replicating the savings reported in the 2010 Portfolio Status report using an extract of the participant tracking database provided by each utility;
- Fielding a phone survey of sample of 2010 program participants; and
- Fielding a survey of non-participants to collect market baseline data.

In all these activities, the utilities and their evaluators were very cooperative and willing to coordinate on developing the survey instruments, evaluation plans, on-site visits, and evaluation reports.

In the remainder of this chapter, the annual savings reported by each utility for 2009 and 2010 are presented, along with a brief summary of the evaluation activities that were undertaken by the utilities each year. Following the utility evaluation results, the Independent Evaluator assessment of the utility evaluation research is presented. Each utility section concludes with recommendations by the Independent Evaluator on the savings calculations and evaluation research.

AEP Ohio

2009 AEP Ohio Reported Savings and Evaluation Research

As described in their Portfolio Status Report, AEP Ohio began introducing programs in the spring of 2009, after a process that included the completion of a Market Potential Study, development of a Portfolio of Programs, receiving input from the Collaborative on program development, and selecting program implementation contractors. Through December 31, 2009, AEP Ohio operated six energy efficiency programs and an existing tariff-based demand response program. These programs included:

[19] Note that some Duke Energy 2010 evaluation reports were completed prior to these guidelines being developed; therefore, not all 2010 evaluation reports followed this template.

Residential Sector

- Efficient Products: Compact Fluorescent Lighting Program (CFL)
- Recycling: Residential Appliance Refrigerator and Freezer Recycling Program
- Energy Conservation Kits

Non-residential Sector

- Prescriptive: Lighting
- Custom: Non-Prescriptive Measures
- Self-Direct: Mercantile Customers' Commitment of Resources
- Demand Response: Mercantile Commitment of Resources & Interruptible Tariff Program (IRP-D)

Reported savings for 2009 from AEP Ohio's Portfolio Status Update report are shown in Table 4.

Table 4: 2009 AEP Ohio Reported Program Savings

Program	Reported Savings (GWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs			
Efficient Products	76.8	86%	31%
Appliance Recycling	6.3	7%	3%
Energy Conservation Kits	6.1	7%	2%
Residential Total	**89.2**	**100%**	**36%**
Non-residential Programs			
Prescriptive	19.2	12%	8%
Custom	0.1	< 1%	< 1%
Self-Direct	142.1	88%	57%
Non-residential Total	**161.4**	**100%**	**64%**
Grand Total	**250.6**		**100%**

AEP Ohio's evaluation contractor, Navigant, completed evaluations[20] for the programs that provided the majority of the 2009 savings, as shown in Table 5.

[20] AEP's Portfolio Status Report and the Navigant evaluation reports are all included in the document *2009 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs* filed with the PUCO on March 15, 2010.

Table 5: AEP Ohio 2009 Evaluation Activities By Program

Program	Reported Savings (GWh)	Impact Evaluation Conducted	Process Evaluation Conducted
Residential Programs			
Efficient Products	76.8	✓	✓
Appliance Recycling	6.3	✓	✓
Energy Conservation Kits	6.1	✓	
Non-residential Programs			
Prescriptive	19.2	✓	✓
Custom	0.1	✓	✓
Self-Direct	142.1	✓	✓

Independent Evaluator Assessment of AEP Ohio 2009 Reported Savings and Evaluation Research

The Independent Evaluator developed a review template that was used to compare the evaluations of the 2009 AEP Ohio programs for thoroughness, a clear description of goals and methods, adherence to best evaluation practice and credibility of results. A copy of the full template that was used for the evaluation report review is included as Appendix B to this report.

Overall, the review of the 2009 AEP Ohio evaluation report found that the evaluation research was of high quality, adhered to good industry practice, and provided credible results. There were two areas where we have issues with the final savings estimates:

- **CFL installation rate.** CFLs that are installed through the residential Efficient Products program are assumed to be 100 percent installed. As discussed previously in this report, common practice is to apply an adjustment factor of less than 100 percent to account for the fact that not all CFLs will get installed (or remain installed) in a given year. Customers may store some CFLs for future use, for example, or the CFL may burn out (or be removed by the customer) prior to the end of the year. For these reasons, the draft Ohio TRM recommends that an installation adjustment factor of 81 to 86 percent be used for CFLs.

- **Mercantile customer savings.** One feature of the overall 2009 report was the reporting of program savings well in excess of the Benchmark Goals for each utility under SB-221, Case No. 08-888-EL-ORD.[21] Under Order and Stipulation in Case Nos. 09-1089-EL-POR and 09-1090-

[21] Public Utilities Commission of Ohio. SB-221, Case No. 08-888-EL-ORDRules for Alternative and Renewable Energy Emission Control and Amendments to 4901:5-1, 4901:5-3, 4901:5-5 and 4901:5-7 OAC. (20 August, 2008). http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=08-0888

EL-POR,[22] a utility is able to "bank" savings in excess of its goal and apply them to meeting future goals. AEP Ohio banked savings of 142 GWh for 2009.

2010 AEP Ohio Reported Savings and Evaluation Research

AEP Ohio began 2010 with the six energy efficiency programs and one existing tariff-based demand response programs that had been in place in 2009, as discussed above. In addition, AEP Ohio introduced five new programs during the second half of 2010 after receiving approval of cost recovery from the PUCO in May 2010. Programs active in 2010 include:

Residential Sector

- Residential Retrofit (Retrofit)
- Low Income (Weatherization)
- Residential New Construction
- Behavioral (Home Energy Report)
- Efficient Products: Compact Fluorescent Lighting Program
- Residential Appliance Refrigerator and Freezer Recycling Program
- Energy Conservation Kits

Non-Residential Sector

- Express Install
- Prescriptive: Lighting, HVAC, Motors and other specific measures
- Custom: Non-Prescriptive Measures
- Self-Direct: Mercantile Customers' commitment of resources

According to the April 15, 2011 Portfolio Status Report and the Navigant evaluation reports[23], both Columbus Southern Power (CSP) and Ohio Power Company (OPCo) exceeded annual energy efficiency benchmarks for overall 2010 portfolio of incentive programs.TRC values for the overall utility portfolios were reported as 1.3 for CSP and 2.3 for OPCo. Using the TRC test, all of the programs submitted to the PUCO in the Portfolio Plan were cost-effective, except for the Low Income Program, which is delivered by Ohio Partners for Affordable Energy (OPAE) through their network of 70 plus non-profit Community Action Program (CAP) agencies and had negligible energy and demand savings.

[22] Public Utilities Commission of Ohio. SB-221, Case No. 09-1089-EL-POR Columbus Southern. (12 November, 2009). http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=09-1089&x=0&y=0. Public Utilities Commission of Ohio. SB-221, Case No. 09-1090-EL-POR Ohio Power. (12 November, 2009). http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=09-1090&x=0&y=0

[23] AEP's Portfolio Status Report and the Navigant evaluation reports are all included in the document *2010 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs* filed with the PUCO on March 15, 2011.

As part of the Independent Evaluator verification activities, an extract of AEP Ohio's participant database[24] for the 2010 programs was requested so that the Independent Evaluator could replicate the kWh savings reported in the Portfolio Status Update report. Using the AEP Ohio participant database, savings were successfully replicated for all programs except for e³Smart, for which AEP Ohio was unable to supply participant data. Results of the savings replication are shown in Table 6.

Table 6: AEP Ohio 2010 Reported and Verified Savings by Program

Program	Reported Savings (GWh)	Participant Data Analysis (GWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs				
Efficient Products	137.70	137.70	88%	38%
Appliance Recycling	17.80	17.80	11%	5%
Retrofit	0.07	0.07	<1%	<1%
Conservation Kits (e³Smart)	1.60	0	0%	0%
Low Income	0.90	0.90	1%	<1%
Residential Total	**158.07**	**156.47**	**100%**	**43%**
Non-residential Programs				
Prescriptive	141.90	141.90	68%	39%
Custom	34.20	34.20	16%	9%
Self-Direct	32.60	32.60	16%	9%
Express Install	0.03	0.03	<1%	<1%
Non-residential Total	**208.73**	**208.73**	**100%**	**57%**
Grand Total	**366.80**	**365.20**		**100%**

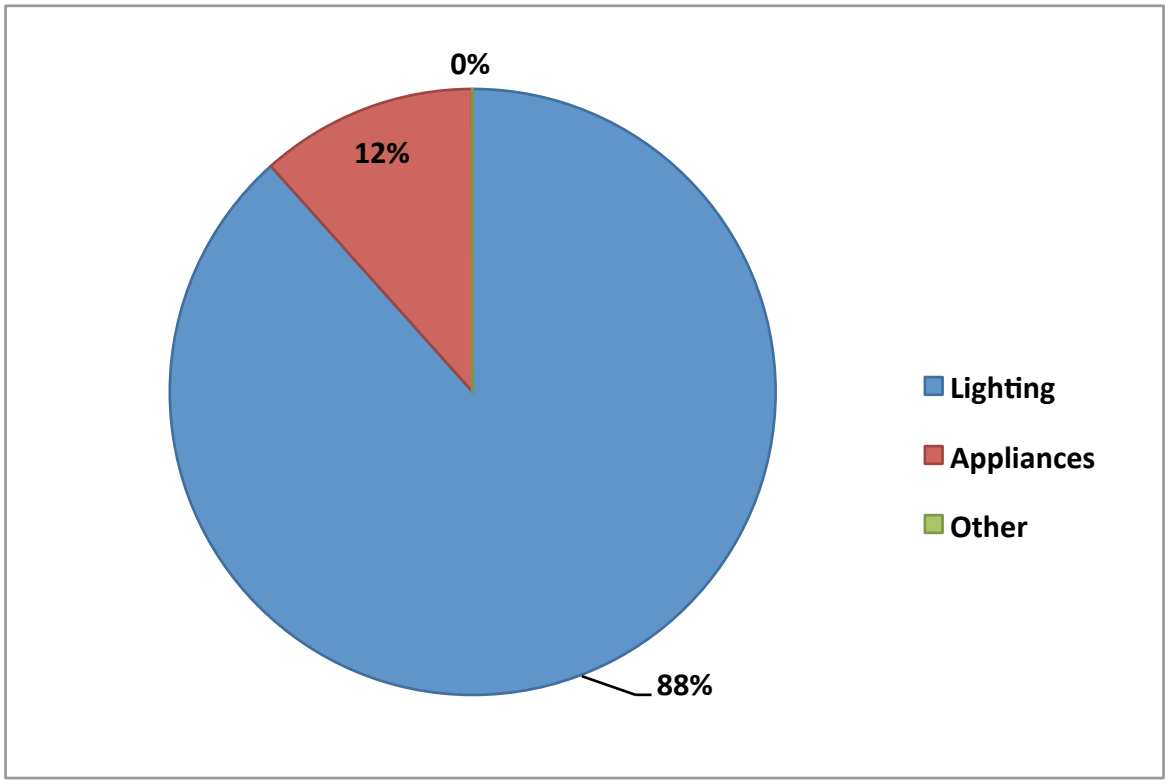
In addition to replicating AEP Ohio savings claims, the independent evaluator used the participant data provided by AEP Ohio to characterize where savings were being achieved by sector and end use. This was done to determine which end uses and measures were making the largest contributions to program savings. Once this is known, these areas can be used to set evaluation priorities in future years as well as provide a focus for comparisons across utilities.

Within both the residential and non-residential sectors, we examined which measures and end uses were contributing to reported savings. Residential results are shown in Figure 1and indicate that the vast majority of savings (88 percent) came from CFLs distributed through the Efficient Products

[24] The participant database contains information on all customers who received incentives through a program, including contact information for each participant as well as the amount of the incentive, the measure installed and the expected savings from that measure.

program. Appliance savings (through the Appliance Recycling program) make up almost all of the remainder.

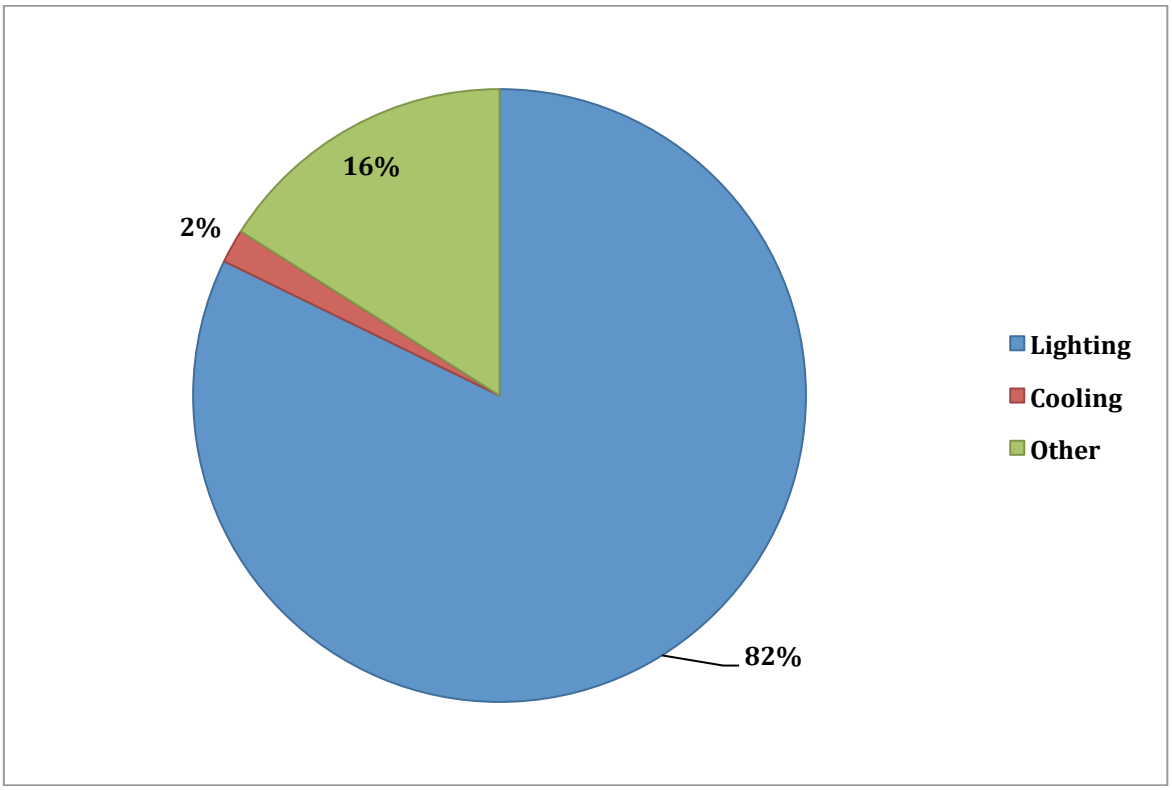
Figure 1: AEP Ohio: Share of Residential Savings by End Use



Note: "Other" includes HVAC and miscellaneous measures

Results for the non-residential sector, presented in Figure 2, show that lighting is the primary source of savings (82 percent), followed by cooling (two percent). A variety of other end uses such as motors, drives, compressed air, virtualization, EMS and other miscellaneous measures account for a 16 percent share.

Figure 2: AEP Ohio: Share of 2010 Non-residential Savings by End Use



Note: "Other" includes Motors, Drives, Compressed Air, Virtualization, EMS and other miscellaneous measures.

The heavy reliance on lighting measures to achieve both residential and non-residential savings is not uncommon, particularly with newer energy efficiency programs. The expectation would be that the lighting measures would also receive the most attention in the utility evaluation work.

Table 7 shows what type of evaluation each of AEP Ohio's programs received in 2010. An impact evaluation refers to the calculation of actual savings from installed measures, while process evaluation refers to an assessment of the efficacy with which the program was delivered to customers. As demonstrated in this table, coverage across programs was relatively comprehensive, as almost each program received some level of both a process and impact evaluation.

Table 7: AEP Ohio 2010 Evaluation Activities by Program

Program	Reported Savings (GWh)	Impact Evaluation Conducted	Process Evaluation Conducted
Residential Programs			
Efficient Products	137.70	✓	✓
Appliance Recycling	17.80	✓	✓
Retrofit	0.07		✓
Conservation Kits (e^3Smart)	1.60		✓
Low Income	0.90	✓	✓
Non-residential Programs			
Prescriptive	141.90	✓	✓
Custom	34.2	✓	✓
Self-Direct	32.6	✓	✓
Express Install	.03		✓

The 2010 AEP Ohio evaluation report provided multiple conclusions based on the process evaluation. The Independent Evaluator team reviewed the process evaluation methods used and concurs with the recommendations detailed in the evaluation report.

Several key process findings and recommendations from the 2010 AEP Ohio evaluation report include the following:

- Work with program implementers to improve documentation and data tracking for the Low Income program;
- Use trade ally and customer input to improve website and improve data entry and communications for both the Prescriptive and Custom programs, using email when possible; and
- Improve tracking of Self-Direct customer applications.

The 2010 AEP Ohio evaluation team also conducted an impact evaluation for each of the 2010 programs. We reviewed the methods used and are generally in agreement with the findings. A few exceptions are discussed below in our overall assessment of 2010 program savings.

Independent Evaluator Assessment of AEP Ohio 2010 Reported Savings and Evaluation

In general, we found the 2010 AEP Ohio evaluation reports to be very thorough and adhering to standard evaluation practices for the types of programs covered. As discussed above, the Independent Evaluator team was able to replicate the reported savings for each of AEP Ohio's 2010 programs, based on our analysis of the participating customer tracking database.

The evaluation methods followed were also consistent with the evaluation plan approved by the Independent Evaluator prior to the start of the 2010 evaluation work. Given these findings, in addition to our participation in survey review and ride-alongs conducted during the analysis period, we have a high level of confidence in the evaluation findings included in the 2010 AEP Ohio evaluation report, although we disagree with the interpretation of some assumptions and calculations as discussed below.

There are two specific concerns we have regarding AEP Ohio's 2010 savings values, as discussed below.

CFL installation rate. As with the 2009 reported savings, the savings claimed for CFLs for 2010 assumed that 100 percent of the CFLs were actually installed. It is common practice, however, to adjust CFL savings estimates to account for the fact that not all CFLs are (or remain) installed. In some cases CFLs are put in storage for future use, while in other cases CFLs may be installed and then removed by the customer for a variety of reasons (e.g., burn out and dissatisfaction with light quality.) The draft Ohio TRM recommends that installation rates of 86 and 81 percent be applied for point-of-sale and direct install CFLs, respectively. The 2010 AEP Ohio evaluation survey of CFL recipients estimated an installation rate of 42.9 percent, which the AEP evaluation contractor found to be incredibly low, and so instead used an estimated first-year installation rate of 75 percent. In future years the draft Ohio TRM recommended installation rate adjustment for CFLs should be applied to savings to account for these issues.

Given that CFLs account for 38 percent of AEP Ohio's total savings portfolio in 2010, applying the draft Ohio TRM CFL installation adjustment of 86 percent would reduce total savings in 2010 by six percent.

Mercantile customers – retrofit versus replacement baseline. As discussed in the overarching issues section, the savings calculations for large custom projects can vary substantially based on whether the baseline is calculated using the replacement or retrofit protocol. As part of the AEP Ohio mercantile savings analysis, the Independent Evaluator team accompanied the AEP Ohio evaluation team on a series of mercantile on-site visits in 2010. Based on the information collected during these on-sites and reviewing the program documentation, we calculated the *ex post* savings for these customers, as shown in Table 8. The largest discrepancy was with Customer 2, for which we believe that the replacement baseline should be used (i.e., savings should be calculated compared to standard efficiency new equipment) while the AEP Ohio evaluation team believes that this should be considered as a retrofit project, where savings are calculated relative to the usage of equipment previously in place. The result of this difference is a 76 percent decrease in kWh savings for this single project when the replacement baseline is applied and a 59 percent decrease in kWh savings overall. While the overall realization rate (that is, the ratio of the evaluated *ex post* savings to the claimed *ex ante* savings) was just 25 percent for kW and 41 percent for kWh, the average realization rate for all customers other than Customer 2 was 114 percent for kW and 143 percent for kWh.

Table 8: AEP Ohio 2010 Mercantile *Ex Post* Savings Analysis

	Realization Rate	
Project	kW	kWh
Customer 1	130%	130%
Customer 2	6%	24%
Customer 3	278%	431%
Customer 4	16%	18%
Customer 5	11%	6%
Customer 6	21%	40%
Customer 7	97%	97%
Customer 8	107%	93%
Customer 9	92%	75%
Customer 10	48%	63%
Customer 11	132%	89%
Customer 12	101%	100%
Customer 13	69%	90%
Totals	25%	41%
w/o Customer 2	114%	143%

Independent Evaluator Recommendations for AEP Ohio

Based on our review of the 2009 and 2010 AEP Ohio Portfolio Status Update reports and associated evaluation research, we make the following recommendations.

Recommendation #1: Apply a CFL installation rate to adjust savings. It is standard practice to assume an installation rate of less than 100 percent for CFLs to reflect the fact that not all CFLs will get installed. The Navigant evaluation report recommended an installation rate of 75 percent while the Draft Ohio TRM recommends using an installation rate of 81 to 86 percent depending the delivery mechanism (i.e., point-of-sale versus direct install). We recommend that all CFL savings be adjusted using an installation rate adjustment factor derived from either current evaluation research using primary data collection from AEP Ohio customers, or taken from the draft Ohio TRM.

Recommendation #2: Ensure mercantile customer savings are calculated using the correct baseline assumptions. Our analysis of a sample of mercantile customer sites turned up one large project where the baseline assumed by AEP Ohio and its evaluation contractor does not comply with the rules established by the PUCO for these projects. We recommend that the savings be recalculated for this customer using the correct baseline assumptions.

Recommendation #3: Develop a complete list of sources for *ex ante* savings values. Origins of all *ex ante* savings values are not clear from the 2009 and 2010 Portfolio Status Update and evaluation

reports. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference.

Recommendation #4: Adopt the recommendations presented in the 2010 AEP Ohio evaluation report. The recommendations for both the process and impact evaluation are summarized above and discussed in greater detail in the 2010 AEP Ohio evaluation report. As the Independent Evaluator reviewed the evaluation plan and was able to review the data collection activities as they occurred, we believe that the evaluation report conclusions are sound (except as noted above) and therefore the recommendations presented in the report should be considered by AEP Ohio.

Dayton Power and Lighting (DP&L)

The 2009 and 2010 DP&L Portfolio Update Status reports include both a Compliance Demonstration and a Program Performance Assessment. The Compliance Demonstration addresses the utility's desire to update its initial benchmark report along with a comparison of applicable benchmarks and an affidavit regarding statutory compliance. For each program, there is discussion of implementation strategy, customer targets, staffing, marketing, and customer service. Each report also includes an evaluation report as an appendix.

2009 DP&L Reported Savings and Evaluation Research

According to DP&L's March 12, 2010 Portfolio Status Update report, the following six programs were active in 2009:

Residential Sector

- Residential Lighting (CFLs)
- Residential HVAC Rebates
- Residential Appliance Recycling

Non-Residential Sector

- Non-residential Prescriptive Rebates
- Non-residential Custom Rebates
- Mercantile Customer Commitments

The 2009 savings reported for these programs is summarized in Table 9. Note that in 2009, DP&L had only two Mercantile Customer Commitments, and these were not included in the energy saving totals in its Portfolio Status Report.

Table 9: 2009 DP&L Reported Program Savings

Program	Reported Savings (MWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs			
Residential Lighting (CFL)	85,210	94%	75%
Residential HVAC Rebates	3,071	3%	3%
Residential Appliance Recycling	2,721	3%	2%
Residential Total	**91,002**	**100%**	**80%**
Non-residential Programs			
Non-Residential Prescriptive Rebates	20,694	89%	18%
Non-Residential Custom Rebates	2,592	11%	2%
Non-residential Total	**23,286**	**100%**	**20%**
Grand Total	**114,288**		

The evaluation of the DP&L 2009 programs was conducted by The Cadmus Group.[25] Each of the 2009 programs (except Mercantile Customer Commitments) received both a process and impact evaluation, as shown in Table 10 below.

Table 10: 2009 DP&L Evaluation Activities

Program	Reported Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Residential Lighting (CFL)	85,210	✓	✓
Residential HVAC Rebates	3,071	✓	✓
Residential Appliance Recycling	2,721	✓	✓
Non-residential Programs			
Non-Residential Prescriptive Rebates	20,694	✓	✓
Non-Residential Custom Rebates	2,592	✓	✓

Independent Evaluator Assessment of DP&L 2009 Reported Savings and Evaluation Research

The Independent Evaluator reviewed the 2009 savings as reported in the 2009 DP&L evaluation report. The template for this review is included in Appendix B of this report and involves assessing

[25] The Cadmus Group. *Dayton Power and Light: 2009 Evaluation, Measurement and Verification*. (Prepared for the Dayton Power & Light Company. March 10, 2010).

the quality of the report in terms of completeness, appropriateness of the evaluation methods, and the credibility of the savings results.

In general, we found the 2009 DP&L evaluation report to be thorough and adhering to industry best practices for evaluating these types of programs. We have a high level of confidence in this evaluation research and do not have any specific recommendations for changes to DP&L's 2009 reported savings.

2010 DP&L Reported Savings and Evaluation Research

DP&L had nine programs implemented in 2010. In addition to the six 2009 programs, three new programs (all residential) were added in 2010:

Residential Sector

- Residential Lighting (CFLs)
- Residential HVAC Rebates
- Residential Appliance Recycling
- Education, School Programs (*New in 2010*)
- Low Income Affordability (*New in 2010*)
- Residential HVAC Diagnostic & Tune-up (*New in 2010*)

Non-Residential Sector

- Non-residential Prescriptive Rebates
- Non-residential Custom Rebates
- Mercantile Customer Commitments

As part of the Independent Evaluator analysis, the participant database for the 2010 programs was requested from DP&L and used to replicate the kWh savings claims contained in the Portfolio Status Report. The results of the replication exercise are shown in Table 11. In general, the participant tracking data were well documented and there were no significant issues in replicating the savings from the Portfolio Status Update report. It is also noted in the Portfolio Status Update report that 178,849 MWh of excess energy savings achievement from 2010 were banked for the following year.

Table 11: DP&L 2010 Reported and Verified Savings by Program

Program	Reported Savings (MWh)	Participant Data Analysis (MWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs				
Residential Lighting (CFL)	112,689	112,689	88%	63%
Residential HVAC Rebates	9,471	9,471	7%	5%
Residential Appliance Recycling	3,834	3,834	3%	2%
Education, School Programs	982	982	1%	1%
Residential Low Income Affordability	379	379	0.3%	0.2%
Residential HVAC Diagnostic &Tune-up	107	107	0.1%	0.1%
Residential Total	**127,462**	**127,462**	**100%**	**71%**
Non-residential Programs				
Non-Residential Prescriptive Rebates	37,663	38,191	73%	21%
Non-Residential Custom Rebates	9,124	9,124	18%	5%
Mercantile Customer Commitments	4,957	4,957	10%	3%
Non-residential Total	**51,744**	**52,272**	**100%**	**29%**
Grand Total	**179,206**	**179,734**	**100%**	**100%**

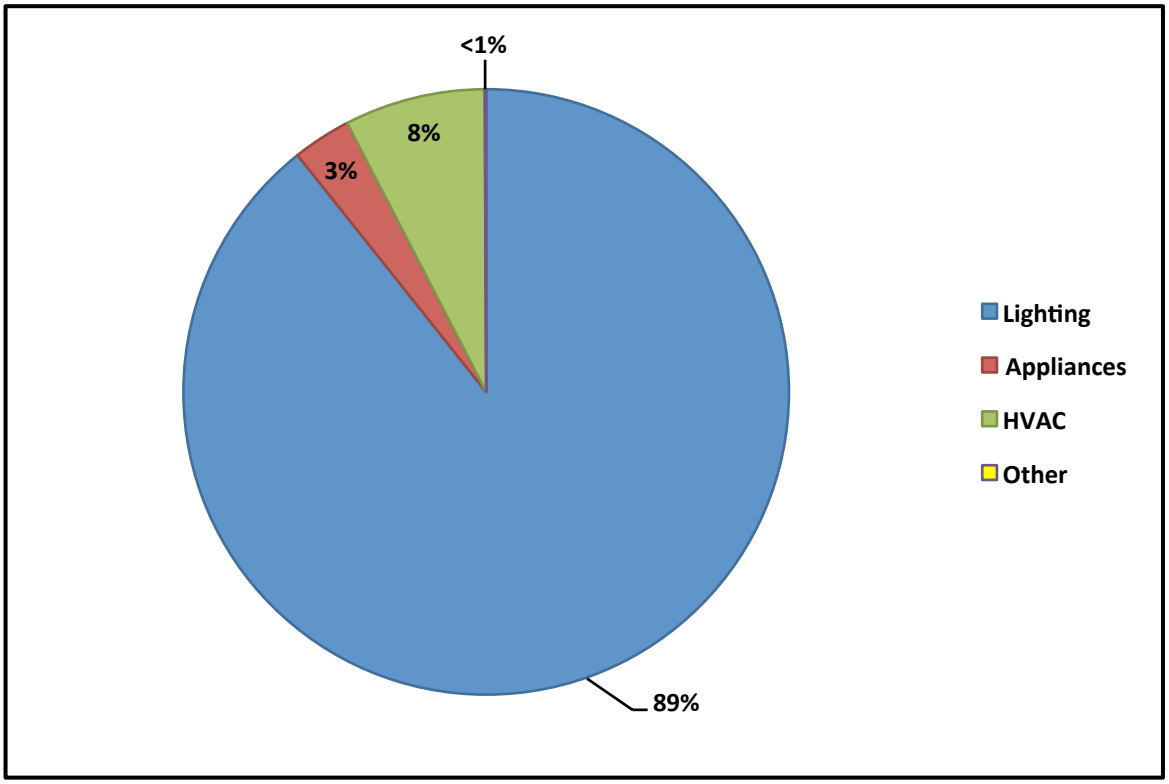
In addition to replicating DP&L savings claims, the participant database was used to characterize where savings were being achieved by sector and end use. This was done to determine which end uses and measures were making the largest contributions to program savings and to help determine evaluation priorities in future years.

Within each sector, we examined which measures and end uses were contributing to reported savings to the extent possible within the DP&L participant data.[26] The results of this analysis are shown in Figure 3 and Figure 4. For the residential sector, the vast majority of savings (89 percent) comes from CFLs distributed through the Residential Lighting program. HVAC measures make up an additional eight percent, while the remainder consisted of appliances and "Other" measures such as low income assistance and education, school programs.

For the non-residential sector, lighting is the primary source of savings (76 percent) followed by motors (14 percent), cooling (six percent) and miscellaneous other end uses.

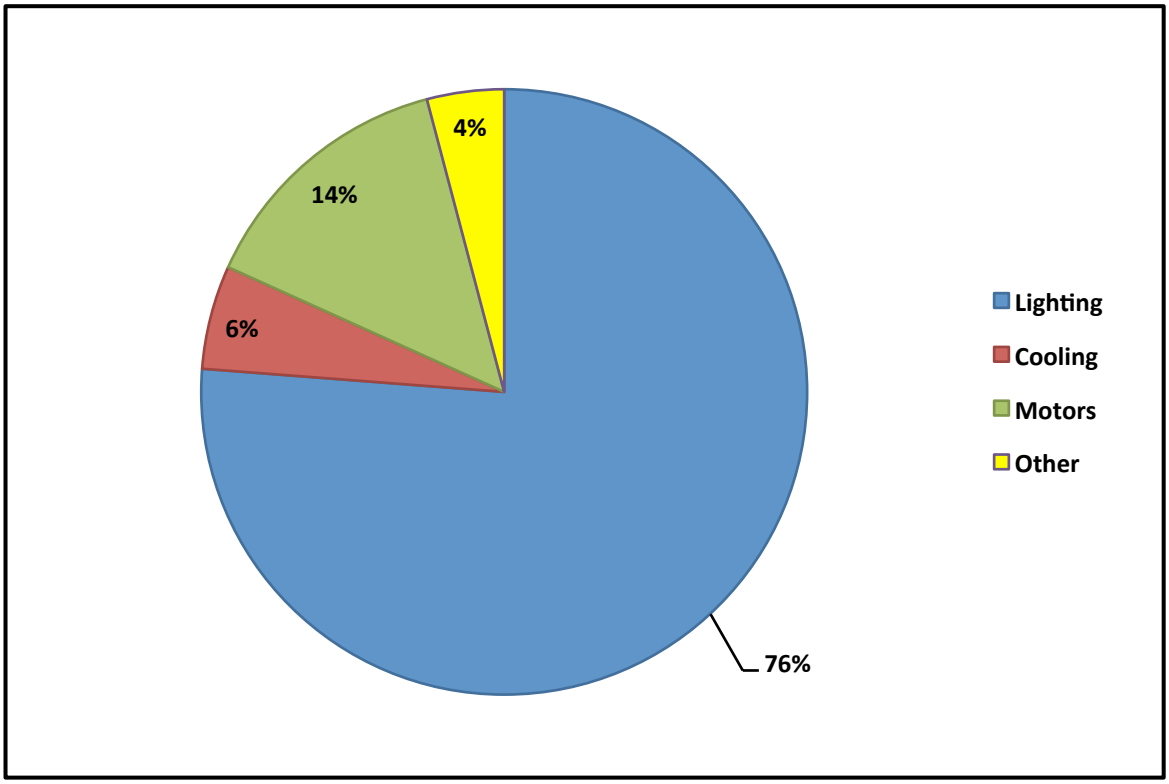
[26] Note that in some cases, the custom and mercantile projects will contain additional lighting, motors, and/or cooling measures. Since this level of detail was not provided for these programs in the data provided by DP&L, they are kept as separate categories in the related charts.

Figure 3: DP&L: Share of 2010 Residential Savings by End Use



Note: "Other" includes low income assistance and education, and additional miscellaneous measures.

Figure 4: DP&L: Share of 2010 Non-residential Savings by End Use



Note: "Other" includes Window Film, Vending Equipment Controller and additional miscellaneous measures.

Table 12 shows what type of evaluation (i.e., impact or process) each of DP&L's programs received in 2010. As demonstrated in this table, coverage across programs was comprehensive as each program received some level of both process and impact evaluation (excluding the Mercantile Customer Commitments, which received only an impact evaluation).

Table 12: DP&L 2010 Evaluation Activities by Program

Program	Reported Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Residential Lighting (CFL)	112,689	✓	✓
Residential HVAC Rebates	9,471	✓	✓
Residential Appliance Recycling	3,834	✓	✓
Education, School Programs	982	✓	✓
Residential Low Income Affordability	379	✓	✓
Residential HVAC Diagnostic &Tune-up	107	✓	✓
Non-residential Programs			
Non-Residential Prescriptive Rebates	37,663	✓	✓
Non-Residential Custom Rebates	9,124	✓	✓
Mercantile Customer Commitments	4,957	✓	✓

Independent Evaluator Assessment of DP&L 2010 Reported Savings and Evaluation

The Cadmus evaluation report covering the 2010 DP&L programs[27] was included as an appendix to DP&L's 2010 Portfolio Status Update filings. As with their 2009 report, we found the 2010 Cadmus report to be very thorough and adhering to standard evaluation practices for the types of programs covered. The evaluation methods followed were also consistent with the evaluation plan approved by the Independent Evaluator prior to the start of the 2010 evaluation work. The evaluation report itself followed the report outline developed by the Independent Evaluator and had all the required elements. Given these findings, in addition to our participation in survey instrument review and attending some of the on-site visits conducted by Cadmus during the analysis period, we have a high level of confidence in the evaluation findings included in the 2010 DP&L evaluation report. As a consequence, we do not have any specific recommendations for changing the savings reported by DP&L in 2010.

Independent Evaluator Recommendations for DP&L

Based on our review of the 2009 and 2010 DP&L Portfolio Status Update reports and associated evaluation research, we do not have any recommendations for changes to the savings reported by DP&L for either year. We do have two general recommendations, which we have also made for the other Ohio utilities.

[27] The Cadmus Group. *2010 Evaluation Measurement and Verification Report*. (Prepared for the Dayton Power & Light Company. March 15, 2011).

Recommendation #1: Develop a complete list of sources for *ex ante* savings values. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference. Note that since the DP&L impact estimates generally rely on the draft Ohio TRM and current Cadmus evaluation research, compiling this list for DP&L should be relatively straightforward.

Recommendation #2: Adopt the process evaluation recommendations presented in the Cadmus evaluation reports. The process evaluation work conducted by Cadmus resulted in a series of recommendations on how to improve the DP&L programs. While these recommendations are not repeated here, the Independent Evaluator did review the recommendations and the research supporting them. Since we were able to review the data collection activities as they occurred, we believe that the Cadmus process evaluation report conclusions are sound and therefore the recommendations presented in the report should be adopted by DP&L.

Duke Energy Ohio

Duke has one electricity distribution company (EDU) within the state of Ohio: Duke Energy Ohio. Duke Energy Ohio has engaged in energy efficiency and demand reduction in programs ordered by the PUCO and approved through a collaborative process with stakeholder participation since the early 1990s. After initially ramping up programs in the 1990s in support of the Integrated Resource Planning process, Duke Energy scaled them back with deregulation of the generation market in 1999 to only residential low-income programs. In early 2006, the company applied to the PUCO to initiate a substantial ramp-up of its energy efficiency programs for all customer classes, which was subsequently approved by the Commission on July 11, 2007.

2009 Duke Energy Reported Savings and Evaluation Research

According to Duke Energy's 2009 Portfolio Status Report[28], the 2009 portfolio of programs was comprised of the following individual programs:

Residential Sector

- Save-A-Watt (SAW)Smart $aver® Residential
- Residential Assessments -- Personalized Energy Report (PER)
- Low Income
- Energy Efficiency Education Program for Schools
- Power Manager (Demand Response)

Non-Residential Sector

- SAW Smart $aver Non-Residential Prescriptive
- Custom Rebate
- Power Share (Demand Response)

[28] Duke Energy's Portfolio Status Report and all of the TecMarket Works Evaluation Reports are included in *2009 Duke Energy Ohio Annual Energy Efficiency Portfolio Status Report* filed with the PUCO on March 15, 2010.

Reported savings for the 2009 program year are shown in Table 13.

Table 13: Duke Energy 2009 Reported Program Savings

2009 Duke Energy Program	Reported Savings (MWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs			
Residential Assessments	6,602	25%	8%
SAW Smart $aver Residential	19,129	72%	22%
Low Income	176	<1%	<1%
Energy Efficiency Education for Schools	815	3%	1%
Power Manager (Demand Response)	0	0%	0%
Residential Total	**26,722**	**100%**	**31%**
Non-residential Programs			
SAW Smart $aver Non-residential Prescriptive	47,150	79%	55%
SAW Smart $aver Custom	12,481	21%	14%
Power Share (Demand Response)	0	0%	0%
Non-residential Total	**59,631**	**100%**	**69%**
Grand Total	**86,353**		**100%**

Duke Energy's evaluation contractor, TecMarket Works, completed individual evaluations for a number of the programs. However, few of the evaluations specifically address the 2009 calendar year and many of the studies were conducted prior to 2009. A few studies were conducted in different states in which Duke Energy operates (primarily Kentucky), and the results were applied to the Duke Energy Ohio programs. The publication date and period covered for the evaluations included with the Portfolio Status update are shown below in Table 14. Note, however, that these evaluation savings values do not appear to have been used as the basis for the 2009 program savings estimates presented in the 2009 Duke Energy Portfolio Status Update report.

While we recognize that the Duke Energy Ohio evaluation cycle was tailored to the previously approved programs and often reflected Duke Energy activities in multiple states, we recommend that Duke Energy Ohio and its evaluation contractor transition to evaluations that more closely match the reporting cycle of the Ohio regulatory framework. In particular, the Duke Energy Ohio evaluation reports should rely on Ohio customer data and be completed as close as realistically possible to the program year being evaluated. This will certainly be an increasingly important issue in future years when Ohio utilities are required to estimate net impacts, as the method used in Ohio may not be consistent with those used in other states in which Duke Energy operates. We believe the source of estimated savings reported in the Portfolio Status Update should be clearly identified either as the Duke Energy TRM database, a specific evaluation result, or a properly documented alternative value.

Table 14: Duke Energy 2009 Evaluation Reports – States and Years Covered

Evaluation Included in 2009 Portfolio Status Update	Publication Date	Period Covered	States Covered
Low-Income Conservation and Energy Education Program	2002		KY, OH
Low Income Refrigeration Program	8/1/2007	2006	KY
ENERGY STAR Energy Efficiency Clothes Washer Pilot	9/15/2008	Feb 08	OH
Personalized Energy Report Program (PER)	10/1/2008	Sept 07 - Jan 08	OH
Home Energy House Call Program (HEHC)	10/1/2008	Jan 06 - Jan 07	OH
National Energy Education Department Program (NEED)	10/1/2008	2007-2008 school year	OH
Energy Efficiency Website	10/15/2008	Sep 07 - Jun 08	OH
CFL Promotion and Lighting Logger Programs	10/1/2008	CFLs: Oct - Dec 07	OH
		Loggers: Nov 07 - Feb 08	OH
Commercial and Industrial Incentive Program	10/1/2008	2007	OH
Payment Plus Pilot Program's Energy Education Workshop	10/1/2005	Jan 03 - Nov 03	OH
Low Income Refrigeration Program Savings Analysis	10/1/2008	Jul 1, 2007 - Jun 30, 2008	KY, OH
Power Manager Program Summary and Impact Evaluation	3/1/2009	Jan - Sep 2008	OH

Independent Evaluator Assessment of Duke Energy 2009 Reported Savings and Evaluation Research

The Independent Evaluator developed a template that was used to assess the evaluations of the 2009 Duke Energy programs for thoroughness, a clear description of goals and methods, adherence to best evaluation practice and credibility of results. The complete checklist used for the 2009 report reviews is included in Appendix B to this report.

Our recommendations based on the review are discussed below. The first is an overarching recommendation regarding CFL savings estimates for all programs:

- **CFL installation rate.** One issue that cuts across multiple programs is the assumed installation rate for CFLs. In the 2009, the savings reported by Duke Energy for CFLs assumes that 100 percent of the CFLs were actually installed and remained installed. It is common practice, however, to adjust CFL savings estimates to account for the fact that not all CFLs are installed. In some cases, CFLs are put in storage for future use, while in other cases CFLs may be installed and then removed by the customer for a variety of reasons (e.g., burn out and dissatisfaction with light quality.) This is particularly an issue for Duke Energy programs, which distributed most CFLs as 6-packs, which tends to multiply the effect of possible non-installation. The draft Ohio TRM recommends an installation rate of 81 - 86 percent be applied for CFLs, depending on program type (point-of-sale or direct install).

We also found additional issues within some of the individual Duke Energy evaluation reports. Our comments on the 2009 evaluation reports primarily center on the need for better documentation and supporting information for some of the impact estimates. Some of the 2009 Duke Energy evaluation reports were thoroughly documented and contained primary data collection relating directly to the 2009 program. However, others did not provide adequate documentation of methods and it was unclear how the results were to be applied to the program moving forward. All of these reports were written prior to the selection of the Independent Evaluator, however, so some variation in report quality and structure was to be expected. In some instances when the savings estimates are much higher than expected and do not have adequate documentation and/or justification for the results (primarily with the large adjustments made to the audit-style and home energy comparison programs), we recommend that the 2009 impact estimates not be used to establish *ex ante* savings values for future program planning.

Specific examples of issues the Independent Evaluator found in the individual reports are summarized below by report title, with a reference to the specific appendix to the Duke Energy 2009 Portfolio Status Update report in which each study can be found.

- **A Report on Duke Energy's ENERGY STAR Programs Energy Efficiency Clothes Washer Pilot (2009 Portfolio Status Update Appendix H).**[29] Overall, the algorithm for calculating gross savings appears reasonable, although the sources for the various calculation parameters are not provided. The net savings calculation takes into account self-selection bias and potential free ridership for the program participants. However, the rationale for the factors used to make the self-selection correction is not explained and appears to be based solely on the evaluator's opinion, which is not sufficient justification for making these types of adjustments.

- **Energy Impact and Customer Satisfaction Evaluation of the Personalized Energy Report Program in Ohio (2009 Portfolio Status Update Appendix J).**[30] The savings estimates for kWh and therms are higher than what we would expect, given the audit information, type of measures installed, and the relatively low installation rates as determined from the phone survey. It appears that the billing regression model may be picking up some non-program effects that are leading to higher savings estimates. Given that there is a fairly detailed phone survey asking a sample of participants what actions they took in response to the program, it would have been useful to do some additional analysis to determine which part of the overall billing regression estimate can reasonably be attributed to the program.

  The adjustments for free ridership and self-selection bias are not documented and appear to be based solely on the evaluator's opinion. This is not sufficient justification for making these types of adjustments. Due to these issues, we do not recommend that the impact estimates in this report be used to calculate *ex ante* savings for this program in future program planning.

[29] TecMarket Works. *A Report on Duke Energy's Energy Star Programs Energy Efficiency Clothes Washer Pilot*. (Prepared for Duke Energy Ohio, September 15, 2008).

[30] TecMarket Works. *Energy Impact and Customer Satisfaction Evaluation of the Personalized Energy Report Program in Ohio*. (Prepared for Duke Energy Ohio, October 10 2008).

- **Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio-Final Report (2009 Portfolio Status Update Appendix L).**[31] The impact analysis appears to be a straightforward examination of survey response frequencies that are then used to compute installation rate and savings estimates based on engineering or deemed savings values.

  The evaluator also applies adjustments for self-selection and false reporting bias that may exist in the sample of survey responses. While we agree that the potential for bias exists, the adjustments applied are not adequately supported. For example, the rationale for setting the self-selection bias adjustment is based on "professional judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding reasonable expectations and experience" (pp. 24-25). For the false reporting bias, the adjustment factor discussion states that "false report bias is typically not a high number, but ranges from a low of two or three percent to a high of 15 percent in our experience depending on the topic and the population being tested" (p. 24). A false response bias adjustment factor is then set at 10 percent for the survey. Later in the report, the false report bias adjustment factor is increased to 50 percent for audit recommendations without any explanation for the increase (p. 32). Similarly, for the baseline assumptions, the report states that "we are not adjusting the baseline conditions applied in this study based on on-site pre-program inspections, but rather we are using the survey results, the literature, our past research and field experience to set what we think are typical baseline conditions" (page 24). None of these adjustments were found to be documented, nor is it possible to tell if baselines adjustments are being made based on the survey or solely on the evaluator's judgment.

  While the report discusses the analysis methods, it does not provide a clear explanation of exactly how the calculations are performed. The savings values are provided in the beginning of the report (page 4), but these numbers cannot be linked to any of the information provided in the rest of the report. The parameters for the engineering calculations are included in Appendix A to the report, but they do not include citations and, rather, refer to other utility evaluations (but not specific studies by name), including the 2007 PER program evaluation (also lacking a complete report citation).

  Due to the lack of documentation and the unsubstantiated adjustments for bias discussed above, there is not enough information provided to assess the credibility of the reported savings. Given these issues, we do not recommend that these values be used to estimate savings for future program planning.

- **Energy Impact Evaluation of the NEED Program in Ohio-Final Report (2009 Portfolio Status Update Appendix K).**[32] The same problems found with the HEHC and PER program impact evaluations discussed above are also present in the NEED impact analysis. Due to

[31] TecMarket Works. *Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio*. (Prepared for Duke Energy Ohio, September 15, 2008).

[32] TecMarket Works. *Energy Impact Evaluation of the NEED Program in Ohio.* (Prepared for Duke Energy Ohio, September 15, 2008).

"data collection issues" (p. 4), savings calculations presented rely on information from an earlier evaluation conducted by TecMarket of Duke Energy's Kentucky PER program (the evaluation report for this program is not cited). Given the different delivery mechanisms for these programs, it is unclear if using the PER survey data is appropriate for assessing the NEED program.

Additionally, while the savings calculation formulas are provided, the sources for the various calculation parameters are not properly cited. It is, therefore, not possible to assess the credibility of the savings estimates. One issue out of particular note is the savings estimate for the CFL included in the kit provided to students as part of the NEED program. The savings value for a single 13 W CFL included in the kit is estimated at 136.5 kWh (page 5, Table 3), which is more than three times the estimated savings using the draft Ohio TRM value for the same measure (40.4 kWh).

Additionally, the final savings values for the program are unclear. At the beginning of the report, in Table 3, the average savings per household is listed as 174 kWh annually, while later in the report the first-year average savings are shown as 125.15 kWh (page 9, Table 9). Still later in the report, in the discussion of effective useful life, the annualized lifetime savings is an average of 181.3 kWh if the savings are condensed to only five years rather than over the 20-year life of the kit measures (page 9). No rationale is provided as to why this condensing should be done and we recommend that either first-year or lifetime savings be used to measure program impacts, instead.

Due to the issues described above, there is not enough information to assess the credibility of the reported savings. We do not recommend that these savings values be used in future program planning.

- **Energy Efficiency Website Program Impact Evaluation (2009 Portfolio Status Update Appendix M).**[33] The same problems discussed above for the HEHC, PER, and NEED program evaluations are present for this report, as well. There are a large number of algorithms used to calculate savings, but these algorithms are not properly cited and the calculations are not entirely clear. There are adjustments made for self-selection and false reporting biases that are entirely opinion-based, without any additional justification provided.

  The savings estimated are adjusted for survey responses to questions regarding how influential the website was for the respondents purchasing efficiency measures. The question is asked generally, however, and not for the individual measures, which would have benefitted the analysis substantially. There is almost certainly some difference in actions taken and the influence of the website across the measures. Some measures such as turning down the thermostat and closing draperies may be viewed as common sense actions on which it is unlikely that the website had much influence, and yet the savings calculations attribute the largest amount of savings for these two measures. For other measures, such as heat pumps, there are no adjustments made for the possibility that at least some of these measures were being rebated through other Duke Energy programs.

[33] TecMarket Works. *Energy Efficiency Website Program*. (Prepared for Duke Energy Ohio, September 15, 2008).

The billing regression analysis also estimates potential savings of 11 to 22 percent, which is almost certainly too high based on our knowledge of other types of audit/informational programs (0-2 percent is standard). Given the issues raised above, in particular the fact that the survey did not link individual actions to the website, we do not believe that the savings numbers in this report are credible and should not be used for future program planning.

- **An Evaluation of ENERGY STAR Products: Results of a Process and Impact Evaluation of Duke Energy's CFL Promotion and Lighting Logger Programs (2009 Portfolio Status Update Appendix N).**[34] The lighting logger results are detailed and provide a credible estimate for savings for those customers that installed CFLs through the program. The statistical model is not consistently defined, but does not factor into the savings estimates. At one point the model is referred to as a logit model, but later it describes a log transformation of the dependent variable – if the dependent variable is a typical 0,1 value found used in a logit model then this transformation is not possible (i.e., you cannot take the log of zero). Later in the report the model is described as an OLS regression, which involves a completely different estimation procedure than the logit model.

- **An Evaluation of the Commercial and Industrial Incentive Program in Ohio: Results of a Process and Impact Evaluation (2009 Portfolio Status Update Appendix O).**[35] The data collection methods are well documented. The interview questions used in the study are presented in the body of the report and the survey instruments are included in the appendix. Additionally, relevant equations and quantitative information are located throughout the technical section.

  However, the secondary sources used are not always well documented. The lighting data are cited as "based on lighting fixture wattage data developed by Franklin Energy Services for Duke Energy" (footnote, page 27), and the coincident peak factors used for the lighting analysis "were developed from load research studies on commercial lightings systems conducted by Pacific Gas and Electric Company and Southern California Edison" (page 28). Full citations are needed for these reports.

  The report explains the analysis methods well, with the exception of the bias and free ridership adjustments discussed below. The process analysis is a straightforward examination of survey response frequencies and includes a wealth of descriptive statistics and summary tables. The impact analysis is far more involved but appears to include all needed mathematical methods. However, as discussed above, some of the source material is not cited appropriately.

  The gross savings numbers based on the data tracking review and field measurements appear to be credible. The adjustments made for free ridership, self-selection bias, and false response bias, however, appear to be arbitrary with no justification provided for the magnitude of the

[34] TecMarket Works. *An Evaluation of ENERGY STAR Products: Results of a Process and Impact Evaluation of Duke Energy's CFL Promotion and Lighting Logger Programs*. (Prepared for Duke Energy Ohio, September 24, 2008).

[35] TecMarket Works. *An Evaluation of the Commercial and Industrial Incentive Program in Ohio*. (Prepared for Duke Energy Ohio, September 30, 2008).

adjustments made. There are also two headings in the report discussing self-selection bias, with two different adjustments presented, so it is somewhat unclear which factors are being recommended.

- **Estimates of the Energy Effects of the Payment Plus Pilot Program's Energy Education Workshop (2009 Portfolio Status Update Appendix P).**[36] The evaluator describes the analysis methods and explains how the PRISM software functions early on in the report. However, the PRISM model is not explained with any detail in the report so we are unable to review how the savings are actually estimated.

  Usage data are an appropriate source to estimate consumption changes caused by the program. When inputted into PRISM, the data collected appeared to have adequate information about the users' changes in behavior due to the program. PRISM has been used in other evaluations so is likely appropriate, however as discussed above there is not enough information provided for us to determine how the PRISM model is used in this study.

  The savings estimates are not credible given the lack of information provided about the model. In particular, the estimates for the educational component (excluding the effects of weatherization) are 1,965 to 2,813 kWh annually, or 19.8 to 22.0 percent of annual usage. This estimate is 10 times higher than what we would expect from an educational program. Given the lack of detail provided on the modeling and the magnitude of the estimate, we do not recommend using these savings estimates to calculate savings in future program planning.

2010 Duke Energy Reported Savings and Evaluation Research

The 2010 Duke Energy Portfolio Status Report[37] describes Duke Energy's energy efficiency portfolio background and its objectives in the fifth year of its multi-year portfolio plan, including both impact and process evaluations of its residential and non-residential efficiency programs for 2010.

Duke Energy's 2010 portfolio comprises the following residential and non-residential programs:

Residential Sector

- SAW Smart $aver Residential
- Home Energy Comparison Report
- Personalized Energy Report (PER)
- Energy Efficiency Education Program for Schools
- Power Manager
- Residential Smart $aver CFL

Non-Residential Sector

[36] TecMarket Works. *Estimates of the Energy Effects of the Payment Plus Pilot Program's Energy Education Workshop*. (Prepared for Cinergy Services, September 13, 2005).

[37] Duke Energy's Portfolio Status Report and all of the TecMarket Works evaluation reports are contained in *2010 Duke Energy Ohio Annual Energy Efficiency Portfolio Status Report* filed with the PUCO on March 10, 2011.

- SAW Smart $aver Non-Residential Prescriptive
- SAW Smart $aver Custom
- Power Share
- Smart Building Advantage Program

As part of the Independent Evaluator analysis, the participant database for the 2010 programs was requested from Duke Energy and used to replicate the kWh savings contained in the Portfolio Status Report. Note that Duke Energy did not report savings in 2010 for all the programs listed above.

As shown in Table 15, we were able to replicate all the 2010 reported savings (up to a rounding error).

Table 15: Duke Energy 2010 Reported and Verified Savings by Program

Program	Reported Savings (MWh)*	Participant Data Analysis (MWh)*	Share of Sector Savings	Share of Portfolio Savings
Residential Programs				
SAW Smart $aver Residential	*	214,535	99%	69%
Home Energy Comparison Report	*	2,956	1%	1%
Residential Total	**217,495**	**217,491**	**100%**	**70%**
Non-residential Programs				
SAW Smart $aver Non-residential Prescriptive	*	84,302	90%	27%
SAW Smart $aver Custom	*	8,958	10%	3%
Non-residential Total	**93,260**	**93,260**	**100%**	**30%**
Grand Total	**310,755**	**310,751**		**100%**

***Note:** Additional detail on the breakdown of savings by program that could be matched with the participant tracking data was not provided by Duke Energy in its Portfolio Status Report.

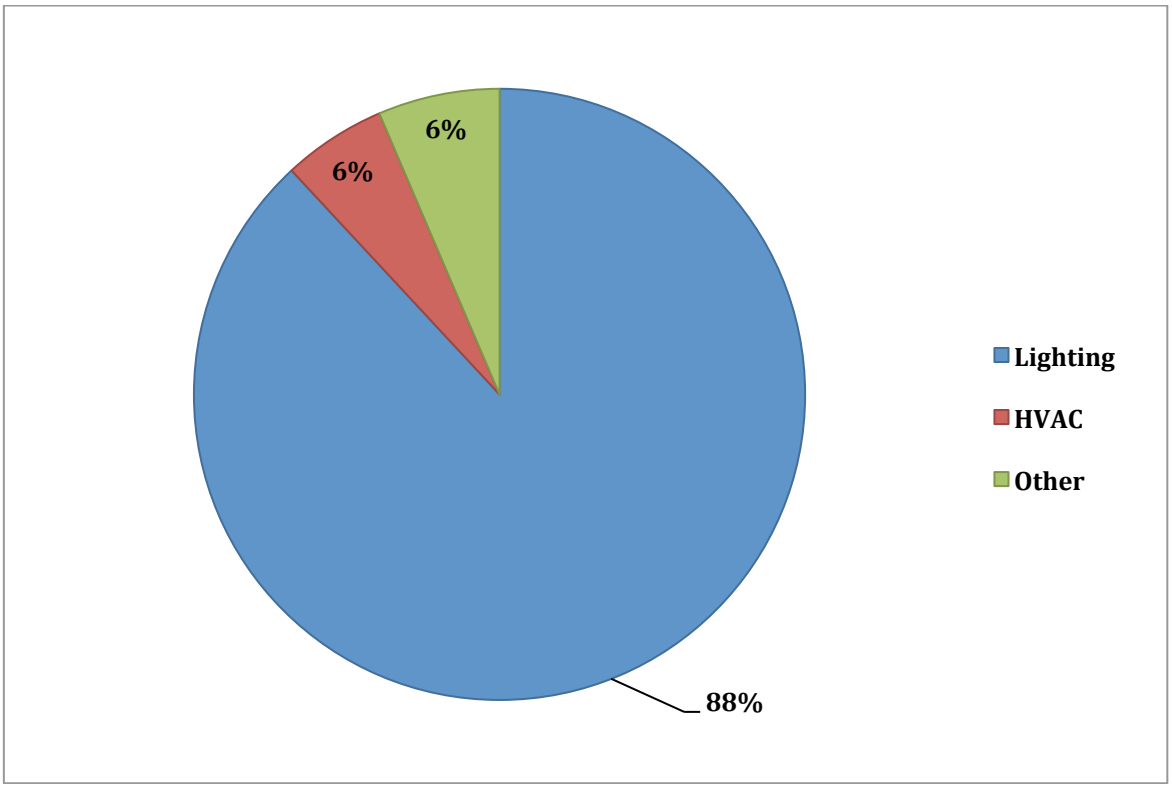
The participant database was also used to characterize where savings were being achieved by sector and end use. This was done to determine which end uses and measures were making the largest contributions to program savings and to help inform future evaluation work.

Within each sector, we examined which measures and end uses contribute to the 2010 reported savings. These results are shown in Figure 5 and Figure 6. For the residential sector, 88 percent of the savings come from the lighting measure of 6-packs of CFLs provided to residential customers. An additional six percent of residential savings was achieved through HVAC measures, with the remainder coming from other sources including, but not limited to, appliance recycling and home audit programs.

For the non-residential sector, 74 percent of savings came from lighting measures, primarily high-bay fixtures (T5s and T8s). An additional 11 percent came from motor measures (VFDs) and 11 percent from cooling measures. The remaining energy savings can be attributed to miscellaneous end uses

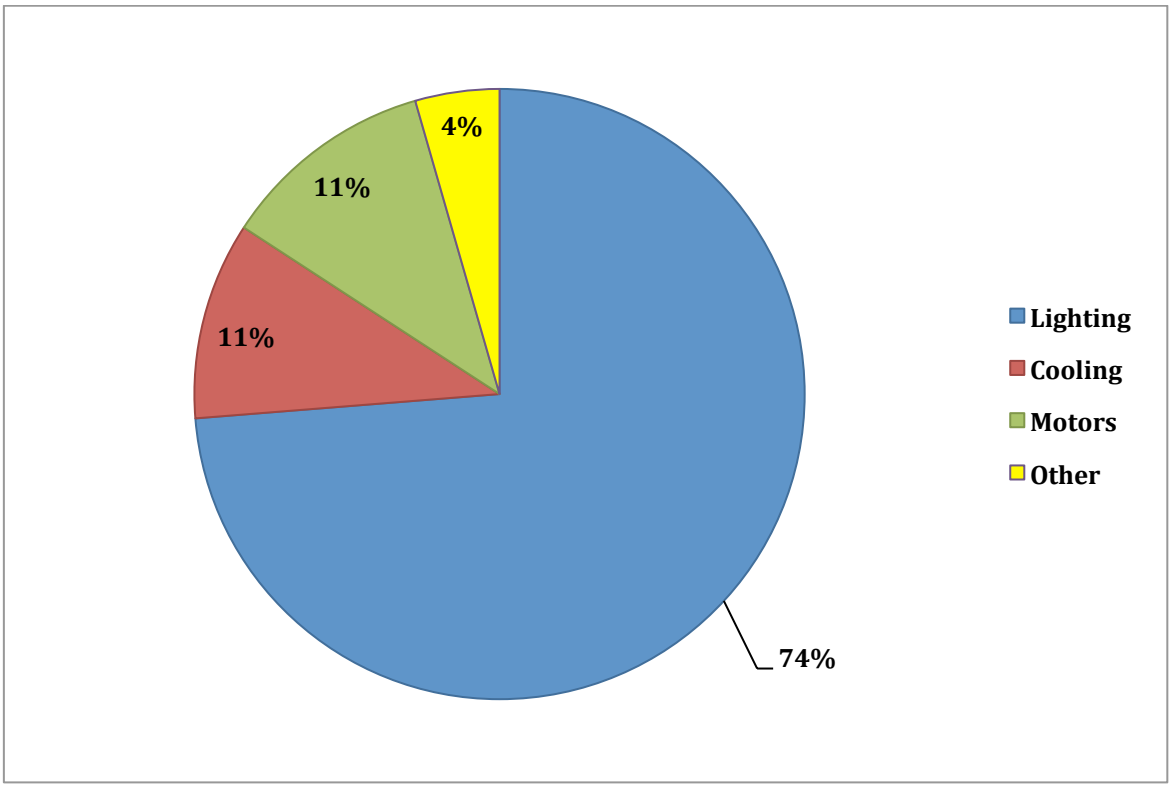
(Non-residential Energy Assessments, Power Share, Appliances, Vending Equipment Controller, Window Film and other miscellaneous measures).

Figure 5: Duke Energy: Share of Residential Savings by End Use



Note: "Other" includes Appliances, Home Energy Comparison Report, PowerManager, Personalized Energy Report and other miscellaneous measures.

Figure 6: Duke Energy: Share of 2010 Non-residential Savings by End Use



Note: Other includes Non-residential Energy Assessments, Power Share, Appliances, Vending Equipment Controller, Window Film and other miscellaneous measures.

The heavy reliance on lighting measures to achieve residential and non-residential savings is not uncommon, particularly with newer energy efficiency programs. The expectation would be that the lighting measures would also receive the most attention in the utility evaluation work. The following section provides a summary of the evaluation research undertaken by Duke Energy followed by an assessment of their evaluation and a discussion of the Independent Evaluator evaluation activities for these same programs.

Independent Evaluator Assessment of Duke Energy 2010 Reported Savings and Evaluation

Table 16 shows what type of evaluation (i.e., impact or process) each of Duke Energy's programs received in support of the 2010 Portfolio Status Update filing. Note that some of these programs were addressed in evaluation reports completed prior to 2010. As discussed in the 2009 programs section above, the Independent Evaluator encourages Duke Energy to continue to move toward an evaluation cycle that more closely matches Ohio's annual Portfolio Status Update cycle to ensure that the Update reflects the best data available.

As demonstrated in Table 16, coverage across programs was relatively comprehensive, with three of the four programs received some level of both a process and impact evaluation. As in 2009,

TecMarket Works developed separate reports to address individual programs and these studies were included as separate appendices to Duke Energy's 2010 Portfolio Status Update report.

Table 16: Duke Energy 2010 Evaluation Activities by Program

Program	Reported Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
SAW Smart $aver Residential	214,535	✓	✓
Home Energy Comparison Report	2,956	✓	✓
Non-residential Programs			
SAW Smart $aver Non-Residential Prescriptive	84,302	✓	✓
SAW Smart $aver Custom	8,958		

Many of the reports (particularly those relating to estimating savings from audits and home energy comparison reports) had the same problems discussed related to the 2009 evaluations. In general, however, the evaluation methods used by TecMarket were consistent with the evaluation plan approved by the Independent Evaluator prior to the start of the 2010 evaluation work. The Independent Evaluator also reviewed survey instruments and participated in ride-alongs for on-site work, which helped increase our confidence in the overall evaluation.

Issues with the 2010 evaluation are discussed below. Several issues are the same as with the 2009 analysis.

The same overarching comment regarding CFLs applies to the 2010 Duke Energy programs:

- **CFL installation rate**. As in 2009, the savings claimed for CFLs in 2010 assumes that 100 percent of the CFLs are actually installed and remain installed. The draft Ohio TRM assumes an installation rate of 81 to 86 percent be applied for CFLs, and the TecMarket survey of CFL recipients as part of the 2010 evaluation work estimated an installation rate of 83.1 percent. We recommend that CFL savings claims be adjusted using either the TRM or TecMarket adjustment factor.

We reviewed all of the 2010 Duke Energy evaluation reports, and issues we found with specific reports are discussed below. Many of the issues found for 2010 are similar to those discussed for the 2009 reports, particularly for the audit-style programs. In some cases, comments are made that point out areas where the evaluation report and/or impact analysis are unclear or not adequately supported. In some more extreme instances, we recommend that the evaluation results not be used to set *ex ante* savings values for these programs in future years.

Specific issues for individual reports are listed below by report title and with a reference to the specific appendix to the Duke Energy 2010 Portfolio Status Update report in which each study can be found.

- **Early Feedback Evaluation of the Home Energy Comparison Report (2010 Portfolio Status Update Appendix E)**[38]. Duke Energy informed the Independent Evaluation team that this report was intended to provide early feedback on this program, and not to establish *ex ante* impacts. With this in mind, and because it was included as an appendix to the 2010 Portfolio Status Report, we provide our comments below as they may help guide future evaluation of this program.

  The report finds that the study results are "quite strong given the relatively small level of savings and the diversity in both the treatment and control groups." However, many of the critical values listed in Table 3 of the report (p. 7) are not statistically significant.

  This analysis does not provide any program theory that would help explain why the method of presenting the results to the customers ("bar/score" versus "usage/line") could result in savings that are four to five times greater, with a possible maximum savings of 10 to 11 percent of annual electricity usage. Given that audit programs are typically expected to save zero to two percent, it seems that the higher savings estimates are likely due to a statistical anomaly rather than an increase in savings due to a change in how the information is presented to the customer. The billing regression also utilized only six months of post-participation billing data, which limits the ability of the model to provide annual impact estimates. Additionally, there was no additional survey effort to determine what specific actions were taken to reduce energy savings that could be linked directly the comparison report. Similarly, the analysis does not adjust savings for those respondents who received CFLs or a rebate through a different Duke Energy efficiency program. Both of these issues are noted in the TecMarket report as qualifiers to their analysis.

  The report does not provide average kWh estimates for participants in this study, only percentage savings estimates. Given these issues, we recommend that a full-year program analysis be conducted for estimating impacts for this program in future program planning.

- **Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio (2010 Portfolio Status Update Appendix F)**[39]**.** The original savings estimate from the billing regression is 2,000 kWh, which is much higher than a typical audit program. It is also far higher than what can reasonably be expected from the measures distributed, especially considering the installation rates reported from the phone survey. Our review of the billing regression results revealed some of the same issues discussed above for the Home Energy Comparison Report. For this model, there are no adjustments for possible participation in other Duke Energy efficiency programs during the analysis period, nor adjustments for CFLs that might have been received from Duke Energy (all of which would help explain some of the savings and would also be counted in the savings achievements of the other programs).

  The estimate is adjusted outside the model, which reduces savings down to 829 kWh. Part of

[38] TecMarket Works. *Evaluation of the Home Energy Comparison Report, Results of an Early Feedback Impact Evaluation*. (Prepared for Duke Energy Ohio, January 27, 2011).

[39] TecMarket Works. *Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio*. (Prepared for Duke Energy Ohio, October 8, 2010).

the adjustment is made for self-selection and false response bias, and the adjustment factors used appear arbitrary with no supporting documentation. While the false response bias is based on survey data and on-site inspections, it is not clear from the report exactly how the adjustment is calculated. For the self-selection adjustment, it is not sufficient to make adjustments based only on "professional judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding reasonable expectations and experience" (page 29). We also disagree with the assertion that these adjustments will result in a conservative or lower bound estimate of savings. While the adjustments result in a lower number, the number is still higher than can reasonably be expected given the nature of the program and the type of measures being distributed. Additionally, if there is self-selection bias present in the survey, then the savings for the non-responding participants will likely be lower than that observed in the survey analysis sample.

While there is an adjustment made for false response bias, there is no analogous adjustment for the recommendations made as part of the program. The same potential for social desire bias exists both for questions regarding measures and those regarding which recommendations from the energy audit are followed. Consequently, if a correction factor is to be applied, a similar correction factor should be applied to both.

Even with these adjustments, the estimated savings are still far higher than we would expect from an audit program and from the measures distributed, given the low installation rates reported. We do not recommend that these results be used to calculate savings for this program.

- **Evaluation of the Non-Residential SAW Smart $aver Prescriptive Program in Ohio (2010 Portfolio Status Update Appendix G).** In our review of the analysis methods and results, we identified some parts of the report that could have benefited from additional detail. For example, the algorithms that caused errors in the third-party program tracking database and what these errors were are not listed. Furthermore, the meaning of "fixture efficacy" in Table 7 of the Impact Analysis section is unclear. The evaluation report notes that the tracking system energy savings were found to be in error and therefore program planning estimates were substituted; however, we found a lack of explanation as to why these planning estimates are an acceptable substitute for tracking data. In another case, two projects in the High Bay Lighting M&V study sample were found to be ineligible for the program and, therefore, had all savings erased from the program totals. In cases like this, we recommend removing only that portion of savings derived from the ineligible measures.

  In Table 7 of the report, a number of sites are noted as having a rebated fixture count that does not match the original, application fixture count. For verification purposes, we recommend that the ratio of rebated to installed fixtures is what should be examined. In Tables 11 and 12 of the report, it is unclear how the savings value for site 8 went from negative to positive since only one type of fixture is noted and program eligibility is not noted. We also found the degree of accuracy between customer application estimates and manufacturer's catalog data fixture wattage to be fairly good and not as widely varying as the report asserts. Finally, the evaluation uses the assumption that a CFL has an annual usage of 3,700 hours (Table 2) and estimates the effective useful life for the CFL to be 12 years.

Considering that a CFL has a 10,000-hour life on average, this estimate is over four times too high.

- **Process Evaluation of a Personalized Energy Report Program in Ohio (2010 Portfolio Status Update Appendix H).**[40] While this report is of a process evaluation, some time is devoted to discussing how savings should be calculated for the program. No actual savings numbers are provided, however, so we were unable to assess the full calculation as part of our review.

  The report discusses correcting savings for self-selection bias and social desirability bias. While it is good that these potential biases are considered, the corrections made are arbitrary and not supported. Again, as in the Home Energy House Call report, the rationale for assuming a 29.9 percent self-report bias is based on "professional judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding reasonable expectations and experience" (page 28). The adjustment for social desirability bias is set at 17 percent for CFLs but zero percent for recommendations made as part of the audit survey. The same potential for social desirability bias exists both for questions regarding CFLs and those regarding which recommendations are followed from the energy audit. Consequently, if such an adjustment is going to be made (and more justification is needed prior to making this adjustment), then a similar correction factor should be applied to both the CFL and energy audit questions.

- **Process and Energy Impact Evaluation of the Power Manager Program in Ohio (2010 Portfolio Status Update Appendix I)**[41]. Our review of the Process and Energy Impact Evaluation of the Power Manager Program identified several issues. In the Summary of Findings section, the team found it is unlikely that the actual participant count and switches associated with each participant were equal for both the 75 percent and 50 percent cycle options.[42]

  Further on, in the M&V data collection subsection of the Impact Analysis, the report claims that device replacement does not bias the results. However, installing new switches inherently introduces bias and in this context the word "results" implies an overall estimate. Therefore, the evaluator suggests that "results" be replaced with "site-specific load reduction estimates." The team also found it unclear as to why premise kWh/kW is distinguished from other variations and what "natural duty cycle" means.

  We also found a number of apparent computational errors in the report. Some of these errors include the potential impact corresponding to hour 16 in Table 5 and hours 17 and 18 in Table 6. The team finds that this potential impact does not approximately equal switch count

[40] TecMarket Works. *Process Evaluation of the Personalized Energy Report Program in Ohio*. (Prepared for Duke Energy Ohio, December 2, 2010).

[41] TecMarket Works. *Process and Energy Impact Evaluation of the Power Manager Program in Ohio*. (Prepared for Duke Energy Ohio, February 24, 2011).

[42] Duke Energy has re-filed this report as part of its 2011 Portfolio Status Update report with the corrected participation information.

multiplied by kW/switch and, therefore, is incorrect. In Table 8 of the report, we found the de-rating factors for CSE load control devices to be quite poor. It is also suggested that a weighted average temperature for the periods listed in Table 9 be included in the report in addition to a plot of impact versus heat index or outdoor air enthalpy. This would aid in clarifying the findings. Finally, the significance of the temperatures listed in Table 11 was unclear, although it appears that they are ASHRAE 2.5 design numbers.

Independent Evaluator Recommendations for Duke Energy

Based on our review of the 2009 and 2010 Duke Energy Portfolio Status Update reports and associated evaluation research, we make the following recommendations.

Recommendation #1: Apply an installation rate adjustment factor for CFLs. It is standard practice to assume an installation rate of less than 100 percent for CFLs to reflect the fact that not all CFLs will get installed and remain installed. The draft Ohio TRM recommends using an installation rate of 81 to 86 percent depending on the delivery mechanism (i.e., point-of-sale versus direct install). We recommend that all CFL savings be adjusted in evaluations for future program planning using an installation rate adjustment factor derived from either current evaluation research using primary data collection or taken from the draft Ohio TRM.

Recommendation #2: Improve Audit and Home Energy Comparison Report impact methods. Both the 2009 and 2010 versions of these programs need more rigorous research to estimate impacts. Acceptable methods include a billing analysis combined with a survey that clearly identifies which activities undertaken by the participant were a direct result of the audit or comparison report. Savings resulting from installing measures through other Duke Energy programs where a rebate is provided (including any upstream lighting programs for CFLs) must be excluded from the savings calculations for these programs. Additionally, adjustments made to correct for biases outside the model must include some type of supporting documentation beyond the evaluator's own experience and opinion.[43] If the impact evaluation does not include these components, we recommend that no savings be reported for the audit and home energy comparison report programs.

Unless the issues with the billing regression can be addressed and a more realistic savings estimate produced, we recommend that a simpler impact approach be adopted using impact values from the draft Ohio TRM for the various measures provided in the program kit multiplied by the installation rates estimated from the participant phone survey. If one of these methods is not adopted, we recommend that no savings be reported for the audit and home energy comparison type programs.

Recommendation #3: Do not use 2009/2010 evaluation results to set *ex ante* savings values for future program planning when the evaluation reports do not adequately document savings. As discussed above, there are a few programs for which we did not find the impact estimates credible given the methods and results presented in the evaluation reports. In 2009, these programs include

[43]During a review of an earlier draft of this report, Duke Energy informed the Independent Evaluator team that these types of opinion-based adjustments would not be made in future evaluations. We will comment on this issue if it arises in future evaluation reports, but these types of adjustments may be limited to just the 2009 and 2010 program years.

PER, HEHC, NEED, Energy Efficiency Website, and Payment Plus Energy Education Workshop. In 2010 this included the HECR and HEHC programs. For the reasons stated earlier, we do not recommend that the evaluation results be used to set the *ex ante* impacts for these programs in future years.

Recommendation #4: Develop a complete list of sources for *ex ante* savings values. Origins of *ex ante* savings values in the 2009 and 2010 Portfolio Status Update and evaluation reports are not clear, although some references are provided in report appendices. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference.

Recommendation #5: Adopt the process evaluation recommendations presented in the TecMarket evaluation reports. The process evaluation work conducted by TecMarket resulted in a series of recommendations on how to improve the Duke Energy programs. While these recommendations are not repeated here, the Independent Evaluator did review the recommendations and the research supporting them. Since we were able to review the data collection activities as they occurred, we believe that the TecMarket process evaluation report conclusions are sound and therefore the recommendations presented in the reports should be considered by Duke Energy.

Recommendation #6: Update evaluation research to be more current and Ohio-specific. While we recognize the desire by Duke Energy to have consistent and aggregated evaluation research conducted across states, there is too much reliance on evaluation research that is outdated and not conducted within Ohio. Future evaluation work should rely on primary data collected from Ohio customers and be completed as close as realistically possible to the program year being evaluated.

Recommendation #7: Full citations needed for secondary research and all adjustment factors. As noted, there are multiple instances in which adjustments are made and sources referenced that do not contain complete citation information. Without this information, it is not possible to follow up with these other studies to determine if they are being used appropriately. Future evaluations should include complete references for all such studies.

FirstEnergy Ohio Operating Companies

FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company ("CEI"), Ohio Edison Company ("Ohio Edison"), and The Toledo Edison Company ("Toledo Edison") (collectively "Companies"). The Companies' Portfolio Status Report was hampered by the fact that as of December 31, 2010, the Companies' Energy Efficiency and Peak Demand Reduction Plans (EEPDR Plans) were not yet approved, and therefore there were no program results from approved EEPDR Plans to address for the established reporting period. Instead, the Companies' 2010 Portfolio Status Update Report[44] provided results for those programs in effect during 2010 that were either independently approved by the PUCO (Interruptible Demand Reduction, Home Energy Analyzer and Community Connections) or authorized by statute (Mercantile Customer Program and the T&D Program).

[44] FirstEnergy's Portfolio Status Report and all of the ADM Associates evaluation reports are contained in *Energy Efficiency & Peak Demand Reduction Program Portfolio Status Report* filed with the PUCO on May 23, 2011.

The following programs made up the 2010 program portfolio:

Residential Sector

- Home Energy Analyzer (Telephone and Online Audits)
- Low-Income Community Connections (Weatherization)

Non-Residential Sector

- Self-Direct: Mercantile Customers' Commitment of Resources (Self-Direct)
- Interruptible Demand Reduction

The Companies' evaluation contractor is ADM Associates, which completed impact evaluations for each of the programs. Although ADM did present individual program results tables in each of the three individual program evaluation reports, including detailed per-measure savings results, and the Companies provided a summary table of all *ex ante* savings with its Portfolio Status Report, an overall aggregated evaluation results table for the entire portfolio was not presented. Using the TRC test, the Companies report that both the Home Energy Analyzer program (TRC=1.35) and the Mercantile program (TRC = 156)[45] were cost-effective, while the Low Income Community Connections program was not, having a TRC of 0.26.

2010 Reported Savings and Evaluation Research

As part of the Independent Evaluator analysis, the participant database for the 2010 programs was used to replicate the kWh savings reported contained in the Portfolio Status Update Report. The results of the replication exercise are shown in

Table 17. In general, the participant tracking data were in good shape and there were no significant issues in replicating the savings from the Portfolio Status Update report.

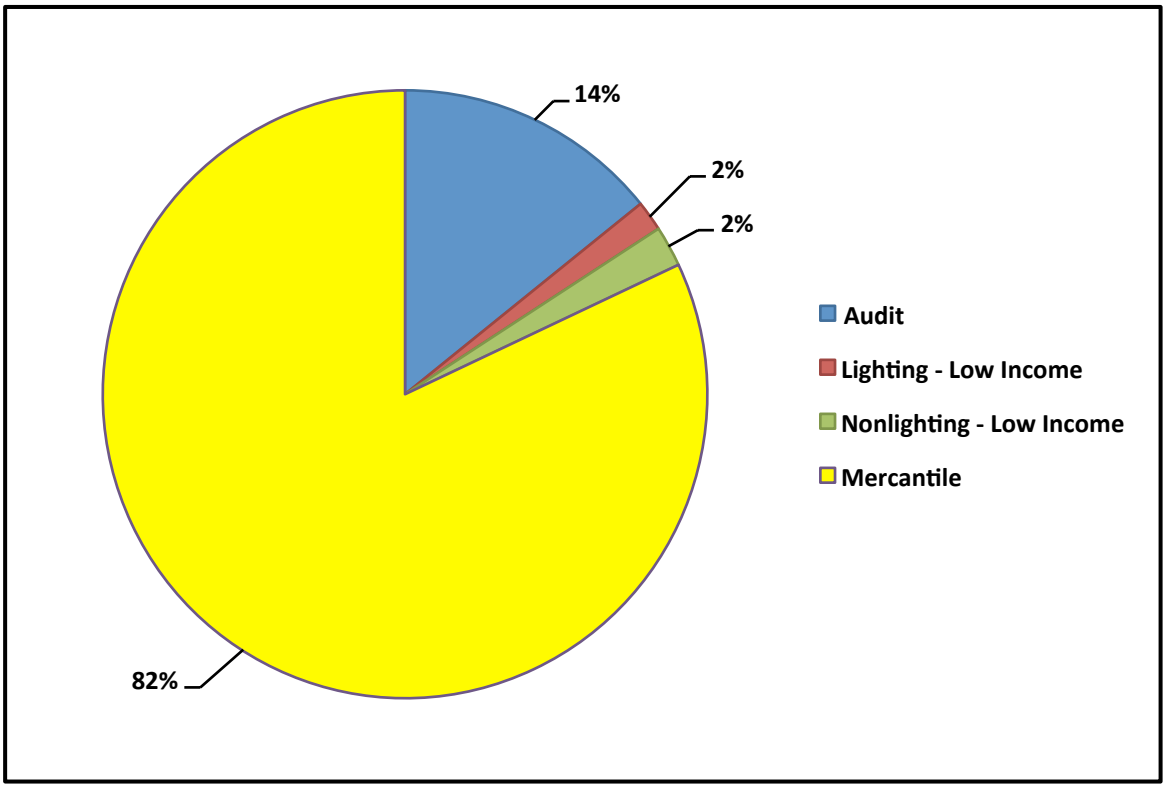
[45] The TRC test calculations for the Mercantile Projects did not include mercantile customer costs, making the number equal to a Utility Cost Test ("UCT"). The Companies interpreted the customer costs as fixed costs (since they happened in the past prior to the start of the Mercantile program) and excluded them from the cost-effectiveness calculation. A similar argument could be made for excluding energy savings from the calculation, however, since these were achieved by past activities done prior to the Mercantile program being instituted. To avoid confusion in the future, we recommend that the TRC test be used for Mercantile projects and that the customer costs be included in this calculation.

Table 17: FirstEnergy 2010 Reported and Verified Savings by Program

Program	Reported Savings (MWh)	Participant Data Analysis (MWh)	Share of Sector Savings	Share of Portfolio Savings
Residential Programs				
Home Energy Analyzer	13,894	13,894	79%	14%
Low Income Community Connections	3,685	3,684	21%	4%
Residential Total	**17,580**	**17,580**	**100%**	**18%**
Non-residential Programs				
Mercantile	80,109	80,109	100%	82%
Non-residential Total	**80,109**	**80,109**	**100%**	**82%**
Grand Total	**97,689**	**97,689**		**100%**

In addition to replicating reported savings, the participant database was used to characterize where savings were being achieved by sector and end use, as shown in Figure 7. Note that the Mercantile projects will involve installing measures such as lighting, motors, and cooling. Savings were not broken out by measure category for the Mercantile projects, and so these measure savings are aggregated into the 'Mercantile' category in the chart below.

Figure 7: FirstEnergy: Share of Residential and Non-residential Savings by End Use



Note: Participant database did not break out Mercantile project savings by measure category, and so these measure savings are aggregated into the 'Mercantile' category. Mercantile project end uses include lighting, motors, cooling and other miscellaneous measures.

Table 18 shows what type of evaluation each of the Companies' programs received in 2010. As demonstrated in this table, no process evaluations were conducted.

Table 18: FirstEnergy 2010 Evaluation Activities by Program

Program	Reported Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Home Energy Analyzer	13,894	✓	
Community Assistance (Low Income)	3,685	✓	
Non-residential Programs			
Mercantile	80,109	✓	

ADM's three 2010 evaluation reports covering these programs were included as part of the Companies' Portfolio Status Update filing.

Independent Evaluator Assessment of the FirstEnergy 2010 Reported Savings and Evaluation

In general, we found most of the impact evaluation reports to be reasonably thorough and to adhere to standard evaluation practices for the types of programs covered. The evaluation methods and reporting formats followed were also consistent with the evaluation plan approved by the Independent Evaluator prior to the start of the 2010 evaluation work. As discussed below, however, the final impact results discussion would have benefited from additional detail about some of the methods used to determine the final results.

Specific issues with the FirstEnergy evaluation reports are discussed below by report title with a reference to the specific appendix to the FirstEnergy 2010 Portfolio Status Update report in which each study can be found.

- **Impact Evaluation of 2010 Community Connections Program (Appendix B).**[46] Overall, the format and content of the report adhered to the Outline for Ohio Utilities Program Evaluation Reports 2011 provided to the utilities by the Independent Evaluator (and provided as Appendix E hereto).

  In general, there is not adequate detail in the evaluation report on how the savings are calculated. Although the methods are described and generally rely on the TRM calculation methods, changes to key parameters are not discussed in detail. While the reader is referred to the calculation in the TRM, the report would have benefited from having the calculations included in the report itself. It is also unclear what verification adjustments, if any, were made based on the data collected during the evaluation. Although the report states that the evaluation conducted a phone survey to determine verification rates for program measures, the verification rates are never reported and they do not appear to be part of any of the savings calculations. At a minimum, the CFL installation rate from the phone survey should have been reported as this was specifically mentioned in the evaluation report. To calculate impacts for CFLs, rather than use the installation rate adjustment factor of 0.81 recommended for direct install CFLs by the draft Ohio TRM, the evaluator uses a higher rate of 0.89, but does not provide a source for this adjustment, only noting that this rate is based on "a recommendation from Duke Energy based on an evaluation of their CFL program" (page 4-2).

  Due to the lack of detail, it is not possible to assess the credibility of the savings estimates presented in this report. However, the average estimated savings per household of approximately 703 kWh is not unrealistic given the measures installed.

- **Impact Evaluation of 2010 Home Energy Analyzer Program (Appendix C)**[47]**.** The Home Energy Analyzer program has an original *ex ante* value of 300 kWh, which is generally consistent with what we would expect for this type of program. However, the impact

[46] ADM Associates. *Impact Evaluation of the 2010 Community Connections Program.* (Prepared for FirstEnergy, April 22, 2011).

[47] ADM Associates. *Impact Evaluation of the 2010 Home Energy Analyzer Program.* (Prepared for FirstEnergy, April 7, 2011).

estimates from the evaluation report are substantially greater than the original *ex ante* value. The evaluation presents impact estimates derived from a fixed effects billing regression model that average 416 kWh annually, with a range of 233 to 1,032 kWh depending on whether it was an online or phone audit.

The billing regression results, particularly the 1,032 kWh estimate for the phone audit, are much higher than what we have seen for similar audit programs. Additionally, there is no program theory provided in the report that would help explain the large difference in savings between the two audit types available through the program. If a billing regression is to be used in the future to estimate audit impacts, it should be accompanied by a phone survey or some other method to identify those specific efficiency actions taken that can also be attributed directly to the audit program. Short of additional analysis to identify more clearly what changes were made due to the audit, we recommend that the 2010 *ex ante* value continue to be used for determining savings for this program. We do not recommend that the evaluation estimate of savings be used in future program planning.

- **Impact Evaluation Report of 2010 Mercantile Program (Appendix D)[48].** The Detailed Evaluation Findings section of the report summarizes kWh savings and kW reductions for the sampled sites and at the program level. *Ex ante* savings, realization rates, and e*x post* savings are reported in tables for the sampled sites by stratum. Program-level *ex ante* and *ex post* savings are reported in tables by service territory.

  There is no detail provided on why particular savings adjustments were made for individual projects to create the *ex post* impacts. The methods used in the impact analysis (e.g., desk review and on-site metering) are only described at a general level. While the methods described are standard for these types of projects, there is not enough detail provided on the actual calculations to assess the credibility of the impact analysis. In the future, we recommend at least some discussion for each project included in the desk review or on-site sample.

Independent Evaluator Recommendations for FirstEnergy

Based on our review of the 2010 Companies' Portfolio Status Update reports and associated evaluation research, we make the following recommendations.

Recommendation #1: Develop a complete list of sources for *ex ante* savings values. The sources for the original *ex ante* savings are not clear from the 2010 Portfolio Status Update and evaluation reports. In 2012, we recommend that a comprehensive listing of all *ex ante* savings values and full report citations be compiled for future reference. Given that the Companies are just beginning their programs, this process should be relatively straightforward.

Recommendation #2: Incorporate customer costs into the TRC cost-effectiveness calculations for the Mercantile Program. As noted earlier, the mercantile projects completed prior to the

[48] ADM Associates. *Impact Evaluation of the 2010 Mercantile Customer Program.* (Prepared for FirstEnergy, April 21, 2011).

program being established did not include customer costs in the related cost-effectiveness calculation. In order for the TRC to be calculated in a manner consistent with standard best practice, we recommend that customer costs be included in future TRC calculations.

Recommendation #3: Improve audit impact methods. Acceptable methods for calculating impacts of audit programs include a billing analysis combined with a survey that clearly identifies which activities undertaken by the participant were a direct result of the audit report. Savings resulting from installing measures through other programs which provide a rebate (including any upstream lighting programs for CFLs) must be subtracted from the savings calculations. While the Companies did not have other rebate programs in 2010, this may be an issue in future years as more programs are added. Given the issues discussed above, we do not recommend that the evaluation report results for the audit program be used to determine *ex ante* savings values for future program years.

Participant Survey Results

A separate component of the Independent Evaluator responsibilities is to conduct a limited amount of process evaluation research. For this first verification report, this involved a limited number of participant phone surveys in addition to a non-participant market baseline survey (discussed in the following chapter). For the participant surveys, residential and non-residential customers who had participated in a variety of programs operated by AEP Ohio, DP&L, and Duke Energy were called. FirstEnergy had not yet begun implementing its programs at the time these surveys were fielded and, therefore, is excluded from these results.

Select residential and non-residential programs contributing the most to the utilities' reported savings were targeted for inclusion in the participant survey effort. These programs also had customer contact information (including names and phone numbers) available from the utilities, which was required in order to conduct the surveys.

The residential programs covered in the participant surveys are as follows:

- AEP Ohio Appliance Recycling Program;
- DP&L Appliance Recycling Program;
- DP&L Residential HVAC Rebates Program;
- DP&L HVAC Diagnostic &Tune-up Program; and
- Duke Energy SAW Smart $aver HVAC Program.

The design of these programs improves residential energy efficiency through the replacement and recycling of inefficient refrigerators and freezers, replacement of inefficient HVAC equipment, and tune-ups of existing HVAC systems.

The non-residential programs covered in the participant surveys are:

- AEP Ohio Business Prescriptive Incentives Program;
- DP&L Non-Residential Prescriptive & Custom Rebate Program; and
- Duke Energy Non-Residential SAW Smart $aver Prescriptive Incentive Program.

These non-residential programs provide rebates for a variety of different measures. However, the research team focused its surveying effort on participants who received rebates for measures resulting in the highest energy savings for the programs evaluated. Most of these measures fall into the lighting measure group including T5/T8 linear fluorescent fixtures, LED exit signs, CFLs, and CFL fixtures.

Data Collection and Methodology

Itron implemented the data collection through the administration of phone surveys using its Computer Assisted Telephone Interviewing (CATI) Center located in Berkeley, California. Data collection for the residential participant surveys occurred throughout June 2011. The CATI center conducted the non-residential surveys during June and the first week of July in 2011. All customer

contact information came from the data supplied by utilities on their participating customers for each program.

A quota of completed surveys was set for each utility prior to the surveys being fielded. The quota was set large enough to ensure that results would be reliable for each utility. Due to budgetary reasons, we did not attempt to survey every program, but rather set an aggregate survey quota for each utility and focused the survey on programs with significant amounts of participation. The quotas by utility and program are shown in Table 19 and total 320 completed surveys across the three utilities. The research team surveyed 324 residential customers across the five programs included in the participant surveys, thereby surpassing the original quota of 320 surveys. A total of 281 non-residential participant surveys were conducted across prescriptive programs included in this study which surpassed the quota of 280 by one survey, as shown in Table 20.

Table 19: Distribution of Residential Participant Surveys by Program

Program	Quota	Completed Surveys	Percent of Total
AEP Ohio Appliance Recycling Program	100	101	31%
DP&L Appliance Recycling Program	40	41	13%
DP&L HVAC Program	40	40	12%
DP&L HVAC Diagnostics and Tune-up Program	40	40	12%
Duke Energy Residential SAW Smart $aver Program	100	102	31%
Total	**320**	**324**	**100%***

*Percent of Total may not sum exactly to 100 percent due to rounding.

Table 20: Distribution of Non-Residential Participant Surveys by Program

Program	Quota	Completed Surveys	Percent of Total
AEP Ohio Prescriptive Program	100	99	35%
DP&L Prescriptive and Custom Program	80	81	29%
Duke Energy SAW Smart $aver Prescriptive Program	100	101	36%
Total	**280**	**281**	**100%**

Topics covered in the participant surveys include sources of program awareness, motivations for participation, level of participant satisfaction with program implementation and delivery, and barriers to participation. The surveys also included a battery of questions to clarify these customers' decision-making processes and the level that program benefits influenced their decision to recycle refrigerators and freezers, purchase new energy efficient equipment, and/or perform diagnostic services and tune-ups on HVAC equipment.

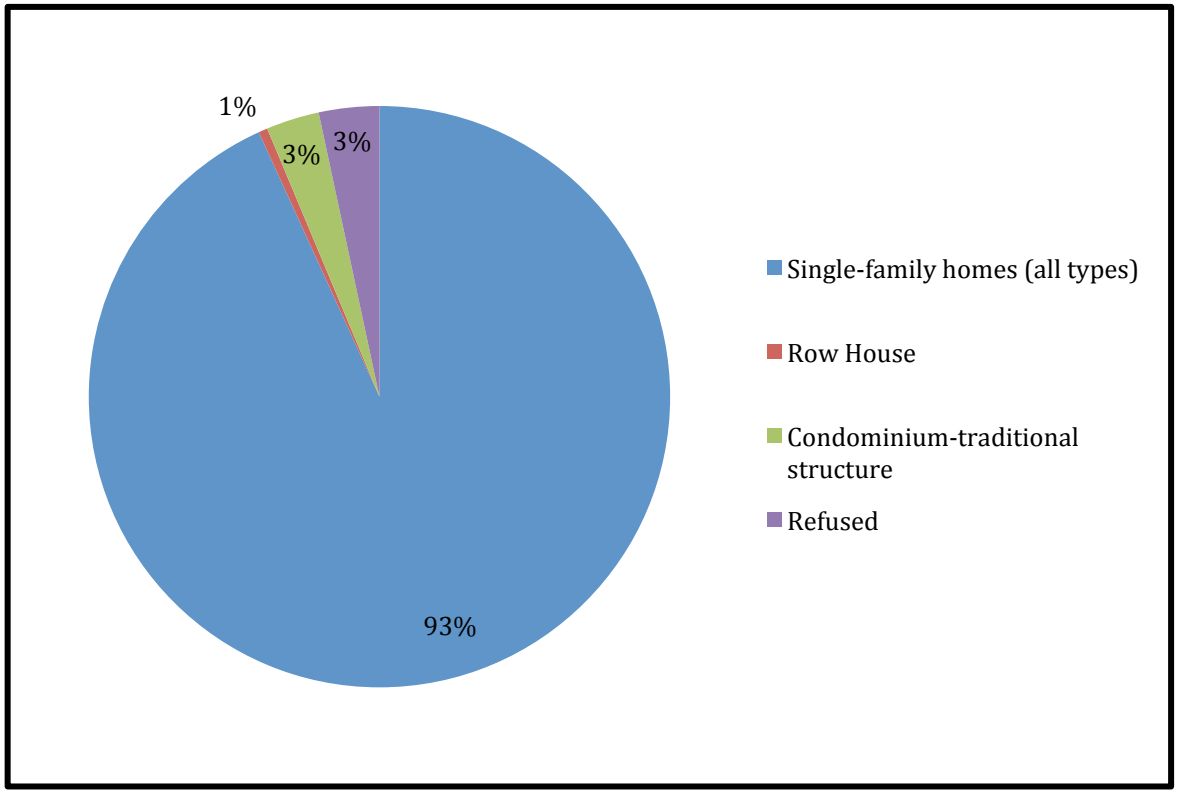
Residential Participant Survey Results

A summary of the overall residential participant survey findings is presented below. Findings are presented for all programs, unless a specific program is identified and discussed. In cases where there are significant or interesting differences across utilities, survey responses are reported separately by utility. Otherwise, survey responses are reported in aggregate for the entire residential participant sample.

Demographics

All survey participants were asked about their home types and on average across the participants of the five programs, approximately 93 percent live in single-family homes, most of which are detached (see Figure 8).

Figure 8: Home Types Across Ohio Residential Program Participant Surveys (n=324)



On average, 96 percent of participants own their homes. Across the programs, this percentage ranges from a low of 88 percent for DP&L Appliance Recycling program participants to a high of 99 percent for Duke Energy SAW Smart $aver Program (HVAC) participants. The high rate of home ownership is not surprising given that renters are generally less likely to purchase high efficiency appliances that will likely remain with the house if they move.

Program Awareness

The survey next asked participants how they first heard of the programs in which they participated. For the two Appliance Recycling programs (AEP Ohio and DP&L), the most common sources of information were media (39 percent and 27 percent), word of mouth (23 percent and 17 percent), and utility bill inserts (22 percent and 34 percent) (see Figure 9 and Table 21). Very few claimed to have first heard about the program through retailers and salespeople, perhaps implying that retailers are not focusing on marketing the programs as customers come into purchase new cooling equipment.

Slightly more than a third of participants (38 percent) claim to have first heard about the HVAC replacement programs from contractors and installers (also shown in Figure 9 and Table 21). The proportion of DP&L HVAC Diagnostic and Tune-up program participants who heard about this program through contractors and installers is closer to two-thirds. This is not surprising, since this program is primarily driven by the services provided by this trade ally.

Figure 9: First Source of Information about Residential Rebate Programs

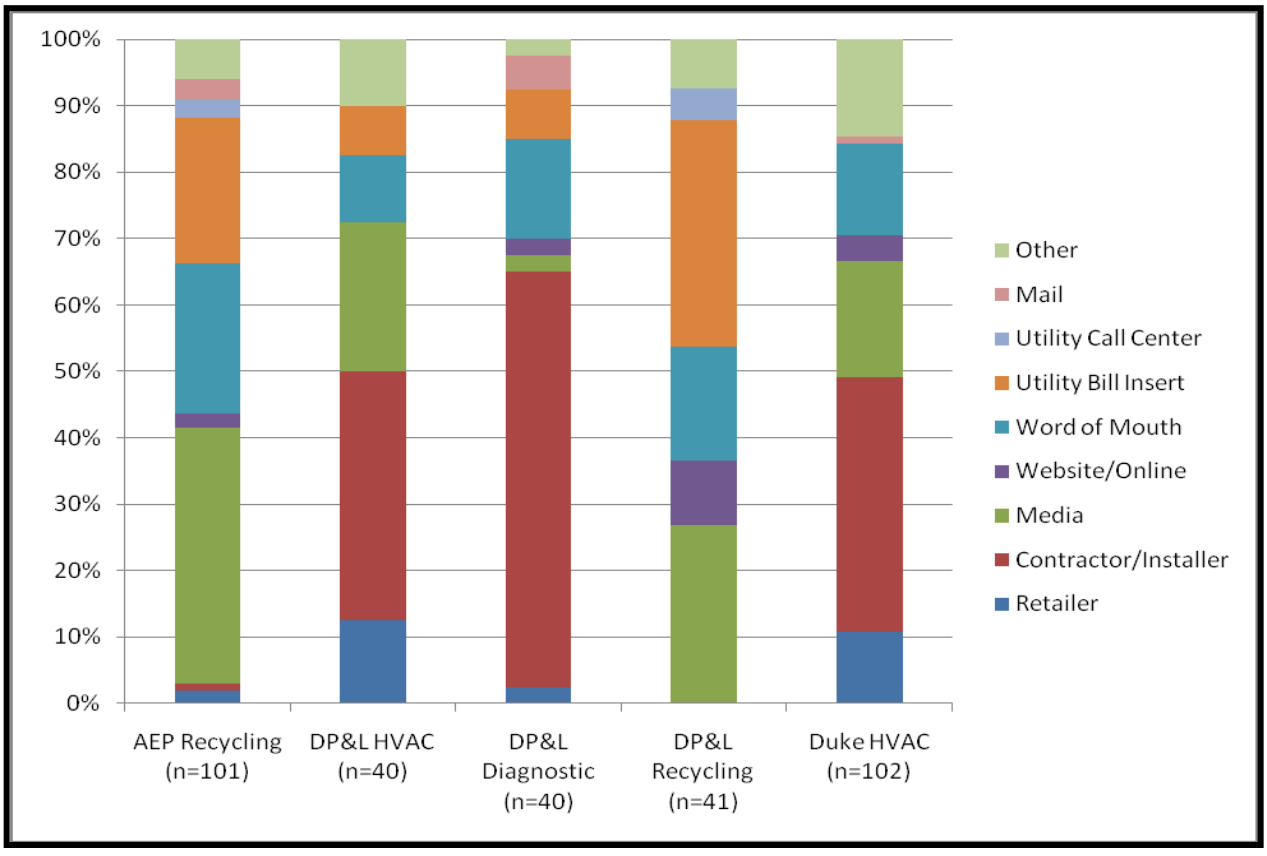


Table 21: First Source of Information about Residential Rebate Programs

First Information Source	AEP Ohio Recycling	DP&L HVAC	DP&L Diagnostic	DP&L Recycling	Duke Energy HVAC
Retailer	2%	13%	3%	0%	11%
Contractor/Installer	1%	38%	63%	0%	38%
Media	39%	23%	3%	27%	18%
Website/Online	2%	0%	3%	10%	4%
Word of Mouth	23%	10%	15%	17%	14%
Utility Bill Insert	22%	8%	8%	34%	0%
Utility Call Center	3%	0%	0%	5%	0%
Mail	3%	0%	5%	0%	1%
Other	6%	10%	2%	7%	15%
n	101	40	40	41	102

While participants across all of the programs did not mention websites as a predominant way they first heard about the programs, between 15 and 20 percent of Appliance Recycling program participants stated that websites served as an additional source of information about the programs. As shown in Table 22, 10 to 15 percent of HVAC replacement program participants mentioned websites as an additional source of information about the program. Note that a majority of participants only stated a first source of program information.

Table 22: Additional Sources of Information about Residential Rebate Programs

Additional Information Sources	AEP Ohio Recycling	DP&L HVAC	DP&L Diagnostic	DP&L Recycling	Duke Energy HVAC
Retailer	2%	3%	0%	3%	3%
Contractor/Installer	1%	8%	0%	0%	5%
Media	4%	3%	0%	3%	4%
Website/Online	15%	10%	5%	20%	14%
Word of Mouth	1%	5%	0%	3%	3%
Utility Bill Insert	3%	5%	0%	15%	1%
Utility Call Center	8%	0%	3%	0%	1%
No Other Source	62%	62%	90%	53%	64%
Other	4%	5%	3%	4%	5%
n	99	39	39	40	96

The research team asked participants about their level of knowledge about the programs in which they participated. Survey findings show that 61 percent of participants in the DP&L Appliance Recycling program stated they are very knowledgeable, while only 30 to 40 percent of participants across the other programs make the same claim. Virtually all participants stated that they are very or somewhat knowledgeable about ways to save energy in the home.

Barriers to Participation

Budget constraints can be an obstacle to making investments in energy efficient equipment. For participants in the AEP Ohio and DP&L Appliance Recycling programs, and DP&L's HVAC Diagnostics and Tune-up program, 38 to 45 percent claim such constraints are a large obstacle (see Table 23). About the same proportion indicated that budget constraints are a medium-sized obstacle. For the HVAC replacement programs, only about 23 to 24 percent claim it is a large obstacle, and about 15 percent claim it is a small obstacle. For the DP&L Diagnostic program and Recycling program, only five percent say it is a small obstacle.

Table 23: Size of Budget Constraint as an Obstacle to Making Investments in Residential EE Equipment

Budget Constraint as an Obstacle	AEP Ohio Recycling	DP&L HVAC	DP&L Diagnostic	DP&L Recycling	Duke Energy HVAC
Large obstacle	38%	23%	43%	44%	24%
Medium-sized obstacle	38%	48%	48%	39%	41%
Small obstacle	10%	15%	5%	5%	17%
Not an obstacle	14%	13%	3%	12%	17%
Don't Know	1%	3%	3%	0%	2%
n	101	40	40	41	102

Program Satisfaction

The survey asked all residential participants who filled out their own rebate applications how satisfied they were with the ease of completing them. An average of 73 percent across all programs was very satisfied and did not find difficulties with filling the application out. For the three HVAC programs, 85 to 95 percent of surveyed participants were very satisfied with the contractor who performed the installation and/or diagnostics. A majority of participants in the two HVAC replacement programs also had an inspection of their equipment and on average, 90 percent were very satisfied with the inspection process.

Virtually all appliance recycling and HVAC replacement program participants were very or somewhat satisfied with the rebate amount received when they recycled their old units. Approximately 50

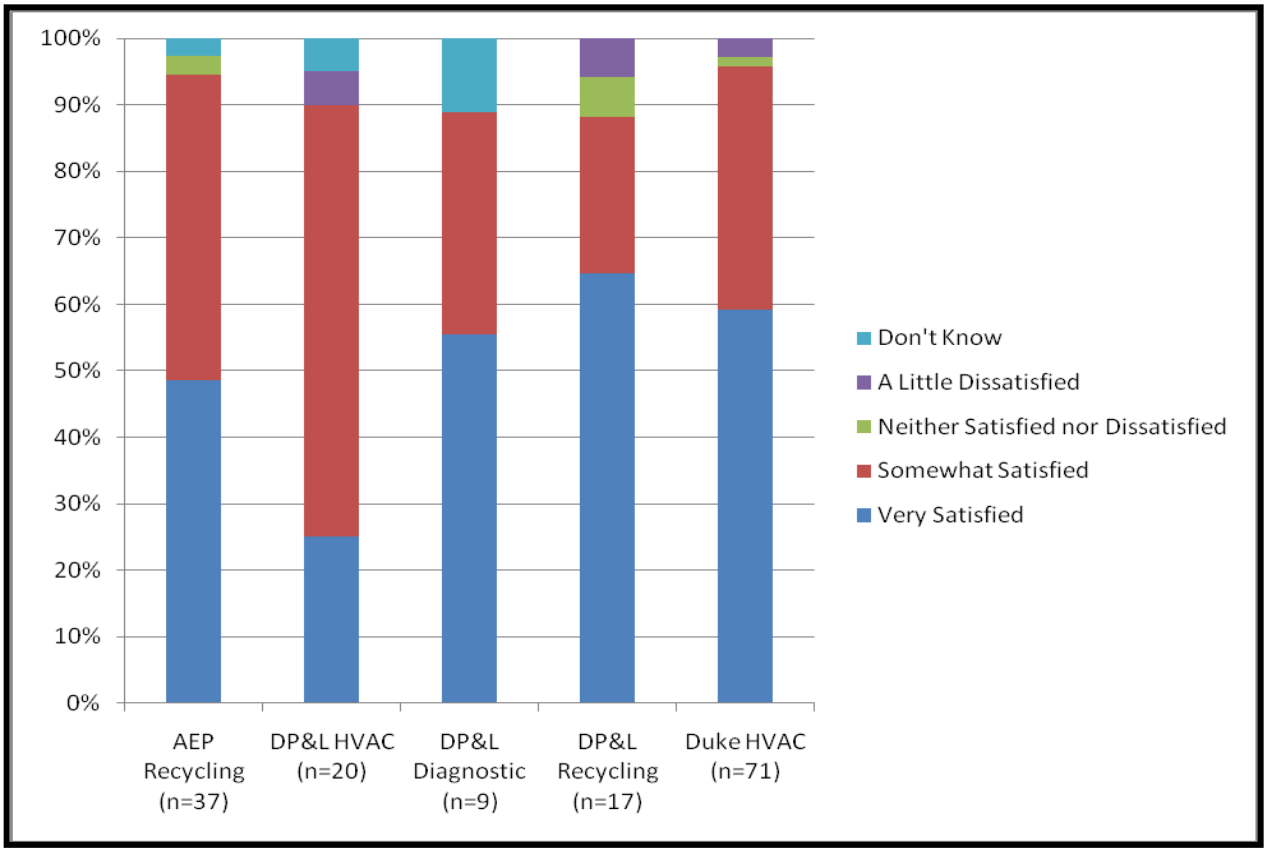
percent of the HVAC Diagnostic and Tune-up program participants were very or somewhat satisfied with the program rebate amount received, with the other 50 percent stating that they did not know.

About 70 percent of the appliance recycling program participants and 66 percent of the HVAC replacement program participants were very satisfied regarding the length of time it took to receive their rebates.

Participants were also asked if they noticed any savings on their energy bill after installing new equipment or tuning up their existing HVAC equipment. Of the appliance recycling participants, 36 to 40 percent of participants stated that they noticed savings. Fifty to 70 percent of HVAC replacement participants noticed savings, while only about 23 percent of HVAC diagnostic and tune-up program participants noticed any energy bill savings.

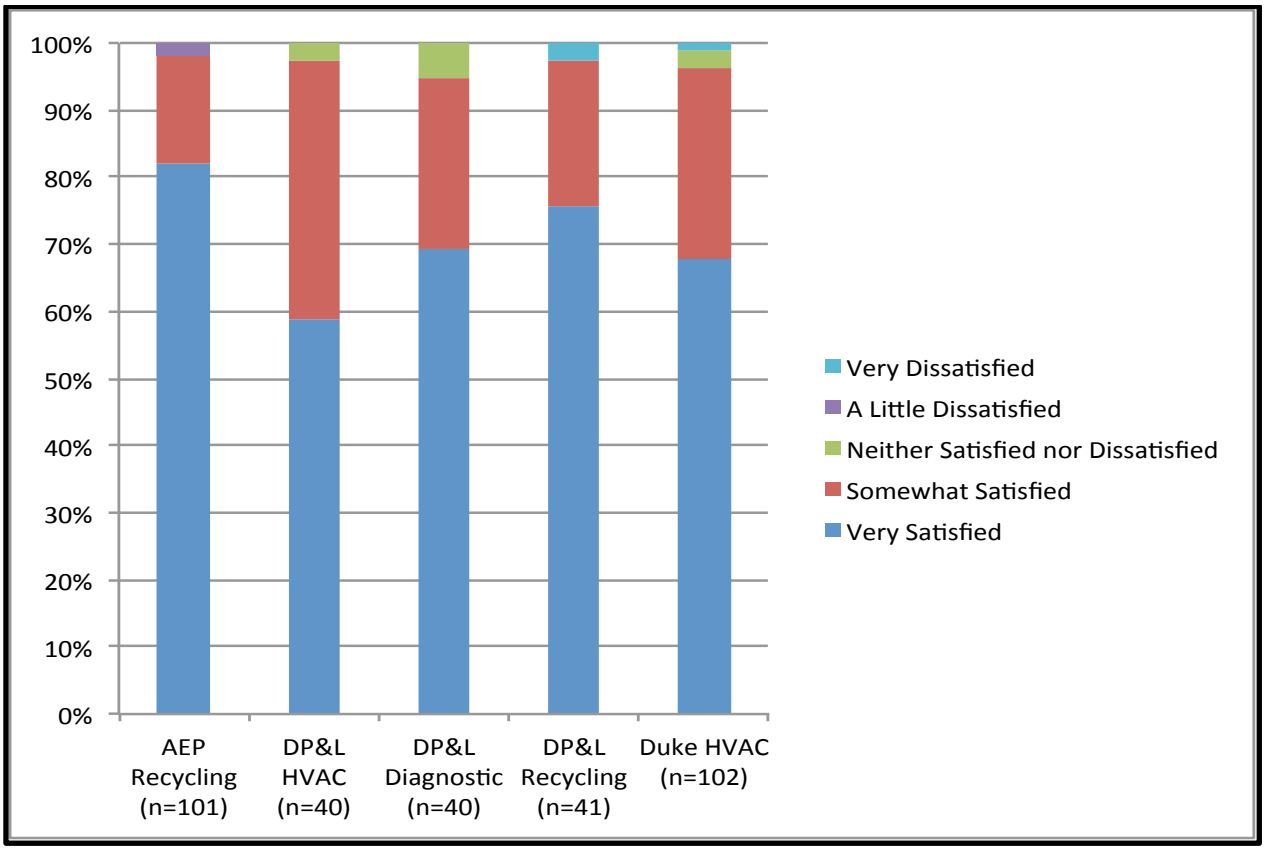
Of those participants who noticed monetary savings on their energy bills, the survey asked how satisfied they were with the savings they received. For virtually all of the programs, approximately 90 percent of participants reported being very or somewhat satisfied (see Figure 10). Notably, far fewer DP&L HVAC replacement program participants were very satisfied (25 percent) relative to those in the other programs (57 percent on average). Note that for all programs, those respondents who did not notice any bill savings (and therefore were not asked this question) were likely less satisfied with bill savings. Findings shown in Figure 10 should be viewed within this context.

Figure 10: Level of Satisfaction with Energy Bill Savings - Residential Rebate Programs



When asked about overall satisfaction with the residential rebate programs, participants in the Appliance Recycling programs had a higher proportion of "very satisfied" responses (78 percent, on average) relative to the HVAC replacement and HVAC Diagnostic programs (64 percent). Over 90 percent of participants are very or somewhat satisfied with the rebate programs overall (see Figure 11.) This result confirms the generally high satisfaction ratings reported in the utility evaluation studies.

Figure 11: Overall Level of Satisfaction with Residential Rebate Program



Free Ridership

As discussed earlier in this report, one of the goals of the participant survey was to gauge the potential for free ridership among current program participants. All programs will likely have some level of "free riders," or participants who would have purchased energy efficient equipment without program rebates. The purpose of asking several free ridership questions in this survey is to determine if this is a significant enough issue that the PUCO should start requiring Ohio utilities to report net energy savings, which would adjust gross savings to account for free ridership.

Measuring free ridership is a complex process that requires more than the few questions that were included in this survey. A well-designed battery of free ridership questions will have multiple

questions addressing similar topics to help ensure that respondents are answering questions consistently. As shown below, even these questions can yield inconsistent responses. For example, customers claim that equipment cost is a significant barrier to installing energy efficiency in response to one question, while in answering another indicate that they are likely to install the equipment even if a rebate were not available. The issue is further complicated by imperfect recall by respondents of the purchase process they went through when installing the equipment. The customer may also not be aware of other market factors relating to the equipment. For example, they may state they would have purchased the same equipment without a rebate, but the equipment (or qualified installation contractors) may not have been available if the rebate program did not exist.

The results of these questions do indicate that there is likely some level of free ridership with the programs examined. However, due to the above-mentioned complicating reasons, the responses should be used for illustrative purchases only – a more thorough series of questions combined with an algorithm for scoring responses is needed to develop a more rigorous estimate of free ridership (and ultimately net impacts.)

With this context in mind, the responses to the questions relating to free ridership are presented below.

The first of the free ridership test questions asked appliance recycling program participants how important the rebate was to their decision to recycle their refrigerators/freezers. Based on the responses presented in Table 24, DP&L Appliance Recycling participants found the rebate less important than participants in the AEP Ohio program did. In fact, only slightly more DP&L participants said the rebate was very or somewhat important (56 percent) as opposed to the DP&L participants who said it was not very or not at all important (40 percent).

Table 24: Importance of Rebate on Decision to Recycle Residential Refrigerator/Freezer

Importance of Rebate	AEP Ohio Appliance Recycling Program	DP&L Appliance Recycling Program
Very important	46%	36%
Somewhat important	36%	20%
Not very important	8%	20%
Not at all important	10%	20%
Don't Know	1%	2%
n	101	44

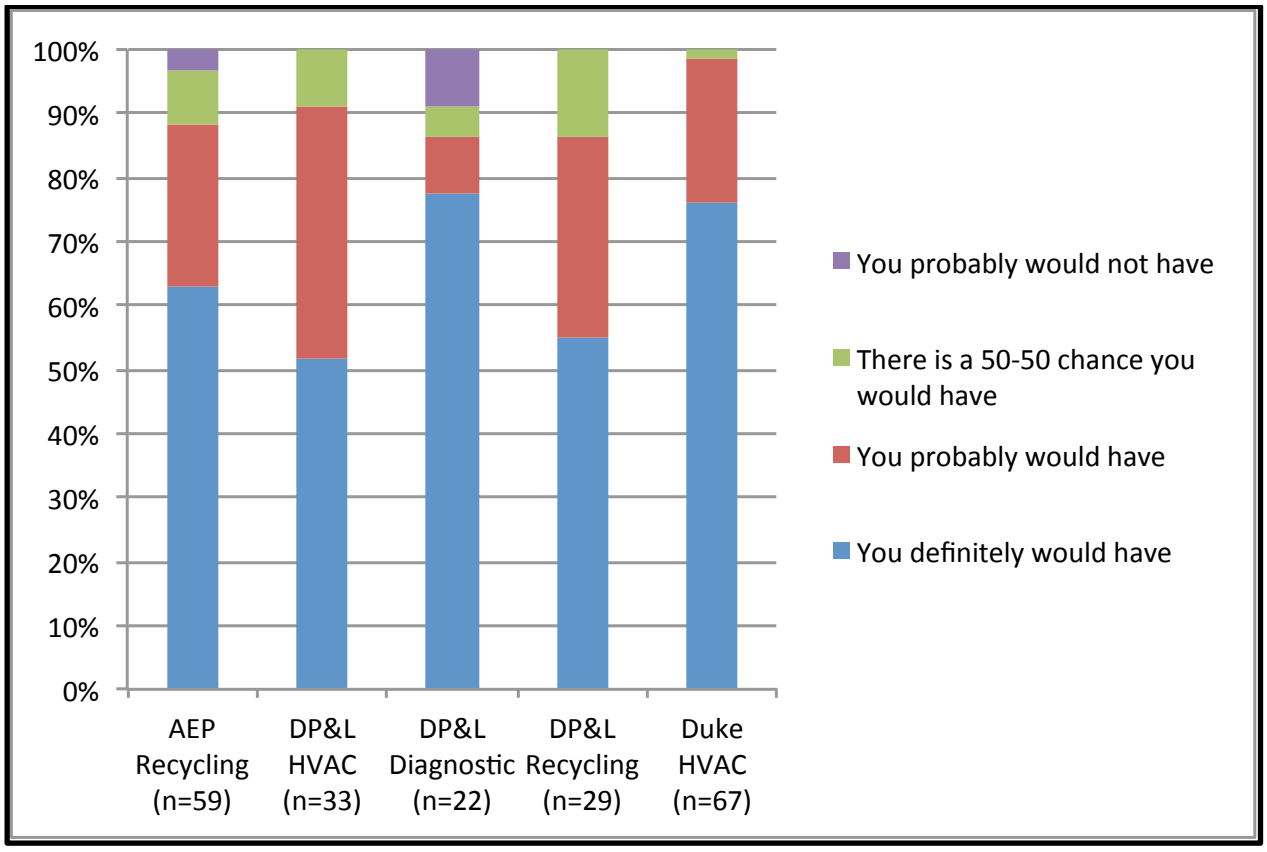
DP&L and Duke Energy HVAC replacement program participants were also asked about the importance of the rebate on purchasing new HVAC equipment. On average, approximately 75 percent of participants found the rebate to be very or somewhat important. About 80 percent of the DP&L HVAC Diagnostic and Tune-up participants stated that the rebate was very or somewhat important.

Table 25: Importance of Rebate on Decision to Purchase New Residential HVAC Equipment/Service Existing HVAC Equipment

Importance of Rebate	DP&L HVAC	Duke Energy HVAC	DP&L Diagnostic Tune-up
Very important	20%	31%	49%
Somewhat important	53%	45%	32%
Not very important	10%	12%	7%
Not at all important	15%	11%	10%
Don't Know	3%	1%	2%
n	40	102	41

Despite the strong level of importance placed upon the rebate in the participation decision, over 50 percent of participants answering this question said that they would have taken action (made the purchase, recycled the appliance, or serviced existing equipment) in the absence of the program. While Figure 12 paints a picture of free ridership, it is important to note that in some cases, the rebate was able to push participants to act sooner than they would have otherwise. Across utilities and programs, 23 percent of respondents said that they would have waited to recycle their appliance, or alter their HVAC system.

Figure 12: Likelihood of Action in Absence of Program



Summary: Key Findings and Recommendations

Program Awareness

Bill inserts and media advertisements are still recommended as ways to inform customers about energy efficiency programs; however, it would also be worthwhile for the Ohio utilities to encourage appliance retailers to inform customers about the availability of rebates for recycling their appliances. By doing so, the utilities could further increase the replacement of older, less efficient refrigerators and freezers with more efficiency ones. This would also help to increase participation in the Appliance Recycling programs.

The utilities should continue to encourage HVAC contractors and installers to inform potential customers of the available equipment rebates. These contractors/installers are a key influence in driving program enrollment. By informing customers of incentives, the Ohio utilities will achieve additional energy savings from customers replacing or improving the operations of older, less efficient heating and cooling equipment.

Barriers to Participation

Across many of the programs included, the survey found budget constraints to be a considerable obstacle in making investments in energy efficient equipment. Providing larger rebates or on-bill financing options can help overcome this barrier and may serve to encourage program participation. However, as a majority of participants indicated satisfaction with the size of program rebates, it is not clear that an increase in the rebate amounts would result in a sizable increase in program participation.

Program Satisfaction

When asked about overall satisfaction with the rebate programs, participants of the Appliance Recycling programs had a higher proportion of "very satisfied" responses (78 percent) relative to the HVAC replacement and HVAC Diagnostic programs (64 percent). With a majority of participants stating that they are very satisfied, it is clear that these programs, as currently implemented, are operating well for participants of all the residential energy efficiency programs included in this evaluation.

Free Ridership

Based on a limited series of survey questions, it appears that there is some amount of free ridership occurring within the Ohio utility efficiency programs. This is not a unique finding as all efficiency programs will have some level of free ridership. As noted previously, the issue of free ridership is a complex one and we did not attempt to develop a comprehensive set of survey questions to explore this issue in the current survey. Rather, the intent was to gauge the degree to which free ridership might be an issue in the early stages of these programs and help inform the PUCO as to the timing of requiring the Ohio utilities to report net impacts. The results presented here do suggest that a more rigorous battery of free ridership questions should be developed so that free ridership and net impacts can be estimated for these programs in the near future.

Non-Residential Participant Surveys

This section presents the results of the non-residential program participant survey, which employed a similar set of questions to that used in the residential participant survey. Aggregated findings are presented for most questions, except in cases where there were significant or interesting differences across programs, utilities, or equipment types. In these cases, survey results are presented by these subcategories of interest.

A total of 281 participants were surveyed, representing a variety of business types including: office, retail, education, grocery, restaurants, health care/hospitals, hospitality, warehouses, industrial and manufacturing, community and religious institutions, agricultural and personal service. Of these, the predominant business types of the surveyed participants were office, retail, schools, warehouses, and industrial electronics and machinery.

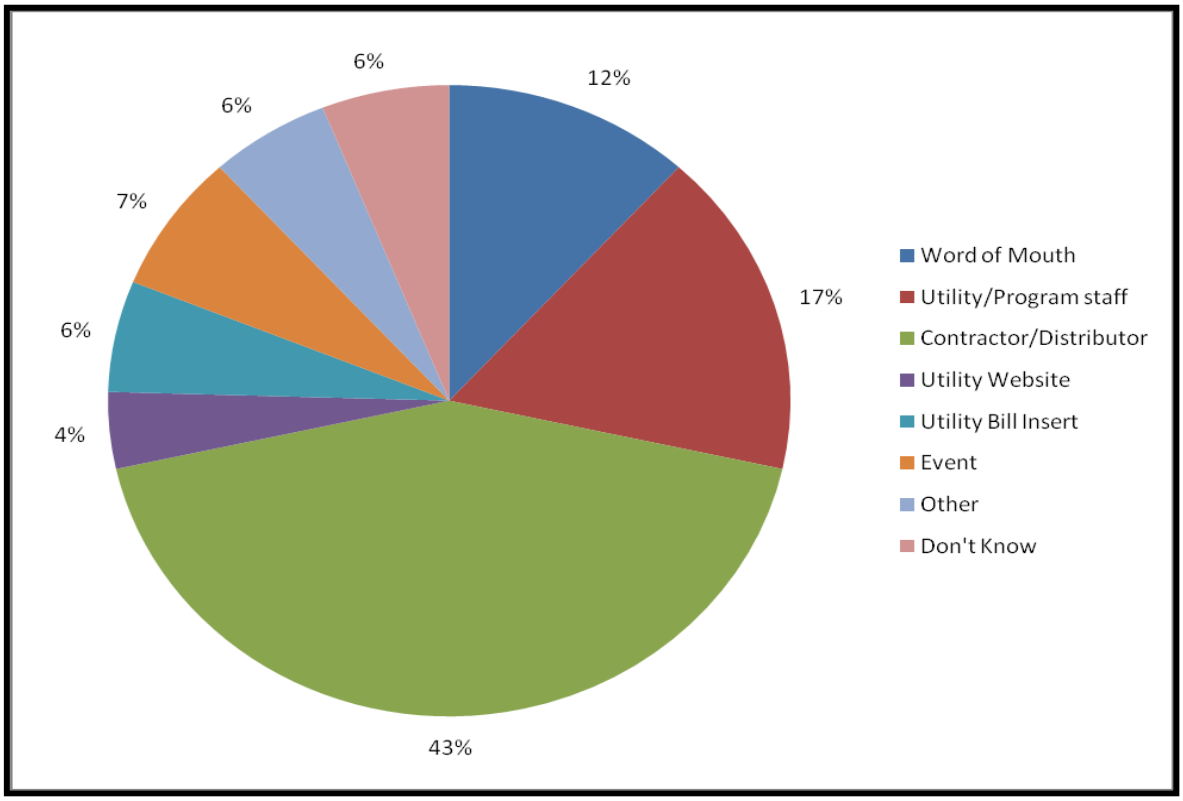
The non-residential programs covered in this the participant surveys are:

- AEP Ohio Business Prescriptive Incentives Program (99 surveys completed);
- DP&L Non-Residential Prescriptive & Custom Rebate Program (81 surveys completed); and
- Duke Energy Non-Residential SAW Smart $aver Prescriptive Incentive Program (101 surveys completed).

Program Awareness

When non-residential participants were asked how they first learned about the programs, they indicated that contractors and distributors were their main source of information (43 percent). Utility representatives and staff (17 percent) and word of mouth (12 percent) follow far behind this as first sources of information about the programs. Other information sources were mentioned as well, including utility website, bill inserts and events such as energy workshops (see Figure 13).

Figure 13: First Source of Information about Non-Residential Prescriptive Programs



The survey asked participants about other sources of information from which they learned about the programs. Over 50 percent stated that they encountered no additional information sources. A sizable proportion, close to 20 percent, found information on the utility websites as well. Overall, the most frequently cited sources of information, as represented by answers to the non-residential participant survey, were contractors and utility websites.

Barriers to Participation

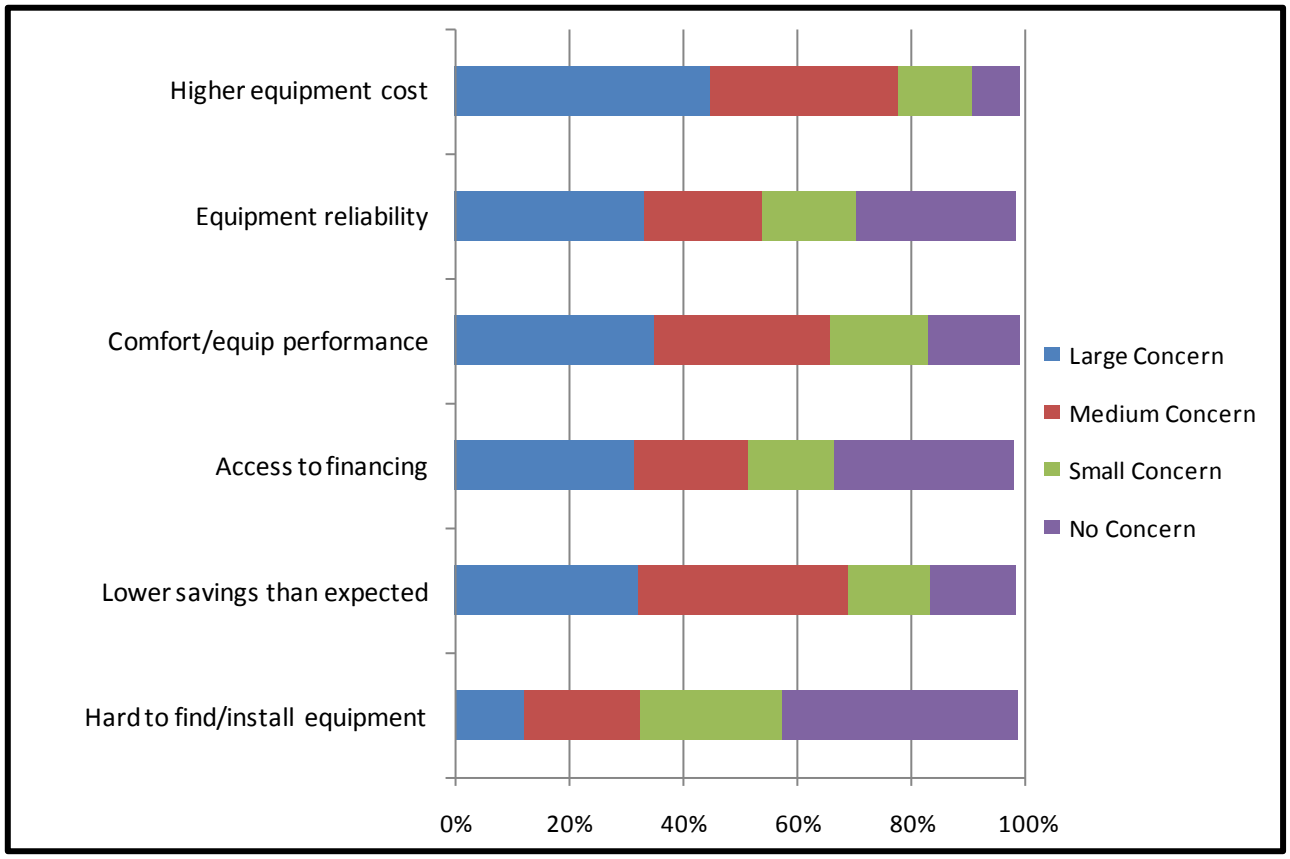
In order to assess how informed participants are about saving energy, the survey asked how knowledgeable they are about ways to save energy at their places of business. Table 26 shows that approximately 22 percent of those surveyed indicated that they were very knowledgeable, while more than half (56 percent) stated that they were somewhat knowledgeable.

Table 26: Knowledge about Ways to Save Energy in Places of Business

Knowledge Level	Percentage
Very knowledgeable	23%
Somewhat knowledgeable	56%
A little knowledgeable	17%
Not at knowledgeable	4%
n	281

The survey also presented a list of possible concerns that participants may have had when considering investments in energy efficient equipment. Participants were asked to state whether each of these was of large, medium, small, or no concern. Responses to this question are shown in Figure 14. The concerns from this list that were most in the minds of the participants were the higher cost of energy efficient equipment, the equipment not saving as much as promised, and performance issues. Over 60 percent of participants surveyed stated that each of these were large- or medium-level concerns.

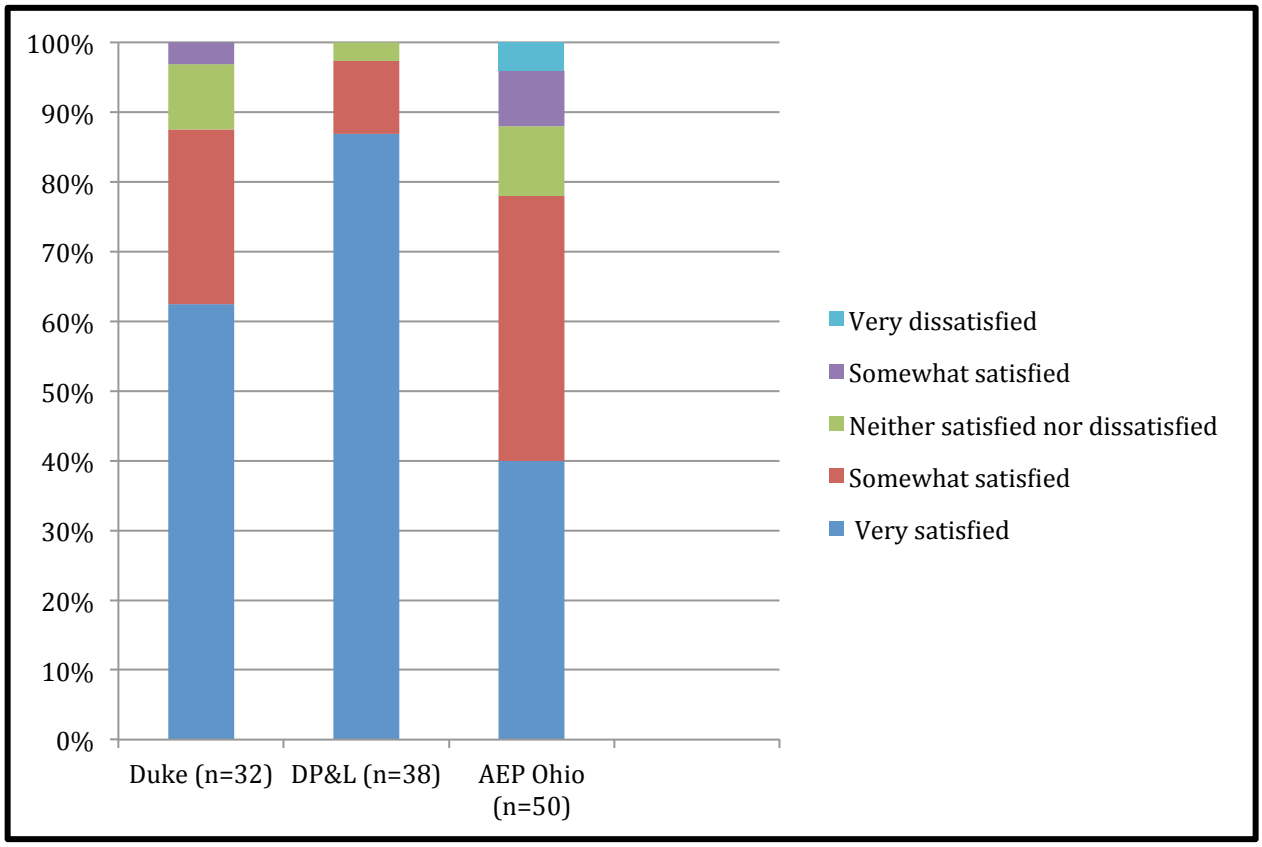
Figure 14: Concern Level Regarding Energy Efficient Equipment



Participation Process and Program Satisfaction

Of the non-residential participants who filled out their own rebate applications instead of having their contractors fill them out, on average 75 percent stated that they were very or somewhat satisfied with the ease of completing the applications (see Figure 15). Across of the utilities, over 86 percent of DP&L program participants indicated that they were very satisfied with the application process.

Figure 15: Satisfaction Level with Ease of Completing Rebate Applications



The research team asked those participants who were somewhat or very dissatisfied how they could have been more satisfied with the application process. Two-thirds of the participants who responded said that it would have been easier if the applications were electronic. All participants surveyed were also asked about how satisfied they were with the amount of the rebate received. A majority of participants (56 percent) were very satisfied with the amount of the rebate with an additional 30 percent stating that they were somewhat satisfied.

All surveyed participants were asked if they had noticed lower electric bills since the installation of the rebated energy efficient equipment. Over 50 percent noticed a reduction, while 27 percent did

not. The remaining participants did not know if their bills were lower or not. Notably, a far smaller portion of DP&L participants (37 percent) noticed a drop in their electric bills relative to participants in Duke Energy and AEP Ohio's programs (51 percent and 68 percent, respectively).

Even though a smaller percentage of DP&L participants noticed a reduction in their electric bills, their satisfaction with the program overall is high, with 77 percent stating that they are very satisfied with the program. On average, virtually all participants were either very or somewhat satisfied with the program overall (see Figure 16 and **Error! Reference source not found.**).

Figure 16: Overall Satisfaction with Non-residential Prescriptive Program

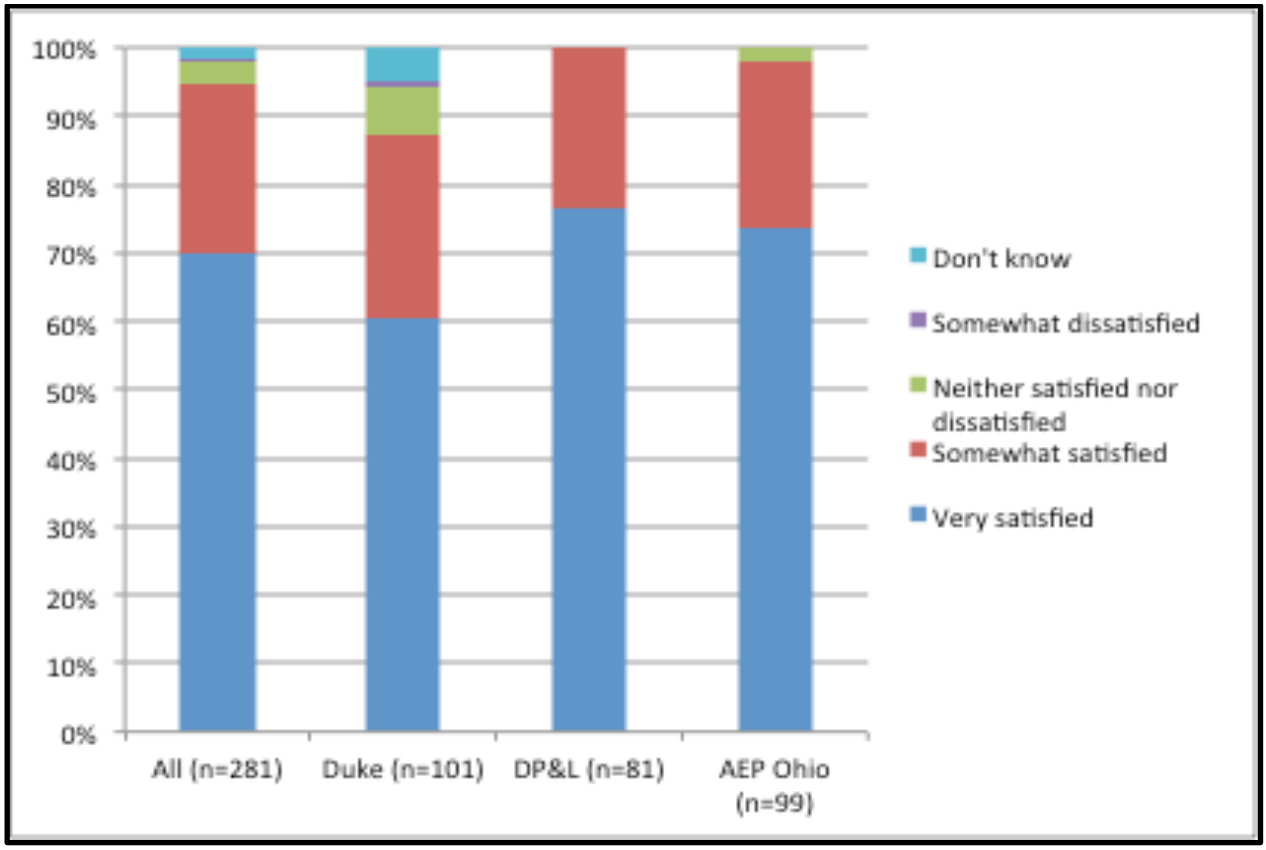


Table 27: Overall Satisfaction with Non-residential Prescriptive Program

Satisfaction Level	Duke Energy	DP&L	AEP Ohio
Very satisfied	60%	77%	74%
Somewhat satisfied	27%	23%	24%
Neither satisfied nor dissatisfied	7%	0%	2%
Somewhat dissatisfied	1%	0%	0%
Don't Know	5%	0%	0%
n	101	81	99

Free Ridership

A series of questions regarding participants' decisions to purchase rebated equipment was asked in order to assess the effect of the program rebate on the decision to purchase energy efficient equipment. A variety of measures were available through the prescriptive programs offered by the Ohio utilities included in this study, the most prominent of which was linear fluorescent lighting. Therefore, the set of free ridership-related question focused on this measure.

As discussed earlier in this report, one of the goals of the participant survey was to gauge the potential for free ridership among current program participants. All programs will likely have some level of "free riders," or participants who would have purchased energy efficient equipment without program rebates. The purpose of asking several free ridership questions in this survey is to determine if this is a significant enough issue that the PUCO should start requiring Ohio utilities to report net energy savings, which would adjust gross savings to account for free ridership.

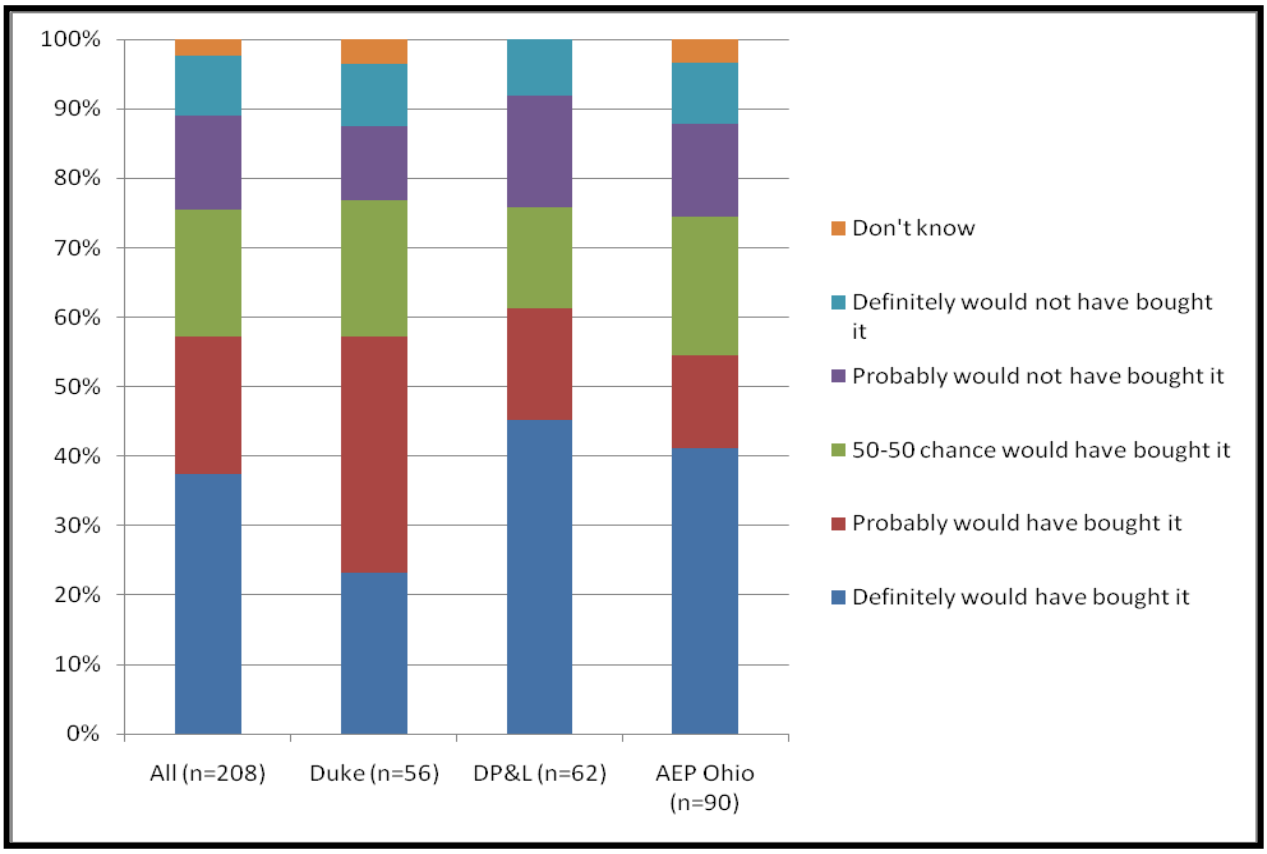
As discussed with the residential survey results, measuring free ridership is a complex process that requires more than the few questions that were included in this survey. A well-designed battery of free ridership questions will have multiple questions addressing similar topics to help ensure that respondents are answering questions consistently. As shown below, even these questions can yield inconsistent responses. For example, customers claim that equipment cost is a significant barrier to installing energy efficiency in response to one question, while in answering another indicate that they are likely to install the equipment even if a rebate were not available. The issue is further complicated by imperfect recall by respondents of the purchase process they went through when installing the equipment. The customer may also not be aware of other market factors relating to the equipment. For example, they may state they would have purchased the same equipment without a rebate, but the equipment (or qualified installation contractors) may not have been available if the rebate program did not exist.

The results of these questions do indicate that there is likely some level of free ridership with the programs examined. However, due to the above-mentioned complicating reasons, the responses should be used for illustrative purchases only – a more thorough series of questions combined with an algorithm for scoring responses is needed to develop a more rigorous estimate of free ridership (and ultimately net impacts.)

With this context in mind, the responses to the questions relating to free ridership in the non-residential sector are presented below.

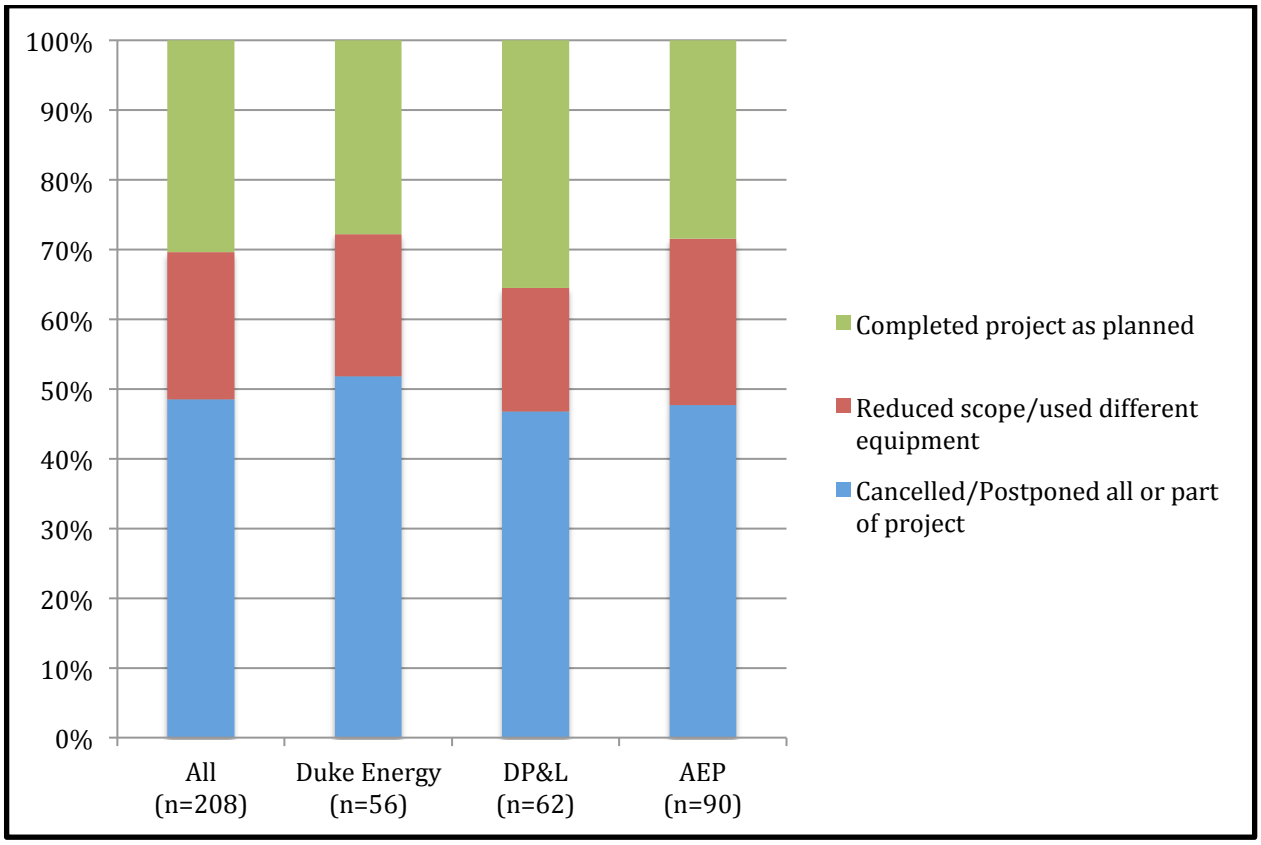
The survey asked those participants who had purchased linear fluorescents how likely they would have been to purchase the same measure had the rebate not been available and were given a series of answers from which to choose. Based on the responses received, about 57 percent of these participants would have definitely or most likely purchased linear fluorescents without the availability of the rebate. This indicates some degree of free ridership. A much smaller proportion of these participants, less than 10 percent, stated that they would definitely not have purchased the linear fluorescents if the rebate had not been available.

Figure 17: Likelihood of Purchasing Linear Fluorescents If Program Rebate Were Not Available



A similar questions (asked as a consistency check), asked how their retrofit project would have changed if the program rebate had not been provided. Responses to this question are shown in Figure 18. These responses provide a little more detail than those to the previous question and suggest that only about 30 percent of the lighting participants would have still done their project exactly as planned even if rebates were not available, which is consistent with our expectation based on our experience with other non-residential lighting programs. The shift in responses across questions also highlights the challenges with estimating free ridership using a limited number of survey questions.

Figure 18: How Project Might Have Changed If Rebates Were Not Available



Summary: Key Findings and Recommendations

Program Awareness

Contractors and distributors have historically been effective promoters of the Ohio utility energy efficiency programs since they directly benefit from them through increased equipment sales. Programs serving the non-residential sectors should continue to utilize contractors and distributors to inform customers of the energy savings and rebates available through energy efficiency programs.

Barriers to Participation

To address the reported concerns of participants related to equipment cost and performance, the Ohio utilities should launch a marketing campaign that provides non-residential customers with specific energy savings information for the most commonly rebated energy efficiency measures. A marketing piece presenting the net benefits of these investments would likely prove useful in overcoming some of the larger barriers to participation. Along with the cost savings that accrue, the marketing campaign could also provide information showing that the energy efficient equipment performs to the same (or higher) standards as less efficient equipment.

Participation Process and Program Satisfaction

Program participants, especially non-residential ones, would prefer to work with electronic applications since most businesses operate and track information digitally. Filling out applications by hand is a tedious process and often difficult for recordkeeping. A digital application process would also improve the quality of the data tracked by the utilities since it would not have to be entered by hand and could be automatically uploaded to the utility program data tracking systems.

Free Ridership

Based on a limited series of survey questions, it appears that there is some amount of free ridership occurring within the Ohio utility efficiency programs. This is not a unique finding as all efficiency programs will have some level of free ridership. As noted previously, the issue of free ridership is a complex one and we did not attempt to develop a comprehensive set of survey questions to explore this issue in the current survey. Rather, the intent was to gauge the degree to which free ridership might be an issue in the early stages of these programs and help inform the PUCO as to the timing of requiring the Ohio utilities to report net impacts. The results presented here do suggest that a more rigorous battery of free ridership questions should be developed so that free ridership and net impacts can be estimated for these programs in the near future.

Residential Baseline Survey Results

This chapter presents the findings from the Independent Evaluator study of Ohio's residential baseline energy use during 2010. The objective of this study was to collect information on residential market activities relating to energy efficiency in order to record a snapshot of the Ohio market at a point in time, which is especially important for those utilities with nascent efficiency programs. Topics covered in this survey include:

- Types of equipment being purchased (standard versus high efficiency for key end uses);
- Attitudes toward energy efficiency;
- Importance of energy efficiency relative to other issues that affect household spending; and
- Awareness of utility DSM programs

The service territories of the following utilities are included in this survey:

- Dayton Power & Light Company (DP&L)
- Ohio Edison Company(Ohio Edison)
- Toledo Edison Company(Toledo Edison)
- Cleveland Electric Illuminating Company (Cleveland)
- Duke Energy Ohio (Duke Energy)
- American Electric Power Ohio (AEP Ohio).

Data Methodology and Collection

Itron implemented the baseline surveys using its Computer Assisted Telephone Interviewing (CATI) Center located in Berkeley, California. Data collection began at the end of November and concluded in mid-December 2010. Itron conducted all surveys with the exception of those conducted in AEP Ohio's service territory. AEP Ohio conducted its baseline survey separately using a survey instrument that was similar to one used by Itron[49]. For the questions asked of AEP Ohio customers that were the same as those asked of customers in the other five utility service territories, the survey answers from AEP Ohio's customers were included with the answers from residential customers in the other utility service territories to create a complete picture of energy use for the state. This is true of the results presented in all the tables in this section.

A total of 1,193 customers were surveyed across the six utility service territories included in this baseline study. As shown in Table 28, the distribution of surveys varied from a low of eight percent completed in Ohio Edison Company's territory to a high of 32 percent conducted with customers in AEP Ohio's service area. The relatively large survey representation of AEP Ohio customers in this study stems from the utility conducting its own survey separate from Itron's effort. Table 28 shows the number of surveys completed for each of the six Ohio utilities included in this study.

[49] The baseline survey was designed to be as similar as possible to the one fielded by the AEP evaluation team. This allowed us to leverage the survey results from the AEP evaluation and combine them with the data being collected by the Independent Evaluator team for Duke, DP&L, and FirstEnergy service territories

Table 28: Telephone Survey Distribution by Ohio Utility Service Territory

Electric Utility	Number of Surveys	Percent of Total
DP&L	202	17%
Ohio Edison	101	8%
Toledo Edison	152	13%
Cleveland	152	13%
Duke Energy	200	17%
AEP Ohio	386	32%
Total	**1,193**	**100%**

Table 29 presents the distribution of surveys completed by residential housing type. Single-family detached residences represent 81 percent of all completed surveys. This differs from the percentage of single-unit detached residences in Ohio recorded by the U.S. Census from 2009, which is just below 68 percent.[50] The slightly higher representation of single-family detached residences in this baseline survey could stem from survey response bias or from the database of phone numbers tracked by the utilities and provided for sampling to the research team. Traditional apartments and condominiums follow far behind, representing only five percent and four percent of the sample, respectively.

Table 29: Telephone Survey Distribution by Residential Home Type

Home Type	Number of Surveys	Percent of Total
Single-Family Detached	970	81%
Single-Family Manufactured	41	3%
Single-Family Mobile Home	28	2%
Row House	7	1%
Duplex or Triplex	42	4%
Apartment (4+ families)	58	5%
Condominium	47	4%
Total	**1,193**	**100%**

Select Survey Results

The tables included in this report present percentage distributions at the utility service territory level and for Ohio statewide. The statewide results were developed by weighting each service territory's contribution to the overall Ohio population. Unless otherwise noted, figures presented in the following sections display results at the statewide level.

[50] U.S. Census Bureau, Ohio Selected Housing Characteristics 2005-2009, http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=04000US39&-qr_name=ACS_2009_5YR_G00_DP5YR4&-ds_name=ACS_2009_5YR_G00_&-_lang=en&-_sse=on

Residential Sector Characteristics

This section presents data on residential sector characteristics by utility and overall results for the state of Ohio. Select results are also presented by residence type. The attributes covered in this section include the following:

- Housing Type
- Home Ownership
- Age of Home
- Home Size

Customer responses to telephone survey questions regarding home characteristics serve as the data source for the findings presented in this report.

Home Type

We asked customers which type of home best describes their residence in an effort to gain an overall picture of residential home types across the state. As shown in Figure 19, over 80 percent of customers live in detached single-family homes in the state of Ohio. Over 80 percent of customers in all service territories reside in this home type with the exception of those in AEP Ohio's territory, as shown in Table 30. The next most popular home type is traditional apartment buildings (those that accommodate at least four families), representing approximately five percent of those surveyed, followed by condominiums and single-family manufactured/modular homes.

Responses at the service territory level in Table 30 show that the percentage distribution of home types across each utility is, for the most part, reflective of the statewide findings.

Figure 19: Distribution of Residential Home Types in Ohio

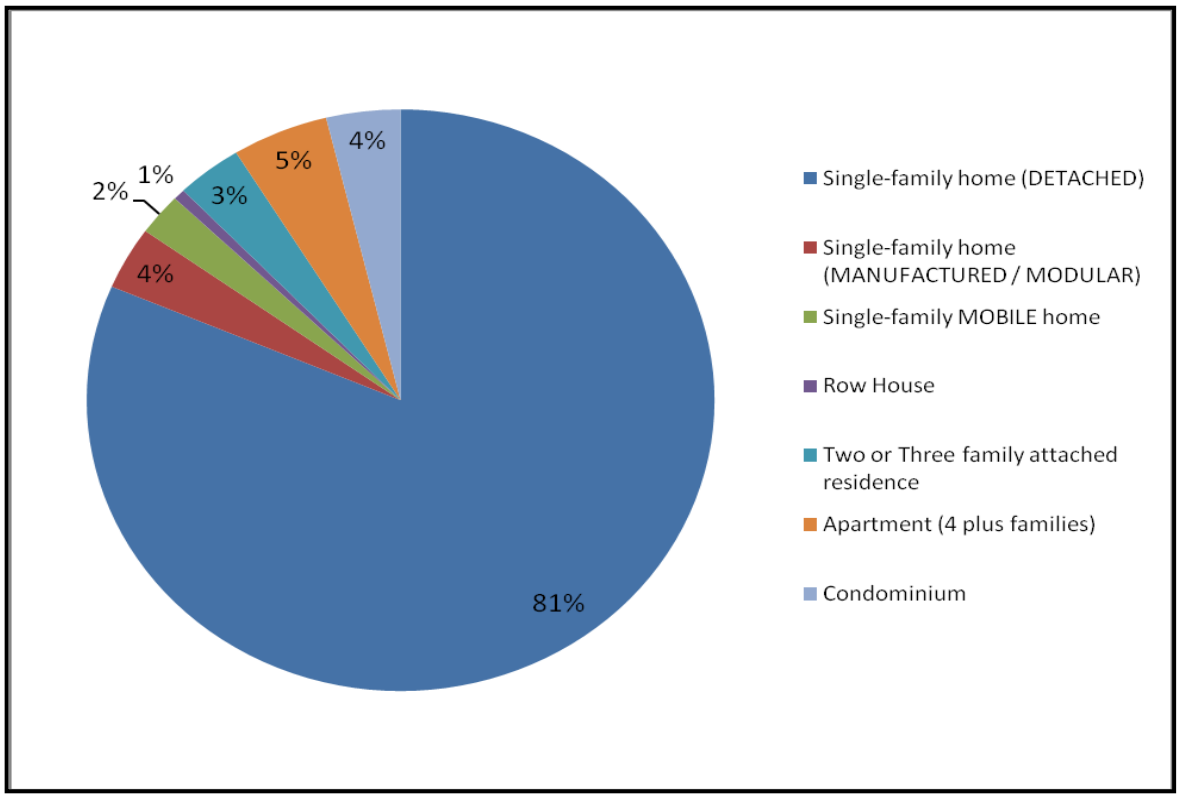


Table 30: Percentage Distribution of Residential Home Types by Utility

Home Type	ALL	Duke Energy	DP&L	Ohio Edison	Toledo Edison	Cleveland	AEP Ohio
Single-family home (detached)	81.4%	83.5%	81.7%	82.2%	82.9%	83.6%	78.2%
Single-family home (manufactured/modular)	3.5%	0.5%	2.0%	5.9%	1.3%	2.0%	6.5%
Single-family mobile home	2.3%	2.0%	1.0%	2.0%	2.0%	0.7%	4.1%
Row House	0.6%	0.5%	0.5%	0.0%	2.0%	0.0%	0.5%
Two/Three family attached residences	3.4%	2.5%	6.9%	4.0%	3.9%	3.3%	2.1%
Apartment Building (4+ families)	5.0%	6.0%	5.4%	4.0%	7.2%	6.6%	2.6%
Condominium	3.8%	5.0%	2.5%	2.0%	0.7%	3.9%	6.0%
n	1,193	200	202	101	152	152	386

Home Ownership

An examination of Table 31 shows that the percentage of customers who own their homes (86.5 percent) is relatively close to the number of customers who live in single-family homes (87.2 percent for detached, manufactured/modular, and mobile homes). This finding is not surprising since this is the most common type of home to own. While over 86 percent of surveyed customers own their residences, approximately 13 percent of Ohio customers rent the residences in which they live. This 13 percent is very close to the percentage of customers who reside in apartments, duplex and triplex residences, and condominiums. The highest percentage of homes owned is in Toledo Edison's territory (89.1 percent), followed closely by AEP Ohio (88.3 percent). These findings are useful as they provide information to the utilities about the types of energy efficiency programs that would best serve customers in Ohio.

Table 31: Percentage Distribution of Home Ownership

Home Ownership Status	ALL	Duke Energy	DP&L	Ohio Edison	Toledo Edison	Cleveland	AEP Ohio
Own	86.5%	86.5%	83.2%	89.1%	83.6%	86.8%	88.3%
Rent	12.9%	13.5%	15.8%	8.9%	16.4%	12.5%	11.1%
Don't own or pay rent	0.2%	0.0%	1.0%	1.0%	0.0%	0.0%	0.0%
Refused	0.3%	0.0%	0.0%	1.0%	0.0%	0.7%	0.3%
Don't Know	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
n	1,193	200	202	101	152	152	386

Age of Homes

Figure 20 shows that over 35 percent of the homes across Ohio were built before 1960 and just over half of all homes were built before 1970. Throughout the state, another 15 percent of homes were built in 2000 or later. The survey results in Table 32 indicate that older homes are more common in Toledo Electric Company's service territory with about 50 percent of homes constructed before the year 1960 and a total of 75 percent of homes in this territory constructed before 1980. The homes in AEP Ohio's service territory are relatively newer compared with age of homes across the state overall. About 25 percent of homes located within AEP Ohio's territory were built in 2000 or later, with another 13 percent built in the 1990s.

Figure 20: Percentage Distribution of Home Age in Ohio

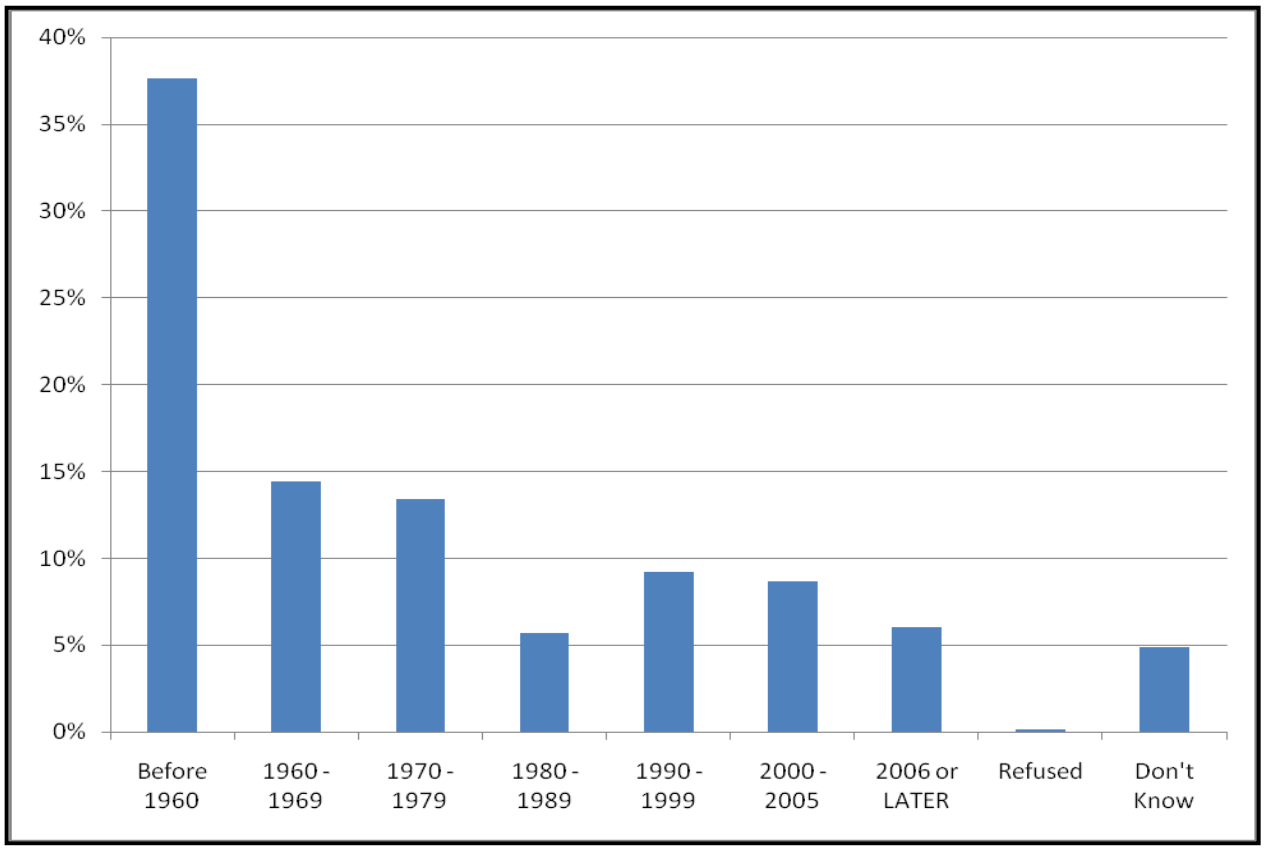


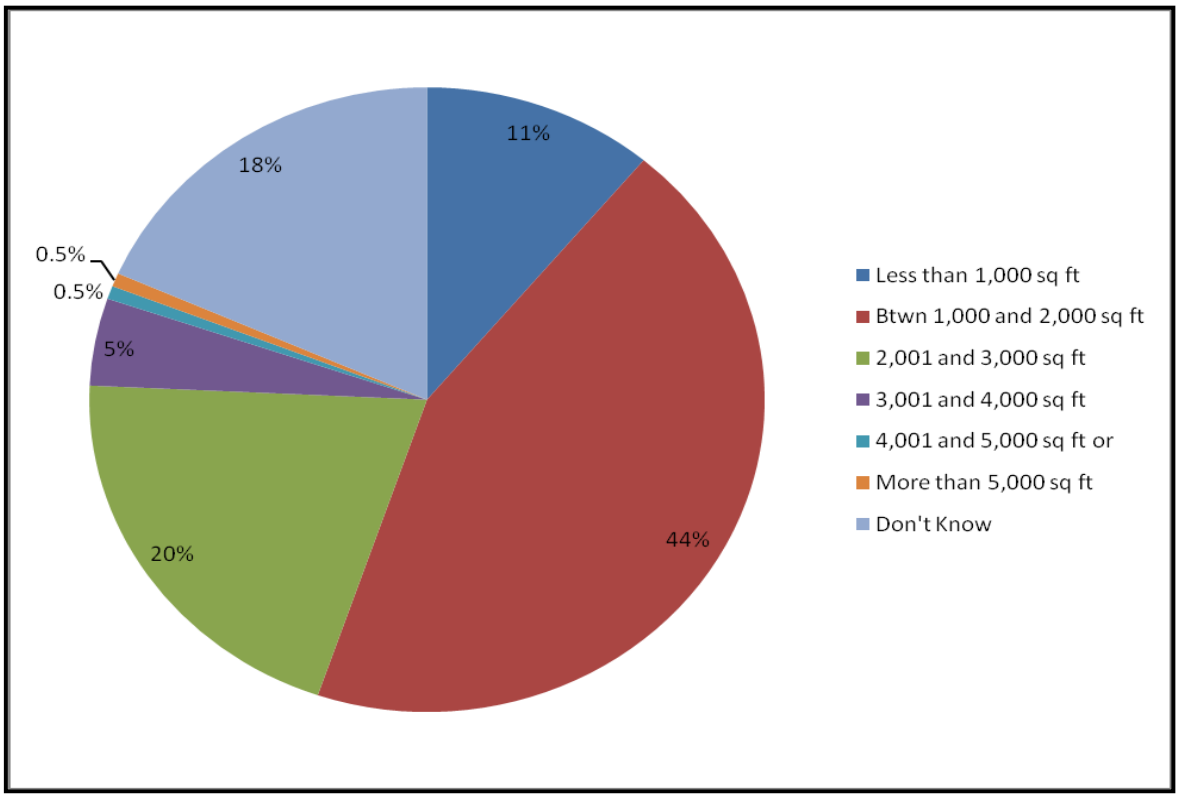
Table 32: Percentage Distribution of Home Age by Utility

Age of Homes	ALL	Duke Energy	DP&L	Ohio Edison	Toledo Edison	Cleveland	AEP Ohio
Before 1960	37.6%	32.5%	40.1%	41.6%	50.0%	44.1%	27.5%
1960 - 1969	14.4%	14.5%	13.9%	14.9%	14.5%	17.8%	12.7%
1970 - 1979	13.4%	12.0%	18.8%	16.8%	10.5%	15.1%	11.7%
1980 - 1989	5.7%	5.0%	5.9%	8.9%	6.6%	7.2%	3.4%
1990 - 1999	9.2%	15.0%	6.9%	9.9%	4.6%	3.3%	12.7%
2000 - 2005	8.6%	12.0%	9.9%	5.0%	7.9%	3.9%	10.9%
2006 or later	6.0%	4.0%	2.5%	1.0%	3.3%	3.3%	13.0%
Refused	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
Don't Know	4.9%	5.0%	2.0%	2.0%	2.6%	5.3%	7.8%
n	1,193	200	202	101	152	152	386

Home Size

The largest percentage of homes in Ohio has between 1,000 and 2,000 square feet of living space, as Figure 21 shows. Approximately 44 percent of homes fall in this range, followed next by about 20 percent of homes that range between 2,000 and 3,000 square feet.

Figure 21: Percentage Distribution of Home Size in Ohio

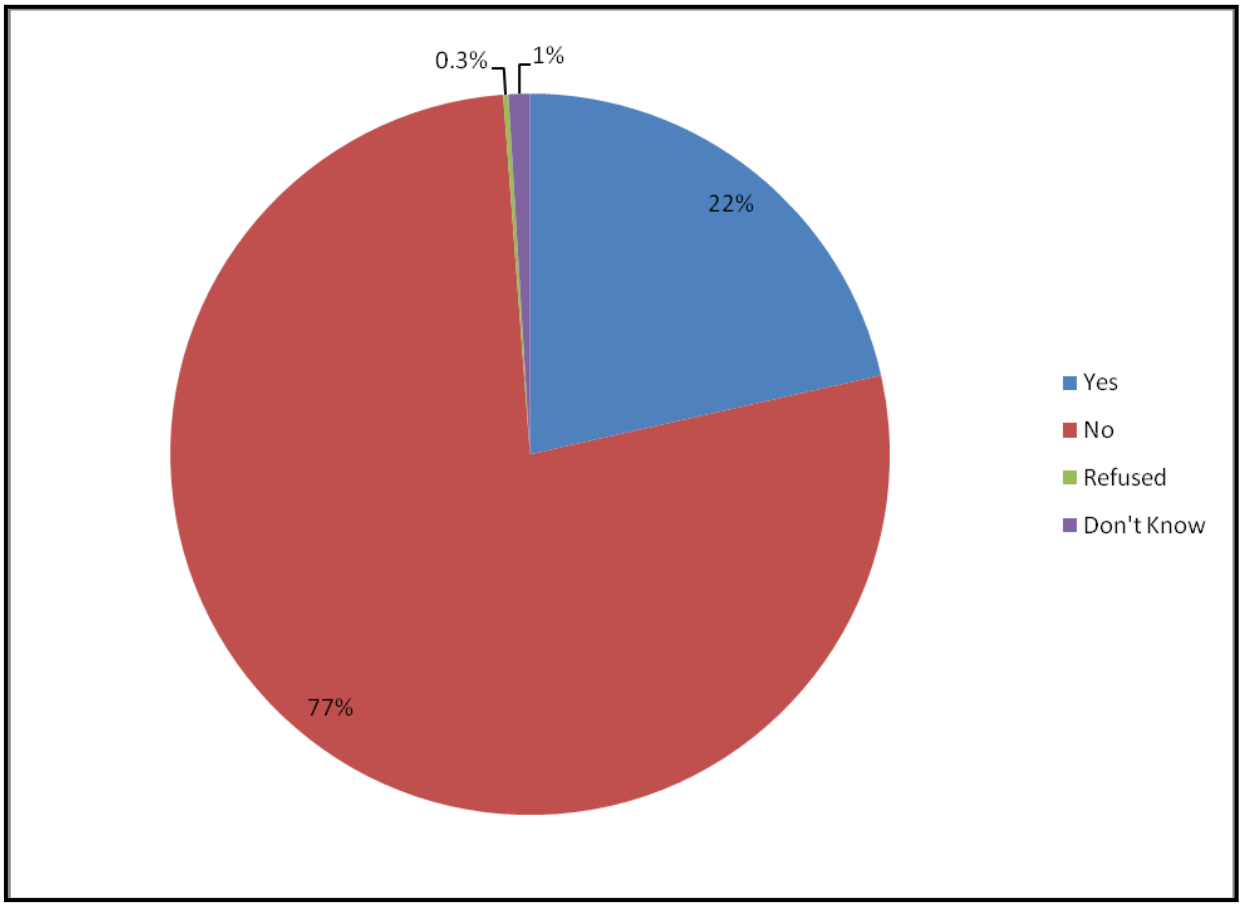


Customer Characteristics

This section presents data on customer characteristics by utility and overall results for the state of Ohio. Survey responses regarding energy efficiency actions considered and those that were taken are the focus of the findings presented here.

We asked customers whether they considered energy efficiency actions (for example, behavior changes or installation of energy efficient equipment) that were not implemented. As illustrated in Figure 22, 22 percent of respondents (or 254) stated that they did consider making changes in the recent past but did not implement these changes.

Figure 22: Percentage of Ohio Customers Who Considered Taking Energy Efficiency Actions but Did Not



This group of individuals was then asked about the types of actions they had considered but did not take. The frequency of responses given is presented in Table 33. The most common action that was considered but not taken was to upgrade appliances to improve energy efficiency, followed by improvements in wall, roof, and window insulation.

Table 33: Energy Efficiency Actions Considered but Not Taken by Ohio Customers

Actions Considered by Not Taken to Improve Energy Efficiency	All Utilities
Upgrade lighting to improve energy efficiency	6.0%
Upgrade appliances/equipment to improve energy efficiency	28.3%
Improve wall or roof insulation	16.7%
Improve window insulation	18.8%
Improve door insulation	4.4%
Self generate electricity/energy	8.0%
Save energy by changing behavior	1.6%
Replace windows	3.7%
Other	10.2%
None	1.5%
Don't Know	0.7%
n	254

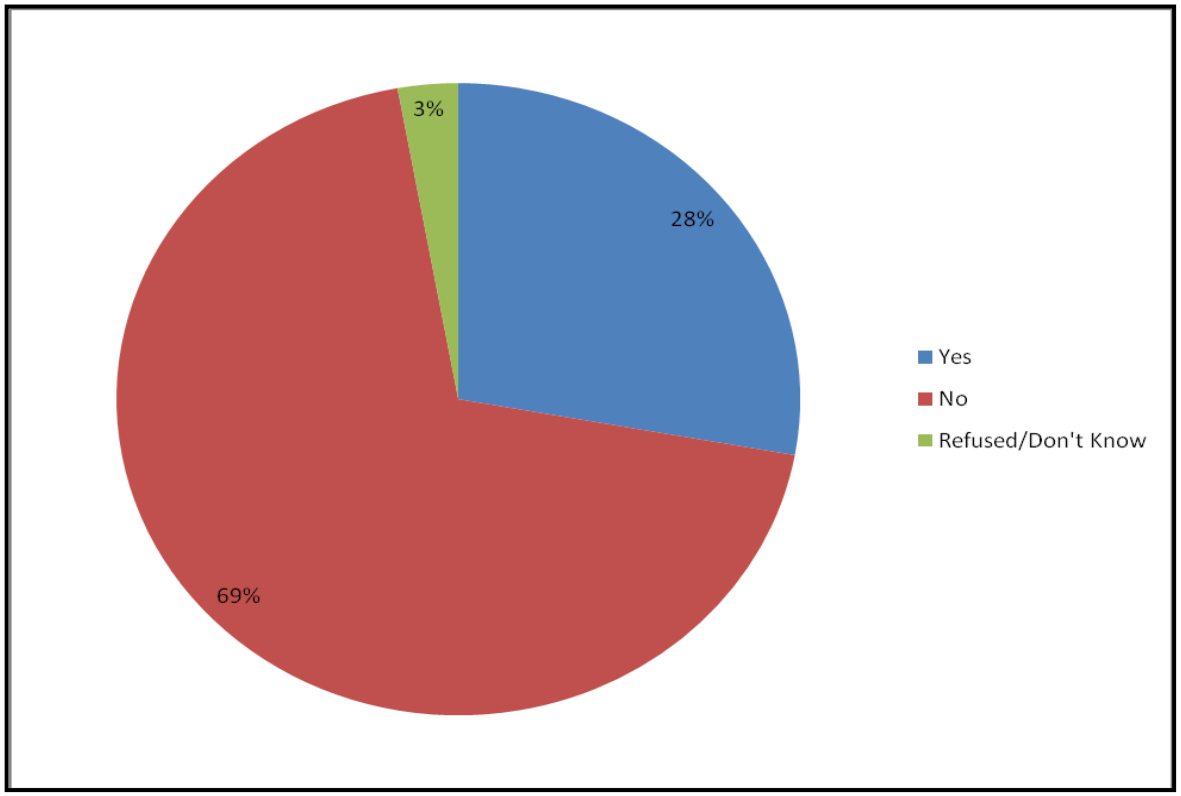
There are many reasons why customers may choose not to implement the changes considered and respondents were asked about these. As shown in Table 34, the main reason Ohio residential energy customers did not make the energy efficiency changes is due to a lack of funds. In addition, some customers did not take action because of other spending priorities and the feeling that the savings would not justify the investment in the action or new equipment.

The survey then proceeded to ask customers if they were planning on making any investments in energy efficiency in the next two years. Figure 23 presents findings to show that more customers do not plan to make changes (69 percent) than those who do plan to make changes (28 percent). The distribution of customers who are and are not considering making energy efficiency-related changes in the future looks to be related to the distribution of customers who considered making energy efficiency-related changes in the past but chose not to (77 percent, see Figure 22). It is possible that the same group of respondents who considered energy efficiency changes in the past is the group that is indicating a desire to make changes to reduce energy usage in the future.

Table 34: Reasons Ohio Customers Reported Not Taking Energy Efficiency Actions

Reasons Why Energy Efficiency Actions Were Not Taken	All Utilities
Other priorities for spending	9.4%
Amount of savings did not justify the upgrade	6.9%
No funds available for investment	59.7%
Energy savings were too uncertain	1.4%
Could not obtain financing for investment	4.8%
Needed more information to make decision	1.5%
Not enough time to take on the project	5.4%
Not my decision	2.3%
Intend to do, but on hold	4.6%
Waiting for old equipment to expire	1.9%
Technical problems make difficult or impossible	3.4%
Don't Know	1.1%
n	254

Figure 23: Percentage of Residential Customers in Ohio Planning to Invest in Energy Efficiency Improvements in the Next Two Years



The 332 customers who claimed they planned to do so were asked about changes they plan on making to their homes in order to improve energy efficiency. The statewide results and results by utility are presented in Table 35. The most common energy efficiency changes planned by customers across all service territories who intend to make changes in the next two years are to upgrade or change walls, roofs, or floors or the insulation contained within them (27.9 percent). The next most cited planned change by respondents is to upgrade or change windows or window insulation (26.3 percent.

Table 35: Percentage Distribution of the Changes Planned During the Next Two Years

Changes Planned During Next Two Years	ALL	Duke Energy	DP&L	Ohio Edison	Toledo Edison	Cleveland	AEP Ohio
Upgrade/change lighting	4.6%	4.4%	1.7%	8.0%	6.4%	4.5%	3.6%
Upgrade/change appliances	17.6%	15.6%	11.9%	16.0%	25.5%	29.5%	9.8%
Upgrade/change wall/roof/floor or wall/roof/floor insulation	27.9%	24.4%	35.6%	44.0%	27.7%	38.6%	16.1%
Upgrade/change windows or window insulation	26.3%	40.0%	23.7%	28.0%	21.3%	27.3%	24.1%
Upgrade/change doors or door insulation	11.0%	8.9%	10.2%	20.0%	8.5%	15.9%	8.0%
Self generate electricity	2.8%	2.2%	5.1%	8.0%	2.1%	4.5%	0.0%
Upgrade AC/heating	9.4%	6.7%	20.3%	0.0%	10.6%	15.9%	5.4%
Upgrade/change water heater/boiler	6.9%	13.3%	6.8%	12.0%	12.8%	6.8%	0.0%
Upgrade/change thermostat	1.0%	2.2%	0.0%	0.0%	4.3%	0.0%	0.0%
Remodeling	15.5%	8.9%	1.7%	4.0%	6.4%	6.8%	35.7%
Install Smart Meter	0.3%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Refused	0.3%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Don't Know	1.9%	0.0%	0.0%	0.0%	2.1%	2.3%	3.6%
n	332	45	59	25	47	44	112

End Use Saturations

In this section, we summarize findings related to end use saturations and densities for Ohio statewide based on data collected through the residential customer telephone surveys conducted for this study. Details regarding the data collection effort are discussed above. We present results at the statewide level in this section, however they are disaggregated at the utility level in the tables included in Appendix D to this report. The end use categories covered in this section include the following:

- Home Heating
- Air Conditioning
- Water Heating
- Lighting
- Refrigerators and Freezers
- Kitchen Appliances
- Clothes Washers and Dryers

Home Heating

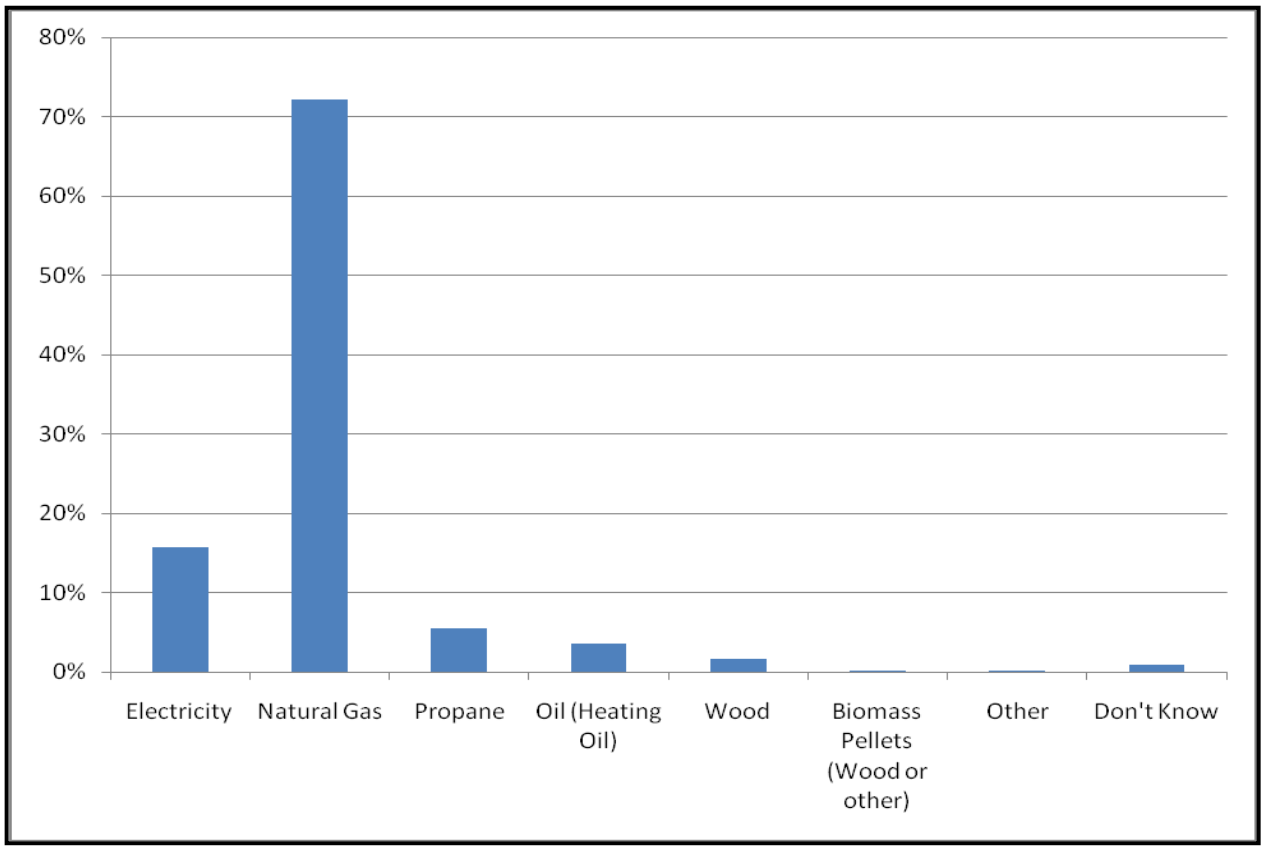
Based on responses to the survey, the most common type of heating system found in Ohio homes is the central furnace, as shown in Table 36. Over 80 percent of the homes rely on central furnaces, a finding consistent at the utility level. Less common home heating systems include electric baseboards, heat pumps (air, water, and ground source), as well as boilers using steam or hot water.

We asked customers about the fuel type used by their primary home heating system and the percentage distribution of the responses is shown in Figure 24. Over 70 percent of respondents stated that natural gas is the main fuel type, followed by 17 percent of respondents mentioning that electricity is used to power their heating systems. Propane and oil are used less frequently for home heating across the six Ohio utilities included in the survey.

Table 36: Percentage Distribution of Home Heating Systems in Ohio

Primary Home Heating System	All utilities
Central Furnace	81%
Electric Baseboard	2.8%
Built-in Electric Room Units	0.3%
Heat Pumps (all types)	6.3%
Boiler / Steam / Hot Water (baseboards or radiators)	4.3%
Electric Radiant Floors	0.4%
Hydronic or Liquid Radiant Floors	0.1%
Stove	1.6%
Fireplace	0.2%
Space Heater / Portable Heater	1.1%
Electric radiant ceiling	0.2%
Don't Know	1.6%
n	1,193

Figure 24: Percentage Distribution of Fuel Type Used for Main Home Heating System in Ohio

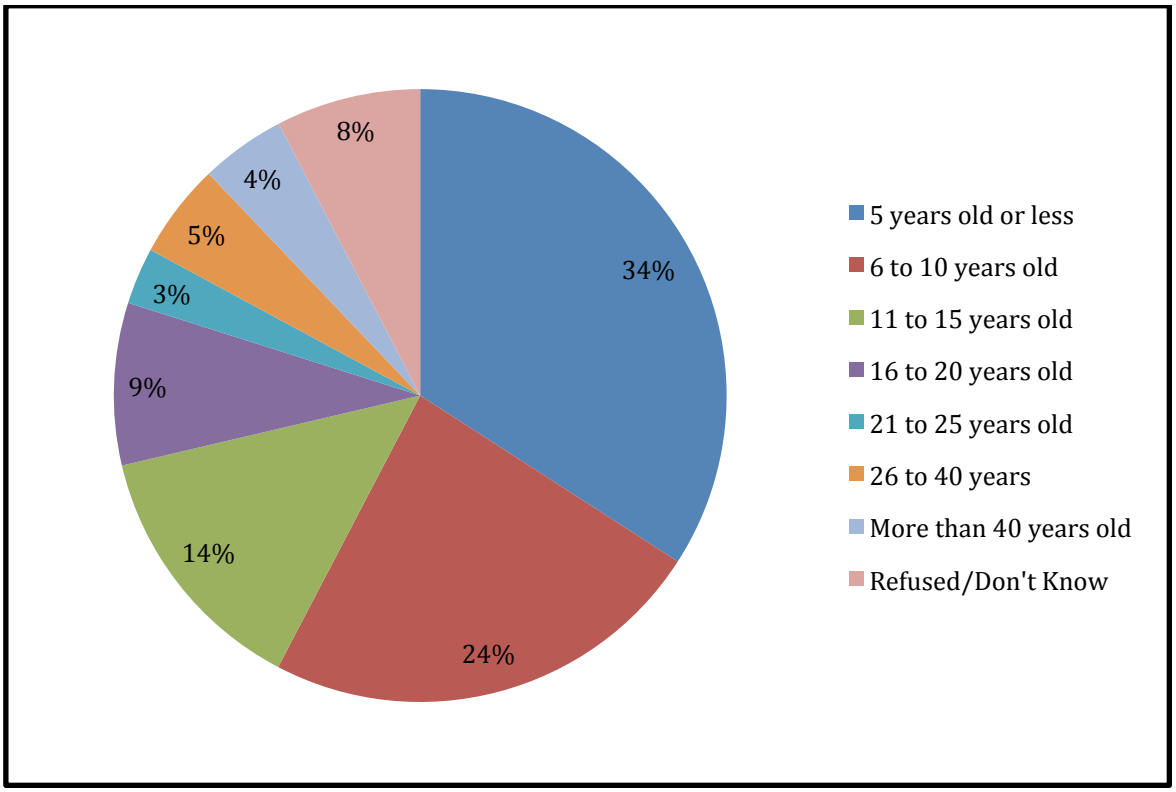


The fuel usage pattern evident at the statewide level is reflected in the results at the utility level, except in the cases of Toledo Edison and Cleveland (see Appendix D). Toledo Edison's use of natural gas for home heating is about the same as it is for all of Ohio, however the customers in this territory rely less heavily on electricity and more heavily on propane relative to the average residential customer in Ohio. Twelve percent of customers in Toledo Edison's service territory use propane as the fuel for primary home heating systems, compared to approximately 5.5 percent across the state. Approximately 77 percent of Toledo Edison residential customers use natural gas as the main fuel for their home heating systems, while about 72 percent of customers at the statewide level do.

Customers in Cleveland's service territory rely more on natural gas than the state average (over 85 percent versus 72 percent at the state level) and rely less on electricity (6.7 percent versus 15.8 percent for the state). Even with these exceptions, it is clear that natural gas is the primary fuel used to generate heat by Ohio residential customers.

Findings on the age of primary home heating systems gathered through the telephone survey are presented in Figure 25. Approximately 34 percent of customers have relatively new heating systems that are five years old or less and just about 60 percent of the respondents stated that their systems are less than 10 years old. Based on this information, the Ohio utilities might be better served by focusing their energy efficiency rebate programs away from the upgrade of home heating systems since they tend to be relatively new.

Figure 25: Percentage Distribution of Primary Home Heating System Age in Ohio



Air Conditioning

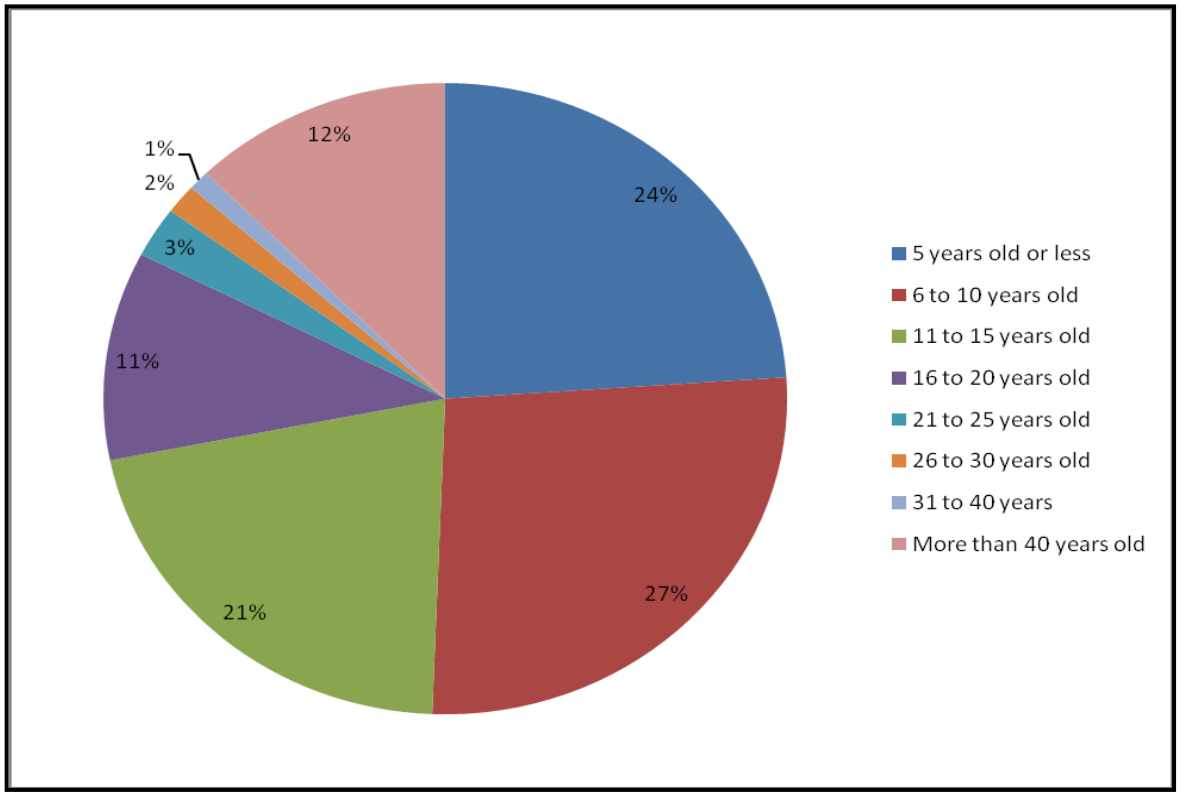
A vast majority of Ohio residential customers have some form of air conditioning installed in their homes (approximately 93 percent). Almost half of those surveyed reported having a split system central air conditioner, making it the most common type (see Table 37). Packaged terminal air conditioners and window or room wall-mounted air conditioners are also common.

When customers were asked about the age of their cooling systems, over 50 percent of the 529 who responded stated that their system is less than 10 years old and almost 72 percent reported that their system was installed within the last 15 years. These findings should be considered as utilities ramp up programs to promote and maintain HVAC systems.

Table 37: Percentage Distribution of Air Conditioning Systems in Ohio

Air Conditioning System Type	All Utilities
No cooling system	3.8%
Central AC - Electric, split system	48.6%
Central AC - packaged terminal	17.4%
Window or Room Wall-Mounted Air Conditioners	14.1%
Air Source heat pump	5.9%
Geothermal air heat pump	0.8%
Ceiling Fans	5.6%
Portable Fans	4.0%
Evaporative (Swamp) Cooler	0.0%
AC type unknown	1.0%
Heat pump - type unknown	0.2%
Refused	0.0%
Don't Know	3.0%
n	1,193

Figure 26: Percentage Distribution of Central Air Conditioning Age in Ohio



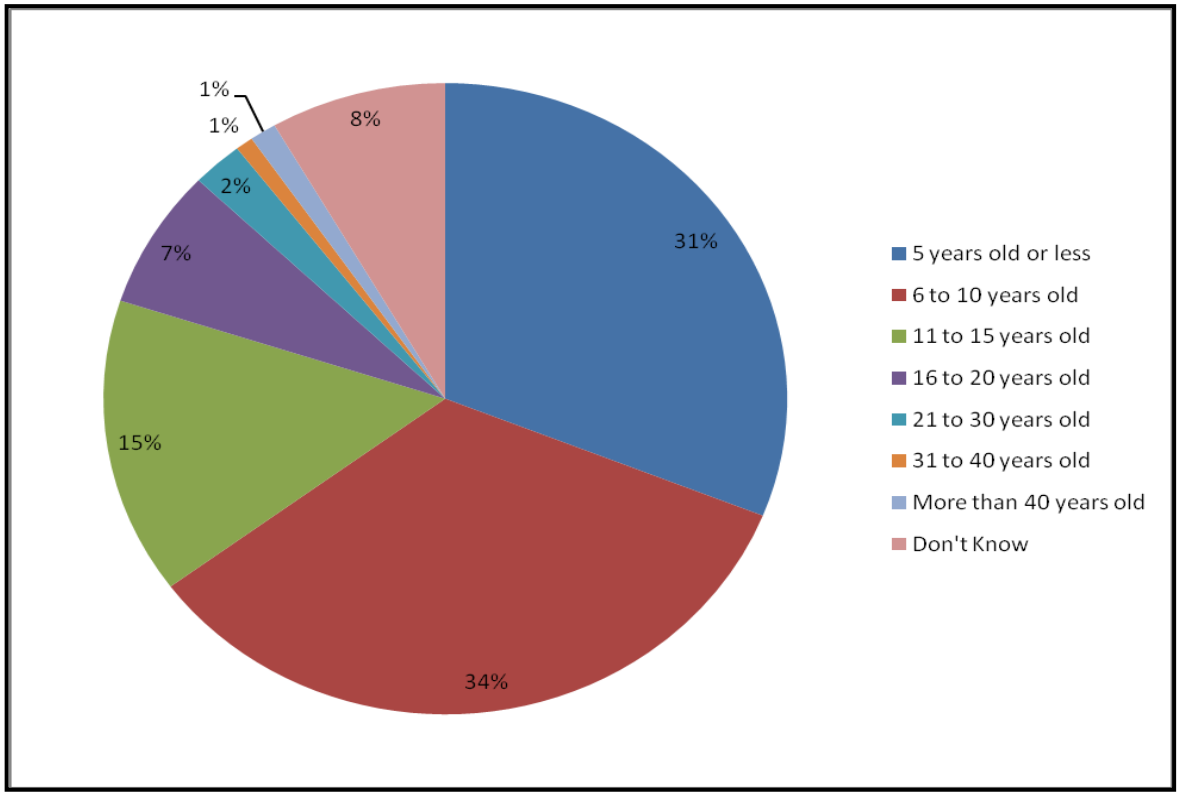
Water Heating

Survey results in Table 38 show that well over 90 percent of the water heating systems found in Ohio are stand-alone tanks. Other types of water heating systems are virtually nonexistent in residential homes. Almost two-thirds of the water heating systems in the state are less than 10 years old, as Figure 27 shows.

Table 38: Percentage Distribution of Water Heating System Types in Ohio

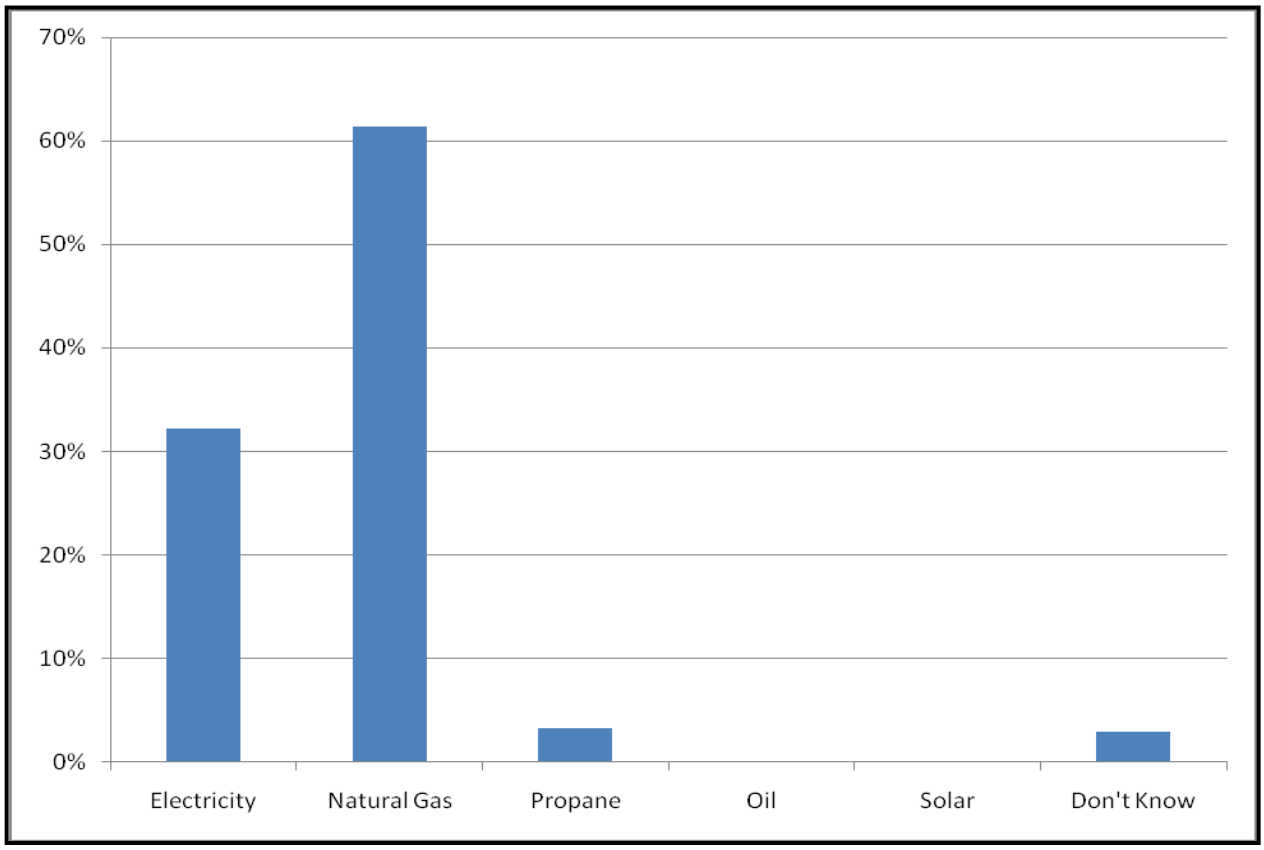
Water Heating System Type	All Utilities
Stand-alone tank	93.8%
Heat pump water heater	1.5%
Indirect fired tank with boiler	0.7%
Tankless coil with burner	0.3%
Tankless / instantaneous on demand	1.5%
Tank with solar collectors	0.3%
Refused/Don't Know	3.3%
n	1,193

Figure 27: Percentage Distribution of Water Heating System Age in Ohio



More than half of the water heating systems in Ohio are fueled by natural gas (see Figure 28). This finding is not surprising since natural gas is also extremely common for home heating systems.

Figure 28: Percentage Distribution of Fuel Type Used for Water Heating Systems in Ohio



Lighting

The survey asked a number of questions regarding the amount of lighting present both inside and outside of homes in Ohio. Results regarding lighting outside the home are included in Appendix D, while the results presented below focus on the amount of lighting found in sockets and fixtures in the home. As shown in to Figure 29, 12 percent of surveyed customers have between one and 10 light bulbs, and an additional 36 percent have between 11 and 20 light bulbs in the home.

We next asked more specifically about the presence of CFLs in the home. Close to half of the surveyed customers have between one and five CFLs in the home, while almost all respondents report having fewer than 20 (see Figure 30). These results suggest that energy efficiency potential remains for the lighting end use.

Figure 29: Percentage Distribution of Light Bulbs in Residential Homes in Ohio

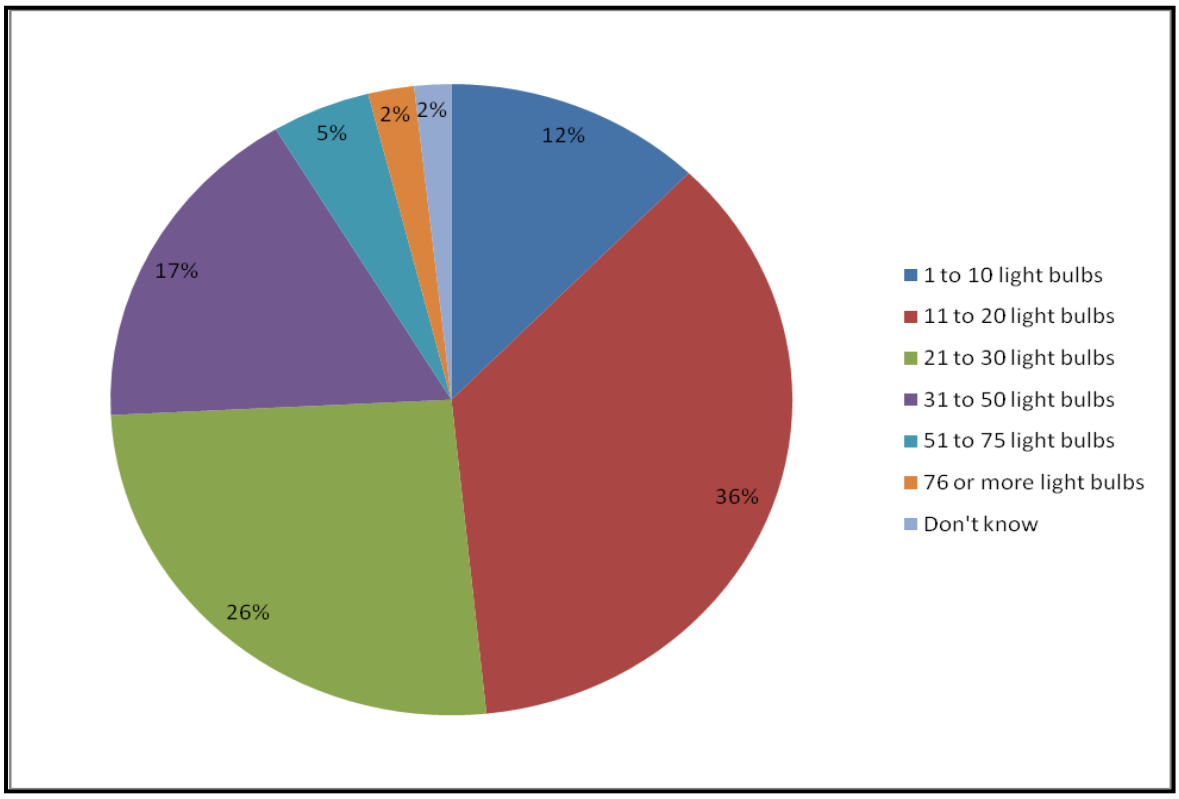
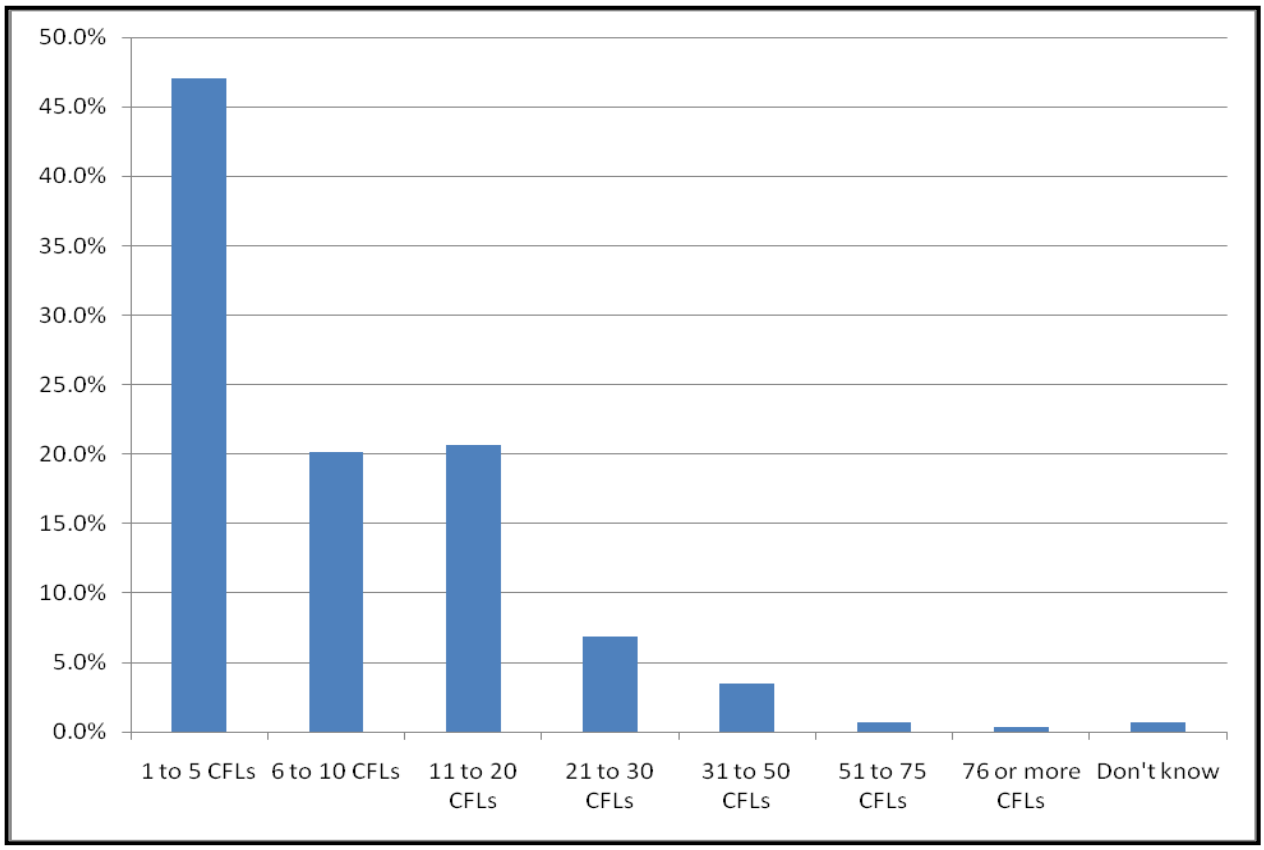


Figure 30: Percentage Distribution of CFLs in Residential Homes in Ohio



Refrigerators

The survey results in Figure 31 show that approximately two-thirds of residential customers in Ohio own only one refrigerator and just less than a third own two. The primary refrigerator in virtually all cases is located in the kitchen area with the second refrigerator (if a customer has one) often found in the garage or the basement (see Table 39 and Table 40).

Figure 31: Percentage Distribution of Number of Refrigerators Owned By Residential Customers in Ohio

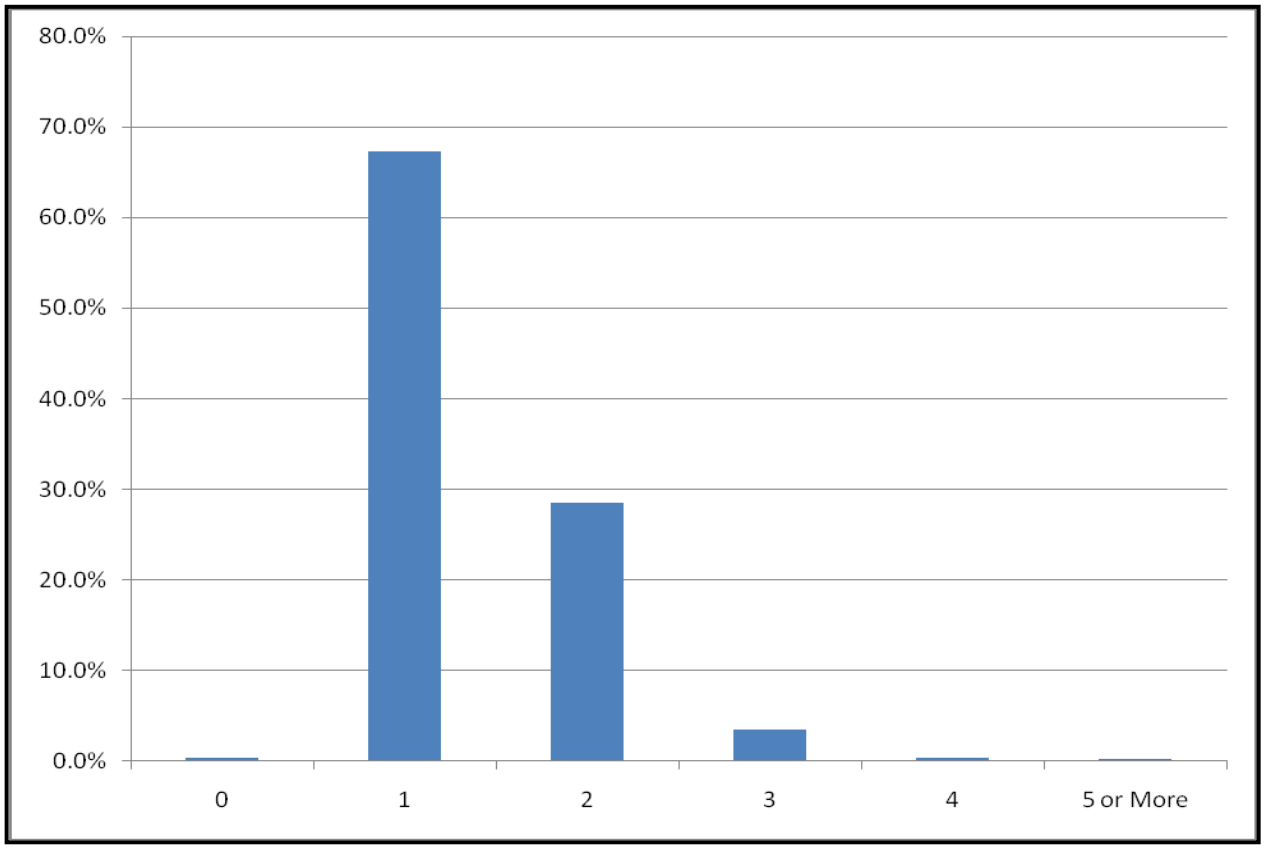


Table 39: Percentage Distribution of Primary Refrigerator Location

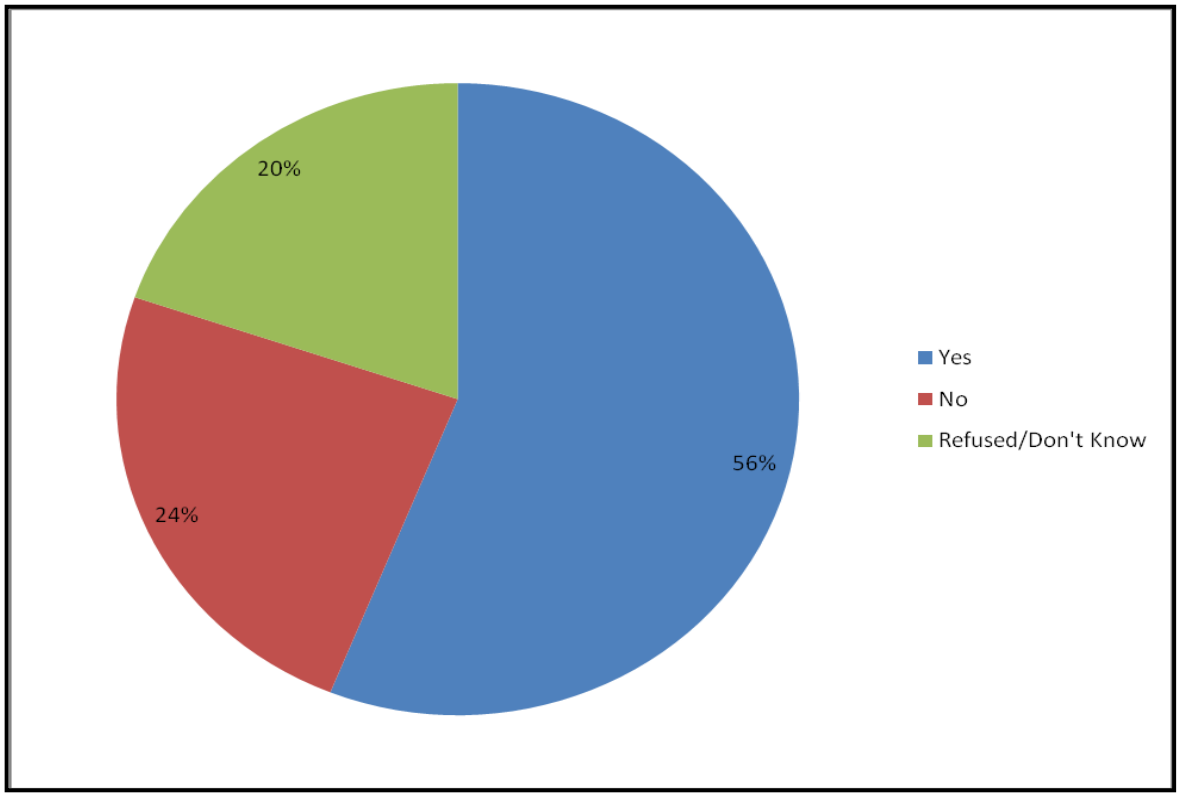
Primary Refrigerator Location	All Utilities
Kitchen	98.9%
Garage	0.3%
Porch	0.2%
Basement	0.2%
Utility Room	0.1%
Dining room	0.3%
n	987

Table 40: Percentage Distribution of Secondary Refrigerator Location

Secondary Refrigerator Location (if customer owns one)	All Utilities
Kitchen	4.8%
Garage	43.4%
Porch	1.2%
Basement	37.6%
Pantry	0.7%
Recreation Room	1.1%
Utility Room	2.4%
Bedroom	1.6%
Dining room	0.9%
Laundry room	1.5%
Detached building/shed	1.6%
Bar	0.6%
Living Room	0.4%
Office	0.7%
Outside	0.2%
Family Room	0.2%
Other	0.7%
Don't Know	0.2%
n	389

Fifty-six percent of customers with at least one refrigerator reported that their primary refrigerator is an ENERGY STAR Appliance (Figure 32). Given that approximately 44 percent of primary refrigerators are either not ENERGY STAR or the customer is not sure, it may be worthwhile to encourage these customers to upgrade their refrigerators to increase energy savings in Ohio.

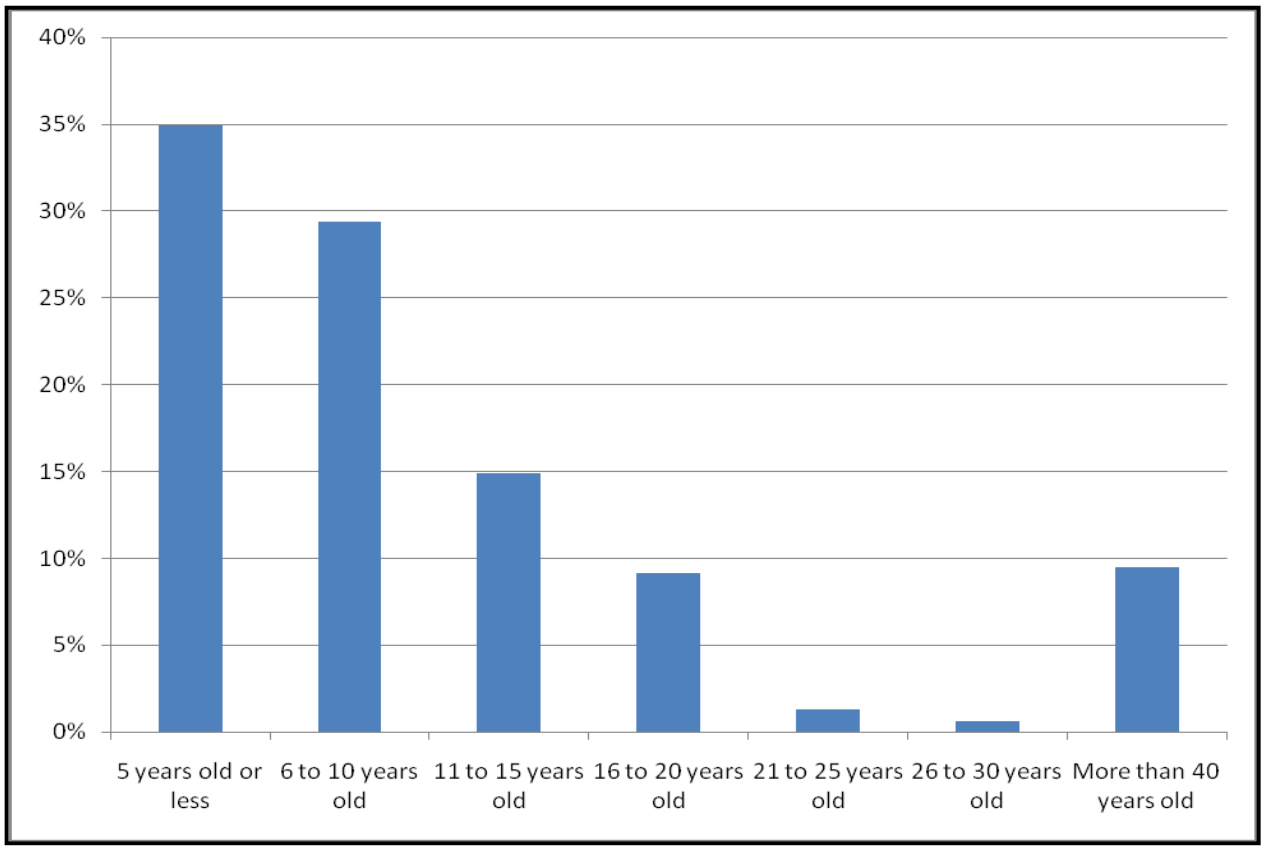
Figure 32: Distribution of Primary Refrigerators Reported as an ENERGY STAR Appliance



While close to half of the residential customers in Ohio either do not have an ENERGY STAR refrigerator or are not sure if they do, Figure 33 shows that almost two-thrids of customers have primary refrigerators that are 10 years old or less, and about 35 percent are less than five years old.

Results about secondary and tertiary refrigerators in residential homes can be found in Appendix D. Evaluation of these results show that these additional refrigerators are used almost continuously throughout the year.

Figure 33: Percentage Distribution of Primary Refrigerator Age



Freezers

Many customers in Ohio have a single refrigerator/freezer appliance in their homes instead of separate refrigerator and freezers. With that said, there still are many respondents who indicated that they have one stand-alone freezer (Figure 34). Table 41 shows that about 46 percent of respondents with a stand-alone freezer stated that it is located in the basement, with an additional 33 percent reporting that it is located in the garage.

Forty-two percent of customers with a stand-alone freezer stated that it is an ENERGY STAR appliance. The stand-alone freezers tend not to be quite as new as the refrigerators (compare Figure 36 to Figure 33).

Figure 34: Percentage Distribution of the Number of Stand Alone Freezers in Ohio

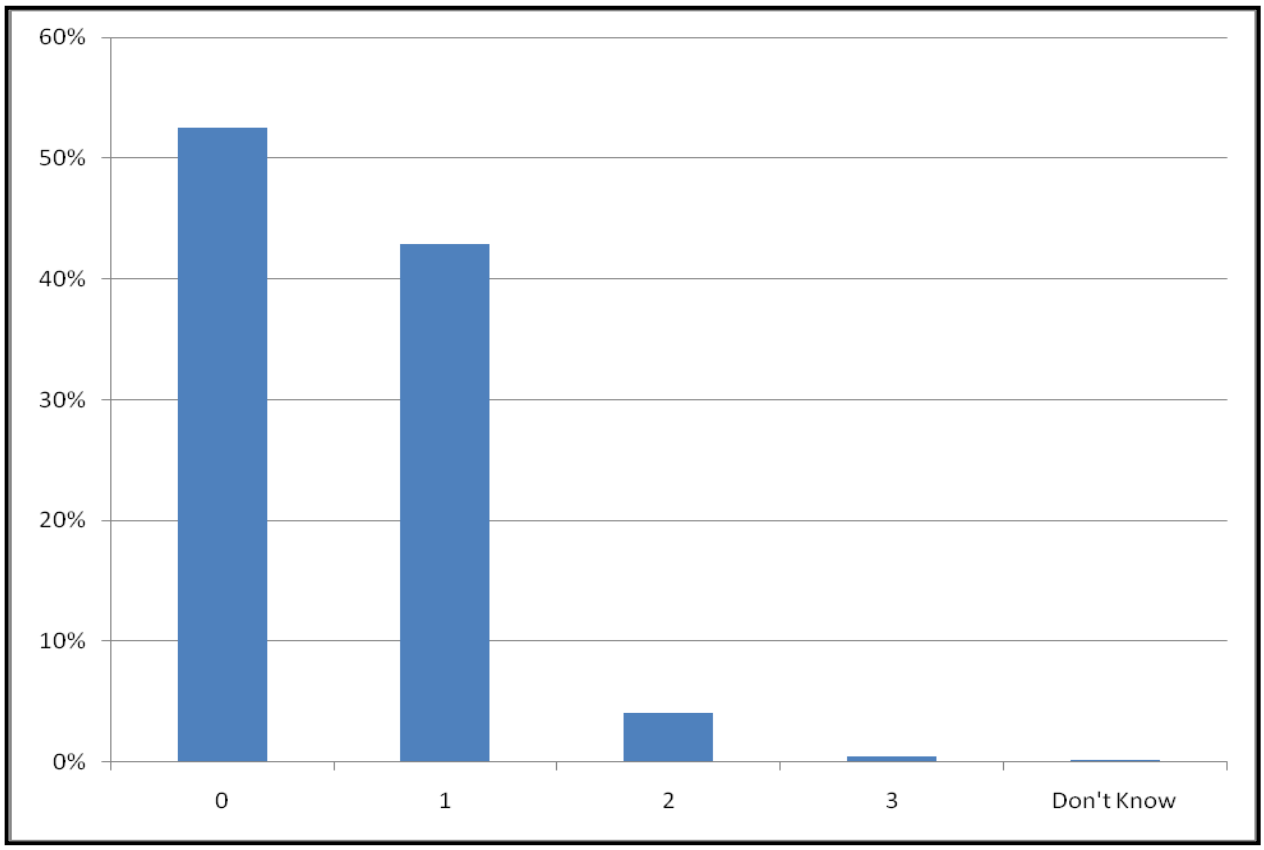


Table 41: Percentage Distribution of Stand-Alone Freezer Location

Stand-alone Freezer Location	All Utilities
Kitchen	6.9%
Garage	31.6%
Porch	2.5%
Basement	47.2%
Bathroom	0.2%
Laundry room	3.6%
Utility room	2.9%
Living room	0.4%
Other	4.7%
n	563

Figure 35: Distribution of Stand-Alone Freezer Reported as an ENERGY STAR Appliance

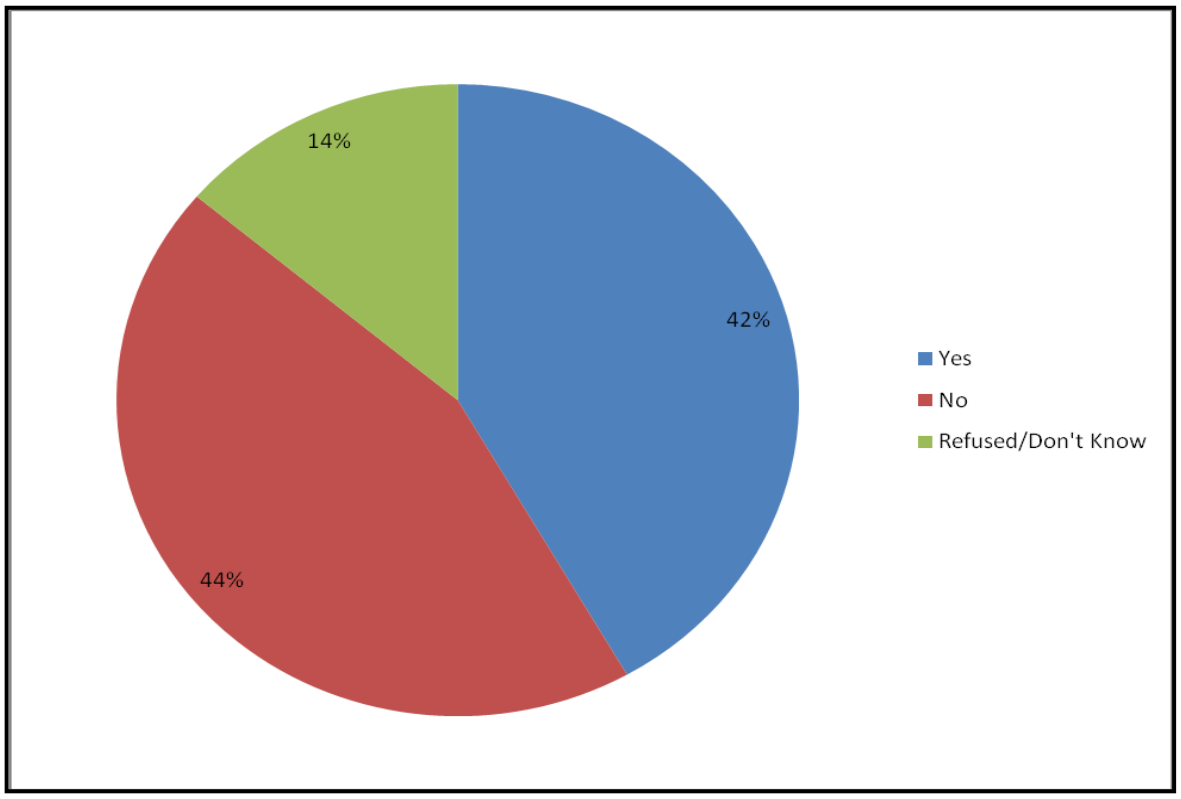
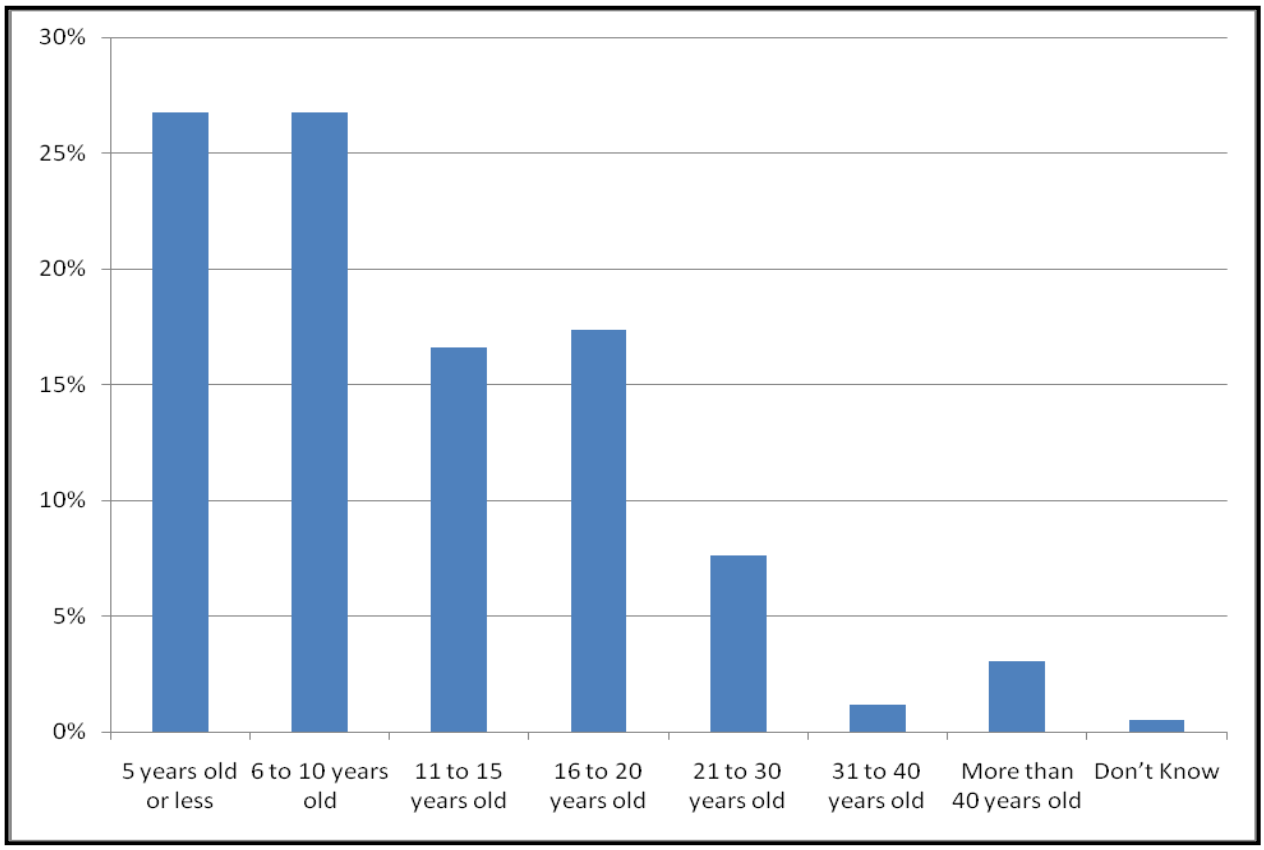


Figure 36: Percentage Distribution of Stand-Alone Freezer Age



Home Appliances

The following home appliances are discussed in this section:

- Cooktops/Ranges and Ovens
- Dishwashers
- Clothes Washers and Dryers

Cooking Appliances

Most cooktops/ranges and ovens of surveyed customers are electric, as Table 42 and Table 43 illustrate. The breakdown across these cooking appliances is almost identical, with about 68 percent of ranges and ovens using electricity and about 30 percent using natural gas.

Table 42: Percentage Distribution of Cooktop/Range Types in Ohio

Cooktop/Range Types	All Utilities
Electric	67.7%
Gas (pilot or IID)	29.6%
Propane	2.1%
Toaster Oven	0.2%
None	0.2%
Don't Know	0.3%
n	1,193

Table 43: Percentage Distribution of Oven Types in Ohio

Oven Types	All Utilities
Electric Oven	69.4%
Gas (pilot or IID)	27.4%
Propane Oven	1.6%
Grill	0.1%
Toaster Oven	0.2%
Microwave	0.5%
None	0.4%
Don't Know	0.4%
n	1,193

Dishwashers

More than half of the customers surveyed indicated that they own a dishwasher in the home (see Figure 37), more than half of which are reported as ENERGY STAR appliances. This result is shown in Figure 38 below.

Figure 37: Percentage Distribution of Residential Customers Owning a Dishwasher

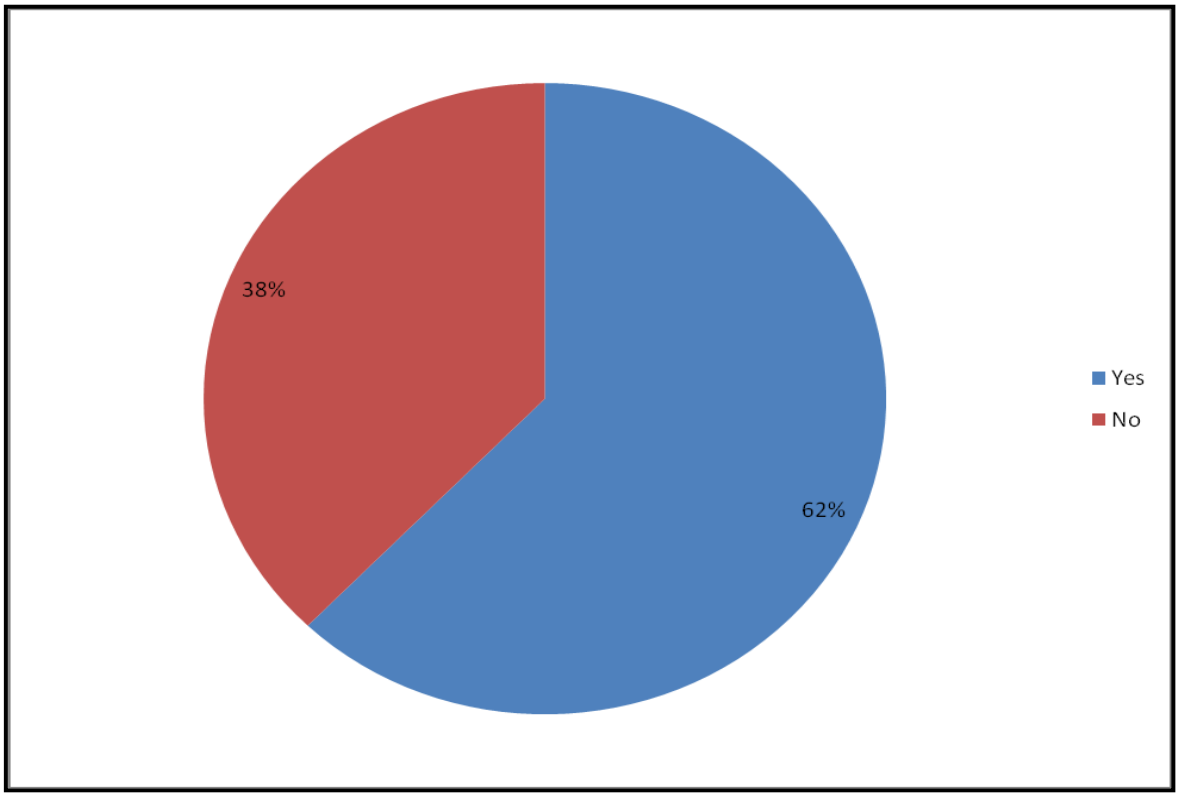
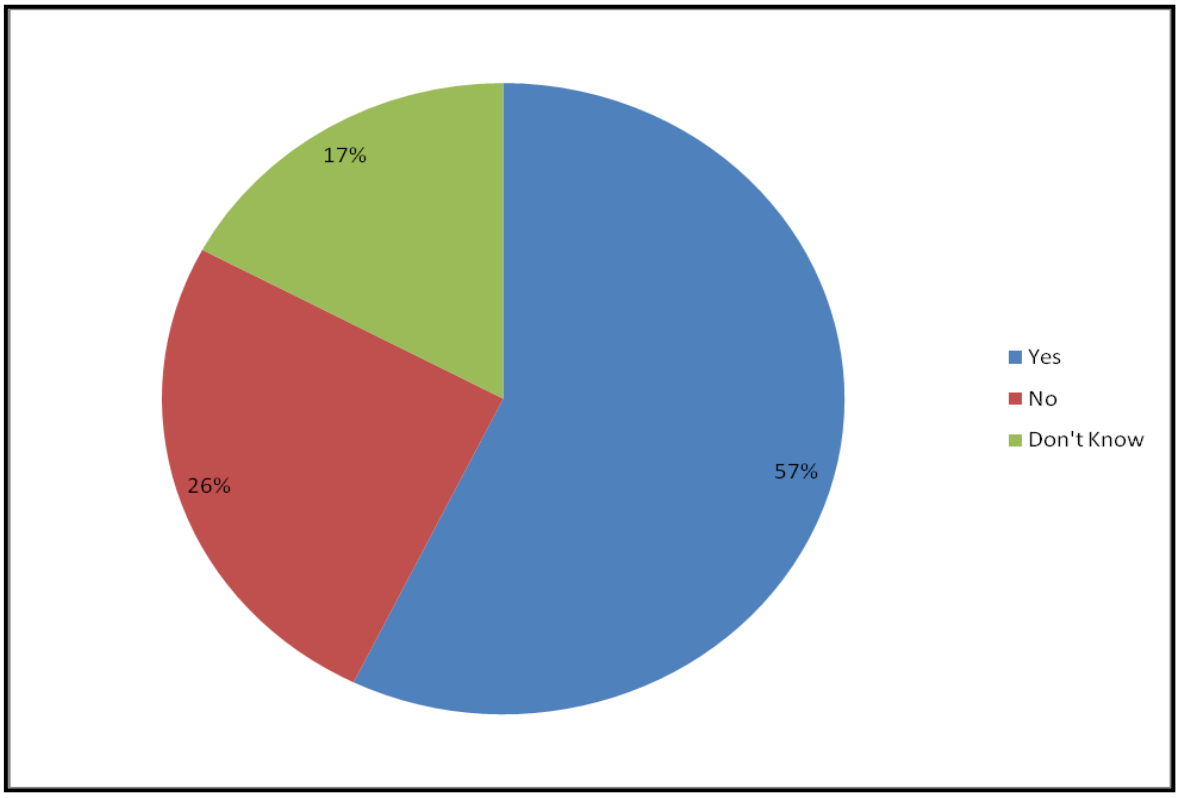


Figure 38: Percentage Distribution of Dishwashers Reported as an ENERGY STAR Appliance



Clothes Washers and Clothes Dryers

Almost 95 percent of all surveyed customers reported owning both a clothes washer and clothes dryer, as shown in Table 44 and Table 45. Over 80 percent of those who own a clothes dryer reported the fuel source as electricity.

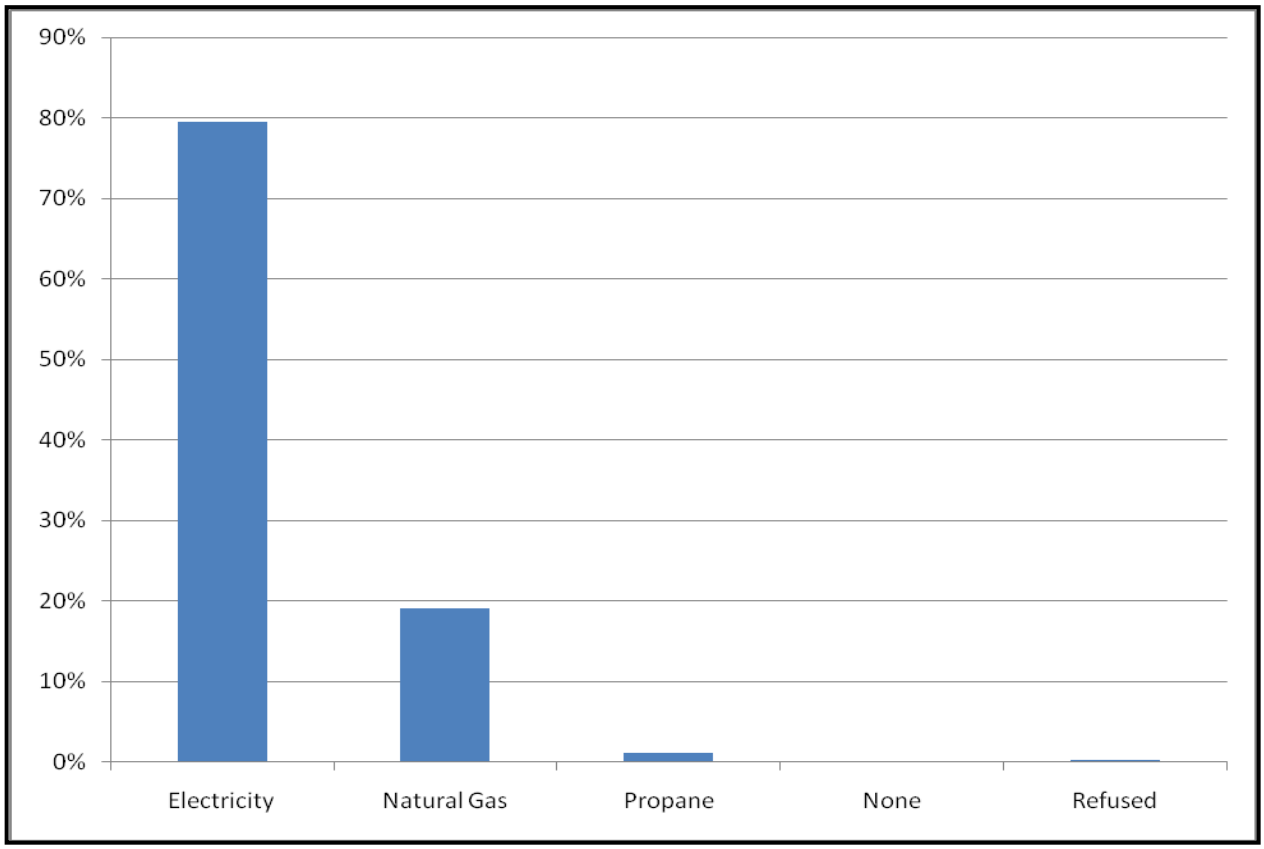
Table 44: Distribution of Residential Customers Who Own a Clothes Washer in Ohio

Do you own a Clothes Washer	All Utilities
Yes	94.5%
No	5.4%
Don't Know	0.1%
n	1,193

Table 45: Percentage Distribution of Residential Customers Who Own a Clothes Dryer in Ohio

Do you own a Clothes Dryer	All Utilities
Yes	94.4%
No	5.7%
n	1,193

Figure 39: Percentage Distribution of Fuel Type Used For Clothes Dryers in Ohio



Summary: Key Findings and Recommendations

The main objective of the residential baseline survey was to collect benchmarking data on market conditions, particularly with respect to attitudes and awareness toward energy efficiency among Ohio residents. The survey fielded in 2010 represents a snapshot of the market, important for utilities with nascent programs. We recommend that the same baseline survey be fielded again in a few years to determine how general attitudes toward efficiency have changed due to these programs.

Non-residential Baseline Survey Results

This chapter presents the findings from the Independent Evaluator study of Ohio's non-residential baseline energy use during 2010. The objective of the non-residential baseline study was to gather and analyze data to produce estimates of non-residential energy use for the state of Ohio. Topics covered in this survey include:

- Types of equipment being purchased (standard versus high efficiency for key end uses)
- Attitudes toward energy efficiency
- Energy management and decision making
- Investment criteria and business outlook with regard to energy efficiency

Data were gathered from telephone surveys conducted with business customers in Ohio across six of the utilities that provide electric service.[51] The service territories of the following utilities are included in this study:

- Duke Energy Ohio (Duke Energy)
- Dayton Power & Light Company (DP&L)
- FirstEnergy Corporation (FirstEnergy), which includes Ohio Edison, Toledo Edison, and Cleveland Electric Illuminating Companies
- American Electric Power Ohio (AEP Ohio)[52]

There are numerous non-residential sectors represented in the survey data, however because of the variety of business types, results from the baseline survey have been grouped into the following categories:

- Office
- Retail
- Industrial
- Other business types

The Office, Retail, and Industrial sectors make up the largest sectors usually targeted by efficiency programs; they are also the most common buildings types contained in the sample. The "Other business types" category includes educational institutions, grocery stores, convenience stores, hospitals and health care, lodging, warehouses, personal services, religious institutions, government,

[51] Ohio Edison Company, Toledo Edison Company, and Cleveland Electric Illuminating Company are FirstEnergy Corporation electric operating companies. Results from the baseline survey group these three companies under the heading FirstEnergy Corporation. The residential baseline survey report presented findings for each of these six utilities separately.

[52] The baseline survey was designed to be as similar as possible to the one fielded by the AEP evaluation team. This allowed us to leverage the survey results from the AEP evaluation and combine them with the data being collected by the Independent Evaluator team for Duke Energy, Dayton Power & Light, and First Energy service territories.

agriculture, food services, and automotive and trucking services. Note that while these building type categories are used in this report for presentation purposes, additional detail on building types is included in the raw survey data and is available for future analysis.

Data Methodology and Collection

Itron carried out primary data collection through the administration of telephone surveys using its Computer Assisted Telephone Interviewing (CATI) Center located in Berkeley, California. Itron's data collection began at the end of November 2010 and concluded in February 2011. Itron conducted all surveys with the exception of those conducted in AEP Ohio's service territory. AEP Ohio conducted its baseline survey separately using a survey instrument that was extremely similar to one used by Itron. Data collection for AEP Ohio began in November 2010 and was completed in May 2011. For the questions asked of AEP Ohio customers that were the same as those asked of customers in the other five utility service territories, the survey answers from AEP Ohio's customers were included with the answers from non-residential customers in the other service territories to create a complete picture of non-residential energy use for the state.

Distribution of Surveys

A total of 1,611 non-residential customers were surveyed across the utility service territories included in this baseline study. The distribution of surveys varied from a low of approximately 12.5 percent completed in each of Duke Energy's and Dayton Power & Light Company's territories to a high of about 50 percent conducted with customers in AEP Ohio's service area (see Table 46). The relatively large survey representation of AEP Ohio customers in this study stems from the utility conducting its own survey separate from Itron's effort. An agreement was made to include AEP Ohio's surveys with those completed for the other utilities to ensure a baseline study that includes statewide non-residential energy use behavior for customers in Ohio. Table 46 shows the number of surveys completed for each of the major Ohio electric operating companies included in this study.

Table 46: Telephone Survey Distribution by Utility Service Territory

Utility	Quota	Number of Surveys	Percent of Total
Duke Energy	200	203	12.5%
DP&L	200	202	12.5%
FirstEnergy	400	410	25%
AEP Ohio	770	796	50%
Total	**1,570**	**1,611**	**100%**

Table 47presents the distribution of surveys completed by business type. Offices, retail, and industrial buildings make up approximately 50 percent of the surveyed customers and all other building types are grouped into a separate category, making up the other 50 percent of the surveys.

Table 47: Telephone Survey Distribution by Business Type

Business Type	Number of Surveys	Percent of Total
Office	280	17%
Retail	169	11%
Industrial	342	21%
Other	820	51%
Total	**1,611**	**100%**

Presentation of Results

The tables and figures included in this report present percentage distributions at the utility service territory level, by business type, and/or at the statewide level. The results were weighted by each site's service territory, building type, and business size, as measured by number of employees. Two of the frequency distributions were left unweighted in order to provide a clear picture of who responded to the survey. These are the questions related to the building type and the number of employees at the business.[53] Note that Appendix D consists of percentage frequency distribution tables by service territory and business type for all survey questions common to the surveys implemented by AEP Ohio and by Itron.

Non-residential Sector Characteristics

This section presents data on the non-residential sectors found in Ohio by service territory group and by business type as described above. The attributes covered in this section include the following:

- Business types by service territory,
- Firm ownership by business type,
- Number of employees by service territory and business type, and
- Age of facility by service territory and business type.

Customer responses to telephone survey questions regarding business characteristics serve as the data source for the findings presented in this report. The sample for the non-residential baseline study was pulled based on NAICS codes with larger proportions of offices, industrial, and retail business types included.

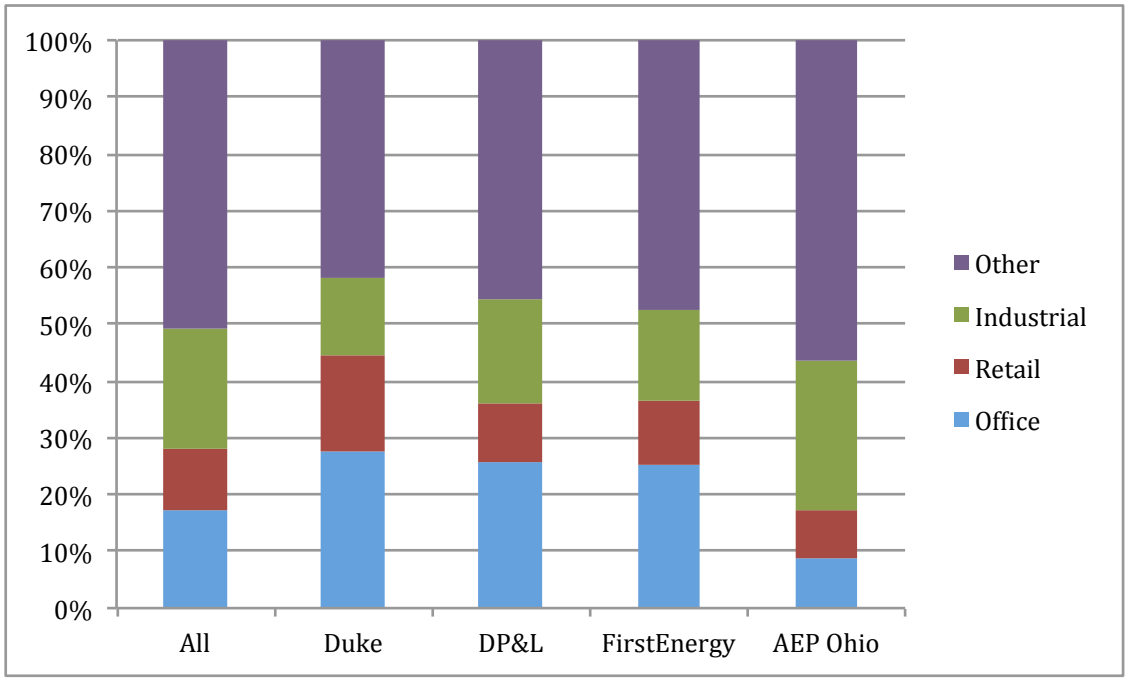
Business Sector

Survey respondents were asked what main business activity is performed at their facilities to see the distribution of the sample surveyed. In the sample used for this analysis, we found that approximately 17 percent of the businesses are offices, 21 percent are classified as industrial, about 10 percent are retail, and the remaining 51 percent is a combination of a number of business types,

[53] These are questions F1 and F4 in Appendix D.

including educational institutions, grocery stores, convenience stores, hospitals and health care, and lodging. As shown in Figure 40, offices make up roughly one quarter of the businesses surveyed in the service territories of Duke Energy, DP&L, and FirstEnergy. The proportion of offices is much smaller in AEP Ohio's territory due to a different sampling plan. However, the industrial presence in AEP Ohio's territory is larger than it is in the other territories, with more than 25 percent of surveyed businesses classifying themselves as industrial. In the other service areas, 14-18 percent of the businesses classify themselves as industrial. Figure 40 illustrates that Duke Energy has the largest proportion of surveyed retail businesses of all the Ohio utilities.

Figure 40: Distribution of Business Types Sampled by Utility Service Territory[54]



Building Ownership

Table 48 shows that approximately 76 percent of non-residential customers own their buildings, while about 22 percent of buildings in Ohio are leased. These findings are reflected in the results by utility as well. Understanding whether businesses in Ohio are owned or leased provides information to the utilities about the types of energy efficiency programs that would best serve non-residential customers in Ohio.

[54] This figure represents the distribution of phone survey respondents and does not represent the distribution of business sectors across the utilities.

Table 48: Percentage Distribution of Building Ownership Statewide and by Utility

Business Ownership	All	Duke Energy	DP&L	FirstEnergy	AEP Ohio
Own	76%	74%	71%	75%	79%
Lease	22%	24%	28%	23%	19%
Refused/Don't Know	2%	2%	1%	2%	2%
n	1,611	203	202	410	796

Age of Buildings

Figure 41 illustrates that just under 30 percent of the non-residential buildings in Ohio were built before 1960 and just about 40 percent were built before 1970. Table 49 shows that the vintage of non-residential buildings statewide is similar to that of businesses in Duke Energy territory. Non-residential buildings in DP&L's territory are newer, with 22 percent being built since 2000. The results are also presented by business sector in Table 50. One in four offices and one in three industrial buildings were built before 1960 in Ohio. Approximately 40 percent of retail facilities were built in 1990 or later.

Figure 41: Percentage Distribution of Building Vintage in Ohio

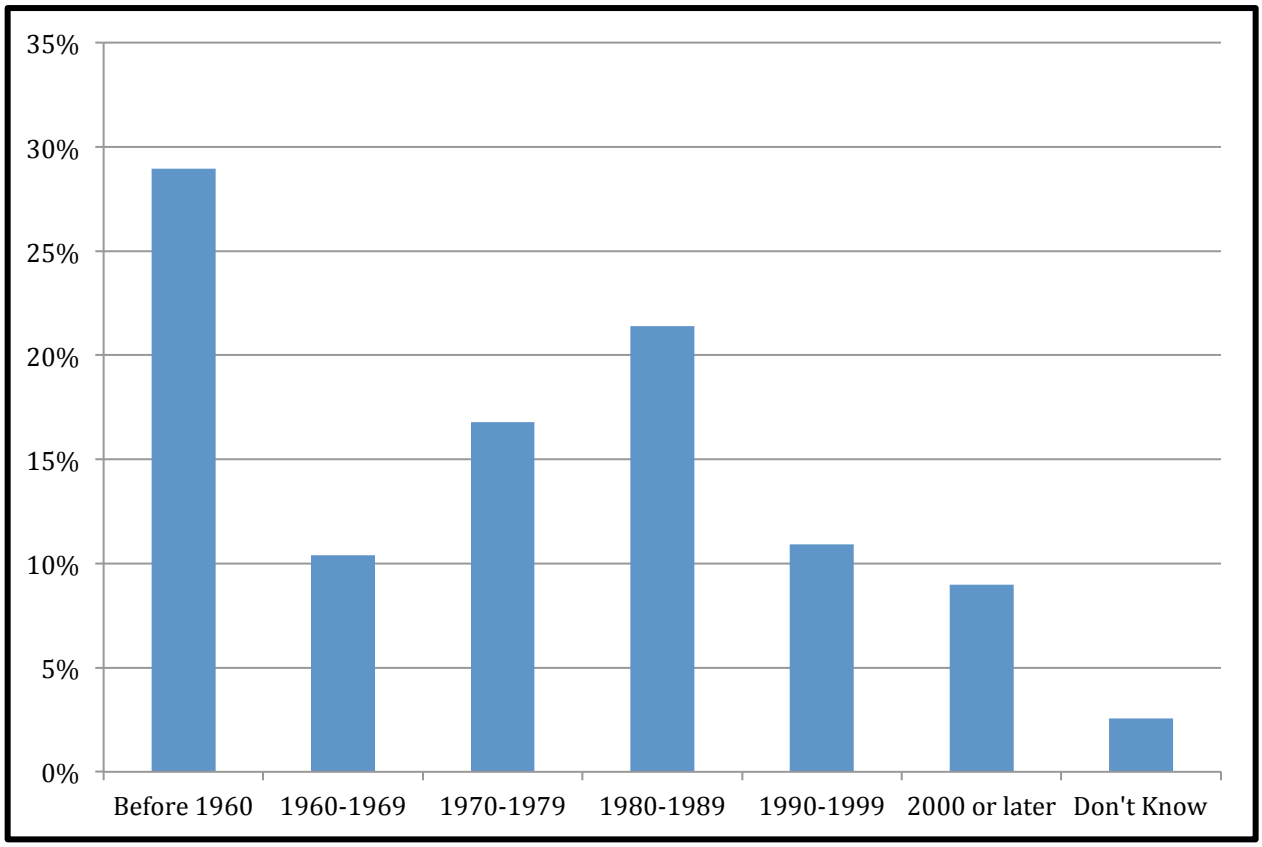


Table 49: Percentage Distribution of Building Vintage Statewide and by Utility

Business Vintage	All	Duke Energy	DP&L	FirstEnergy	AEP Ohio
Before 1960	29%	27%	23%	38%	18%
1960-1969	10%	12%	7%	10%	11%
1970-1979	17%	11%	28%	17%	17%
1980-1989	21%	29%	11%	17%	27%
1990-1999	11%	15%	8%	10%	11%
2000 or later	9%	5%	22%	5%	12%
Don't Know	3%	1%	1%	3%	3%
n	1,611	203	202	410	796

Table 50: Percentage Distribution of Building Vintage by Business Sector

Business Vintage	Office	Retail	Industrial	Other
Before 1960	27%	20%	32%	32%
1960-1969	4%	2%	16%	15%
1970-1979	14%	25%	13%	17%
1980-1989	46%	9%	13%	13%
1990-1999	5%	26%	15%	9%
2000 or later	3%	13%	7%	12%
Don't Know	1%	5%	4%	2%
n	280	169	342	820

Building Type

About 56 percent of the non-residential sector in Ohio conducts its operations in single unattached buildings. Another 14 percent of businesses are located in groups of two to five unattached buildings (which are considered different than a campus of facilities) and another 11 percent are part of high rise office buildings.

Table 51 shows that most office, retail, and industrial businesses are located in single, unattached buildings and over 40 percent of offices are in high rise buildings, as would be expected.

Figure 42: Percentage Distribution of Building Types in Ohio

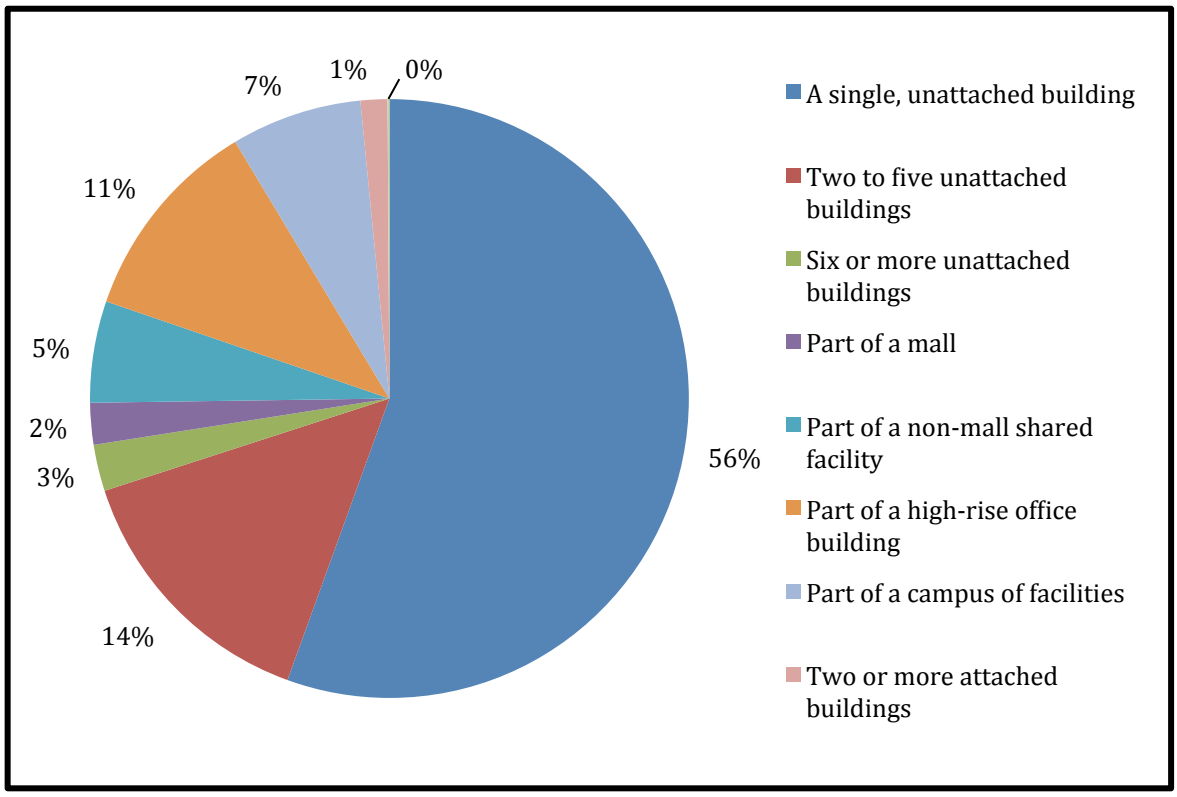


Table 51: Percentage Distribution of Building Types in Ohio by Non-residential Sector

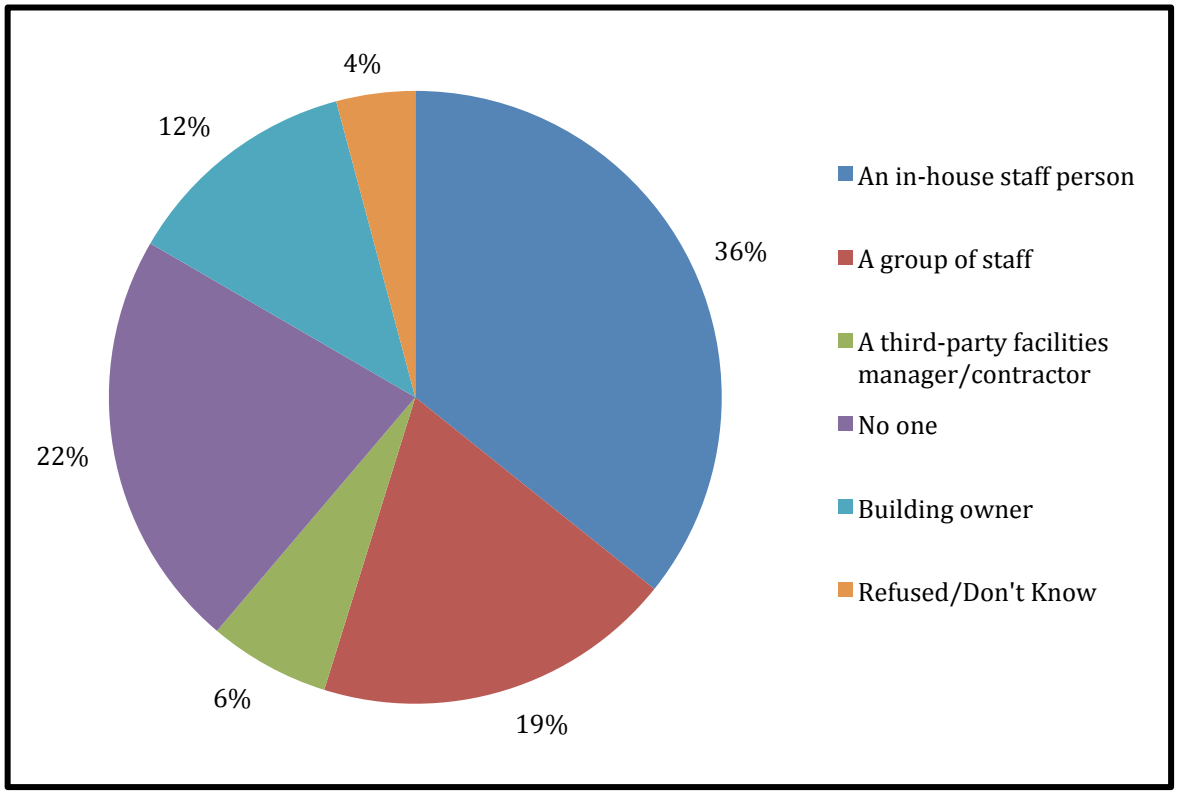
Building Type	Office	Retail	Industrial	Other
A single, unattached building	47%	46%	71%	58%
Two to five unattached buildings	3%	32%	20%	14%
Six or more unattached buildings	1%	1%	3%	4%
Part of a mall	0%	11%	0%	2%
Part of a non-mall shared facility	6%	9%	4%	5%
Part of a high-rise office building	40%	0%	0%	1%
Part of a campus of facilities	3%	0%	1%	14%
Two or more attached buildings	1%	0%	0%	2%
Other/Don't Know	0%	0%	0%	0%
n	280	169	341	820

Customer Characteristics

This section presents data on customer characteristics at the statewide level for Ohio and, when warranted, by utility or by business sector. Management of energy usage, participation in energy efficiency programs, and future plans to invest in energy efficiency improvements are the focus of this section.

We asked businesses about who manages their energy usage and associated costs. As depicted in Figure 43, about 55 percent of Ohio's non-residential sector uses its own staff member or members to perform this function and approximately six percent contract this service out to a third party. Surprisingly, over 22 percent of the respondents stated that no one at their company was responsible for energy management.

Figure 43: Percentage Distribution of Ohio Non-residential Energy Usage Manager



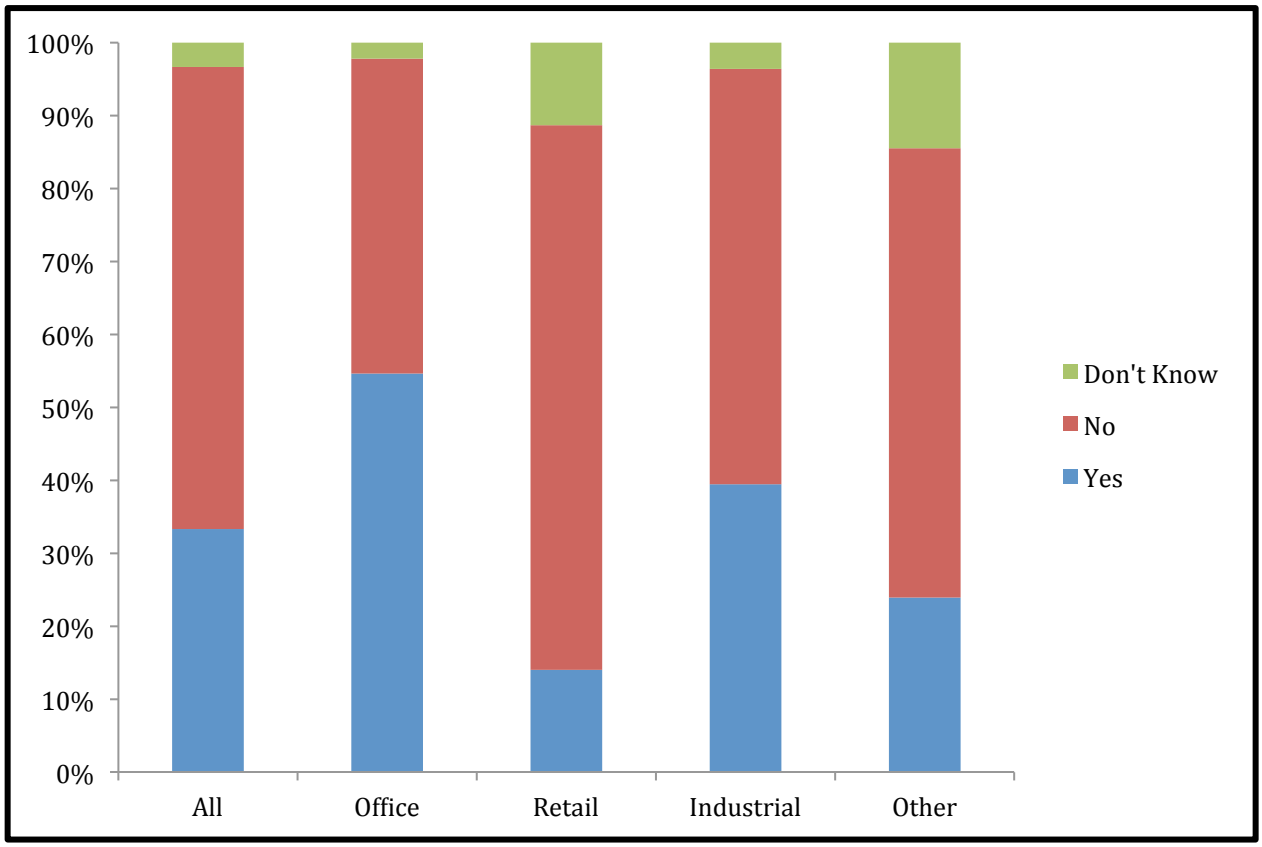
These customers were then asked about their past participation in energy efficiency programs sponsored either by the government or other entity. Across the state about 58 percent of non-residential customers surveyed said that have not participated in a program, and 33 percent stated they have not. About 9 percent stated that they did not know. Table 52 shows that businesses in Duke Energy's service territory have higher participation relative to businesses in the other

territories.[55]When participation in energy efficiency programs is looked at by business sector, it is clear that offices and industrial facilities have participated more than retail facilities and other business types (see Figure 41).

Table 52: Distribution of Ohio Participants in EE Programs in the Last 5 Years

Participate in EE Programs in Last 5 Years	All	Duke Energy	DP&L	FirstEnergy	AEP Ohio
Yes	33%	46%	33%	29%	33%
No	58%	45%	63%	65%	52%
Don't Know	9%	9%	3%	6%	15%
n	1,611	203	202	410	796

Figure 44: Percentage Distribution of Non-residential Businesses Participating in Energy Efficiency Programs in Ohio



[55] This finding likely corresponds to the level and timing of energy efficiency offerings at each utility. For example, Duke Energy has been offering a wide variety of programs to their customers over the past five years, while other utility programs were just beginning when the survey was fielded.

The survey then proceeded to ask customers if they were planning on making any capital investments in energy efficiency in the next two years. As Table 53 shows, about 40 percent of the non-residential sector plans on making such investments, with a large majority of these coming from the industrial sector and other business types. Fewer respondents from the office category stated that they are considering investments in energy efficient equipment.

Table 53: Plans to Make Energy Efficient Investments in Next 2 Years by Non-residential Sector

Future EE Investments	All	Office	Retail	Industrial	Other
Yes	39%	32%	28%	54%	42%
No	47%	48%	58%	35%	47%
Refused/Don't Know	14%	20%	14%	12%	11%
n	1,611	280	169	342	820

A subset of customers was asked about their specific capital investment plans are for the next two years. Just over a third of those asked stated that they planned to renovate or remodel their buildings.Another 15 percent was not sure or refused to answer the question. Other specific capital investment plans include adding/upgrading lighting, HVAC systems, business equipment, and enery management systems. Very few mentioned plans to invest in self generation of energy.

Table 54: Specific Plans for Capital Investment in the Next Two Years

Planned Capital Investments in Next Two Years	Statewide
Renovation or Remodeling	36%
Add/Upgrade Business Equipment	10%
Add/Upgrade EMS	8%
Upgrade Doors	0%
Upgrade Windows	3%
Upgrade Ceiling	4%
Add/Upgrade HVAC	11%
Self Generate Power	1%
Add/Upgrade Lighting	16%
Add/Upgrade Insulation	1%
Electrical Upgrade	3%
Other	1%
Refused/Don't Know	15%
n	440

End Use Saturations

This section summarizes findings related to end use saturations and densities for Ohio statewide based on data collected through the non-residential sector telephone survey conducted for this study. Details regarding the data collection effort are included above. We present results at the statewide level in this section, but they have been disaggregated to the utility and business sector levels in the tables included in Appendix D. The end use categories covered in this section include the following:

- Indoor Lighting
- Air Conditioning
- Space Heating
- Commercial Refrigeration
- Energy Management Systems

Indoor Lighting

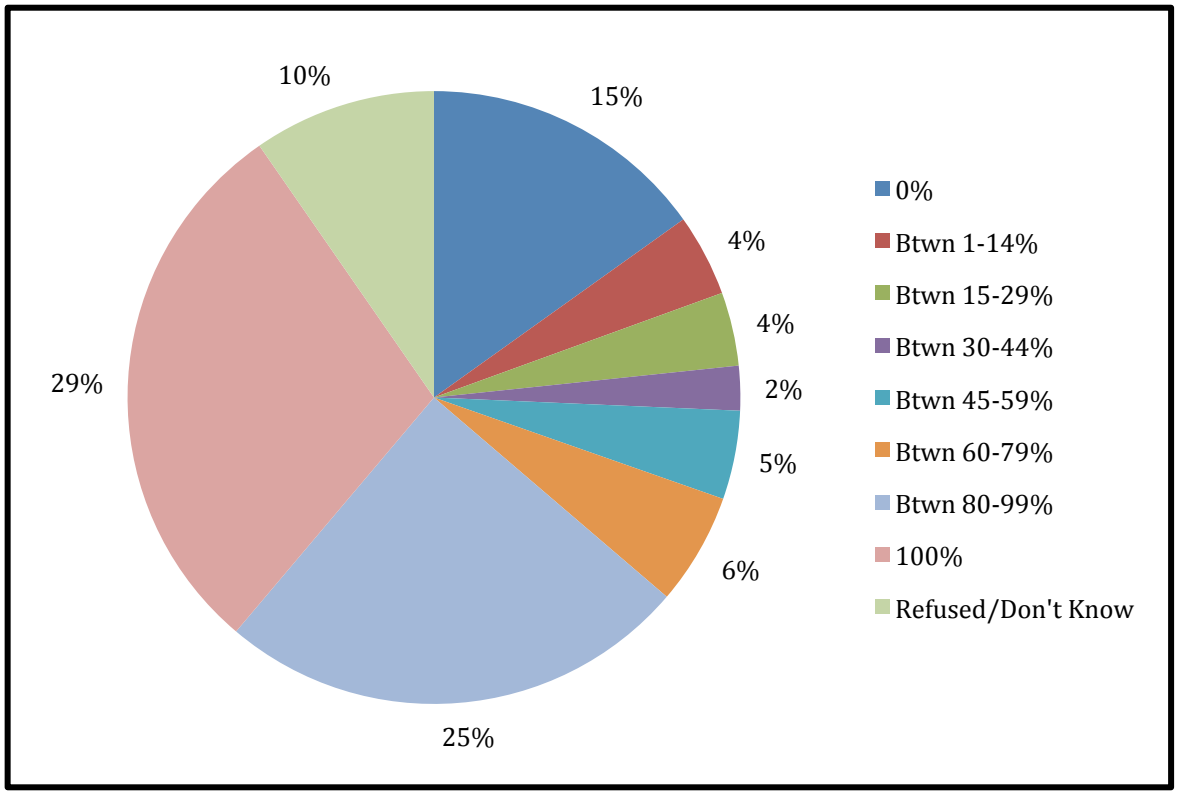
The non-residential baseline survey posed a series of questions to respondents about the types of lighting present in their buildings. Specifically, they were asked about the amount of electric light provided by different lighting types for their facilities, including linear fluorescent tubes, incandescent lamps, CFLs, halogen lamps, HID lamps, LEDs, and others. An overview of the findings shows that the non-residential sector in Ohio relies mostly on linear fluorescents and less so on the other lighting types. In fact, 66 percent of those surveyed stated that at least 80 percent of their lighting comes from linear fluorescents. As Table 55 shows, linear fluorescent tubes provide most of the lighting in the non-residential sector in Ohio, with small amounts of lighting coming from incandescent and compact fluorescent lamps. Less common are halogen, HIDs, LEDs, and other types of lighting.

Of those who stated linear fluorescent tubes are present in their facilities (regardless of the amount), we then asked about the breakdown of the percentage of those tubes that are the more efficient T5/T8's versus T12s. Table 55 shows that for almost 30 percent of the customers 100 percent of the linear fluorescents present in their facilities are T5/T8s (in other words, no T12s are present). Another 25 percent have at least 80 percent of their linear fluorescent lighting coming from T5/T8s.

Table 55: Proportion of Interior Lighting Provided by Different Lighting Types

Statewide	Linear Fluorescents	Incandescent Lamps	CFLs	Halogen Lamps	HID Lamps	LEDs	Other
<1%%	1%	42%	50%	67%	65%	82%	89%
1-14%	4%	44%	32%	23%	16%	12%	8%
15-29%	3%	5%	9%	2%	3%	1%	0%
30-44%	5%	2%	2%	0%	5%	0%	0%
45-59%	4%	1%	1%	1%	1%	0%	0%
60-79%	16%	2%	1%	1%	2%	0%	0%
80-99%	47%	1%	1%	1%	2%	0%	0%
100%	19%	0%	0%	0%	0%	6%	0%
Refused/Don't Know	1%	3%	4%	5%	5%	4%	3%
n	1,590	1,259	1,184	1,101	1,175	1,029	1,003

Figure 45: Distribution of Linear Fluorescents that are T5s/T8s



Air Conditioning

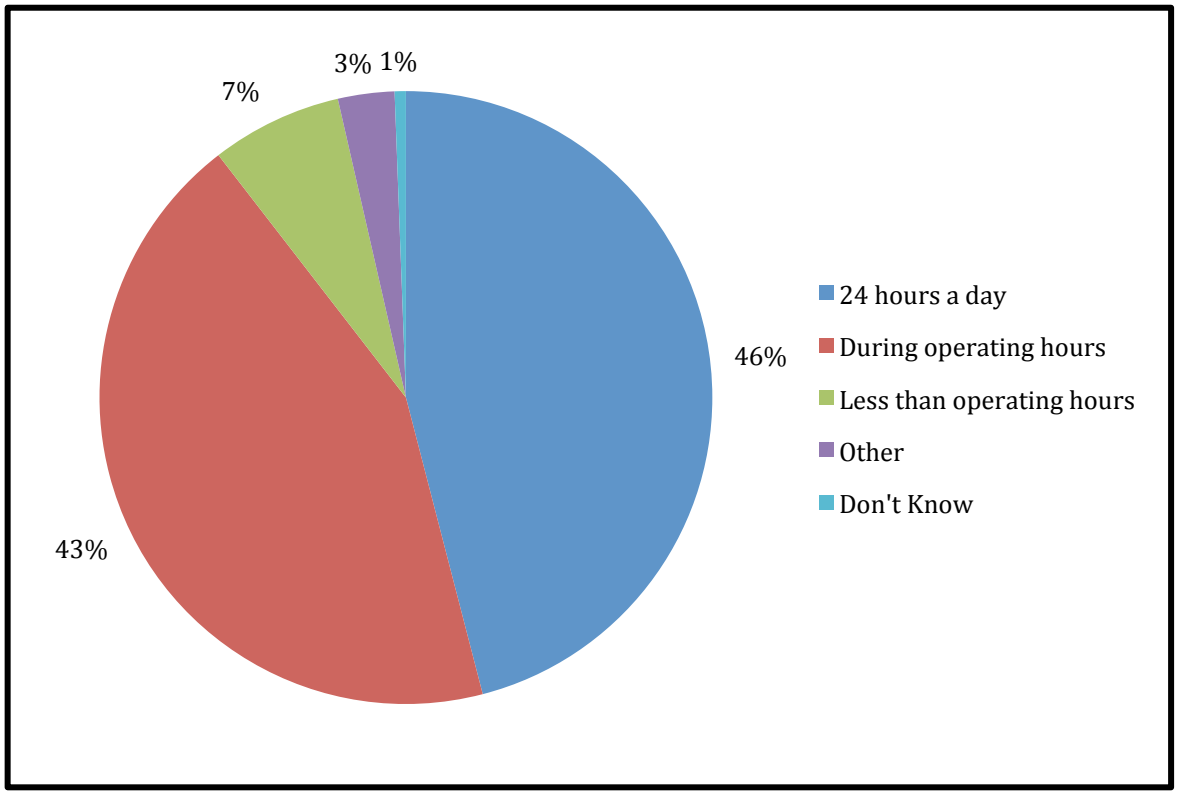
Survey respondents stated that packaged central air conditioners are the most common type of system used for air conditioning in the non-residential sector (see Table 56). Over 50 percent of the businesses in Ohio use this type of equipment. This is followed by central chilled water plant equipment, which is present in about 29 percent of the businesses surveyed. Less common are individual AC units attached to walls or in windows, chilled water piped in from outside, ceiling fans, and other. The Other category includes heat pumps, modulated shading, dehumidifiers, and movable fans.

Table 56: Percentage Distribution of Air Conditioning Systems in Ohio

Primary AC System Type	Statewide
Central Chilled Water Plant Equipment	29%
Packaged Central Air Conditioners	50%
Split-system Air Conditioners	20%
Individual Window/Wall Units	5%
District Chilled Water Piped in From Outside	2%
Ceiling Fans	1%
Other	3%
Don't Know	2%
N	1,459

AC systems in businesses in Ohio are operated heavily during the summer months. Over 45 percent operate their cooling systems 24 hours a day, regardless of how many hours they are open for businesses. 43 percent of the business respondents stated that they cool their buildings during operating hours only. Other schedules include more than solely during operating hours but less than 24 hours, and those operating at a higher level during operating hours and turned down at night.

Figure 46: Duration of Air Conditioning Operation during Summer Months



Space Heating

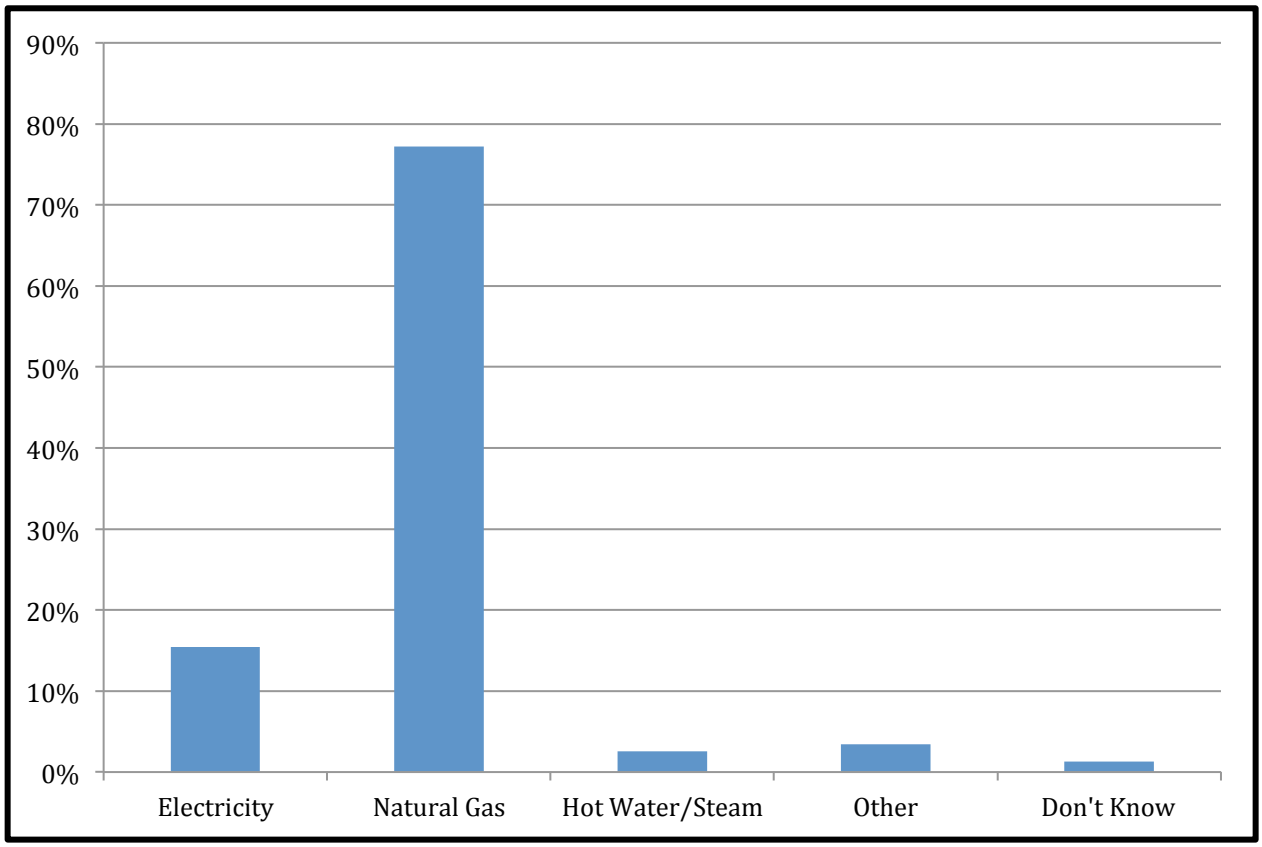
Survey results show that 78 percent of the non-residential customers surveyed can heat their entire facility. Such a result is not surprising given the severity of the climate in Ohio during the winter months (see Table 57).

Table 57: Percentage of Heated Non-residential Building Space in Ohio

Percentage of Heated Space	Statewide
100 percent	78%
75 to 99 percent	14%
50 to 74 percent	3%
25 to 49 percent	1%
1 to 24 percent	4%
0 percent	0%
Refused/Don't Know	0%
n	1,611

, Natural gas is the predominant fuel type for non-residential facilities in Ohio, followed far behind by electricity, as shown in Table 53. The combination/Other category includes those answers such as oil, liquid petroleum gas, geothermal, wood, or a combination of fuels. This result is similar to what was found in the residential sector.

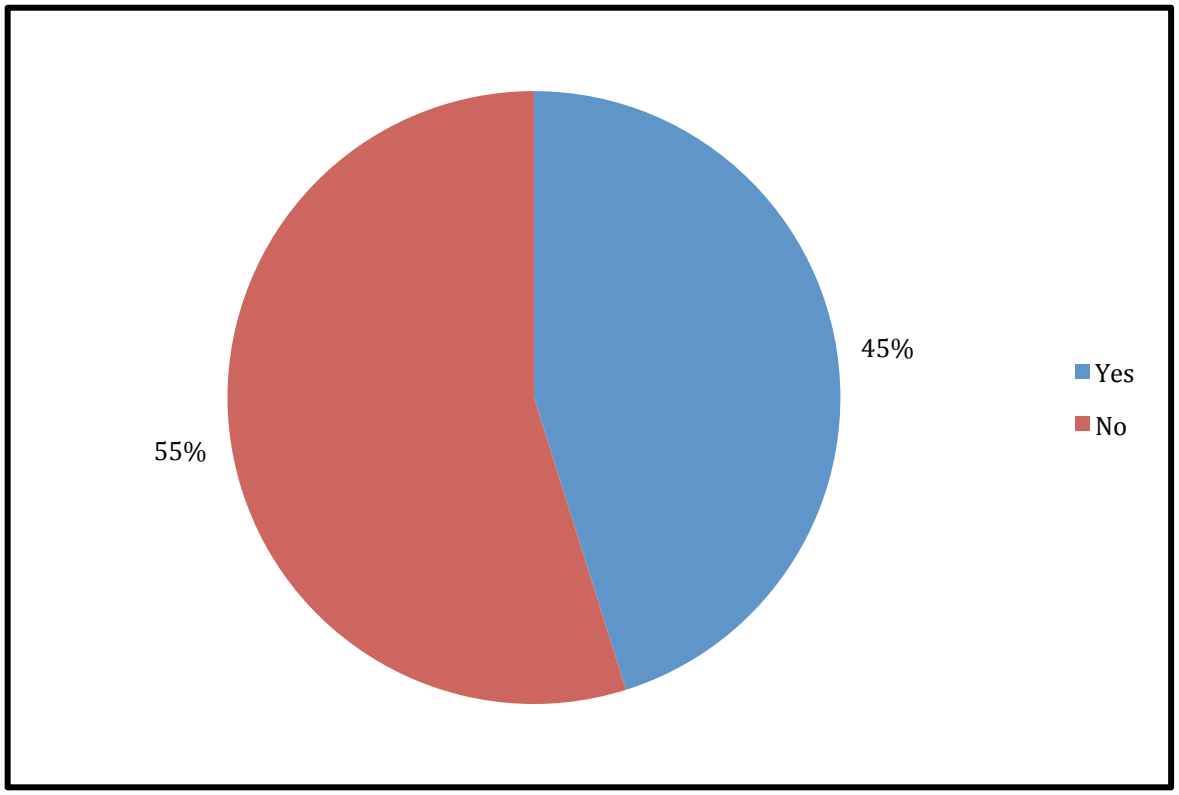
Figure 47: Main Fuel Used for Space Heating



Commercial Refrigeration

More than half of Ohio businesses surveyed have commercial refrigeration equipment. The results in Appendix D show that more businesses in Duke Energy's and FirstEnergy's service territories have commercial refrigeration equipment than those in any of the other territories.

Figure 48: Presence of Commercial Refrigeration in Ohio Businesses



Energy Management Systems (EMS)

The survey asked a number of questions regarding the presence of energy management system equipment in businesses. Based on responses received from customers, about 60 percent do not use EMS equipment to manage energy usage in their building (see Figure 49). The use of energy management systems was then further examined by asking customers who stated that they did use an EMS about the types of equipment controlled using it. Respondents were able to give more than one response to this question. Figure 50 shows that virtually all these respondents stated that their HVAC systems are controlled through EMS, and over 40 percent stated that EMS also controls their lighting.

Figure 49: Distribution of Facilities with Energy Management Systems

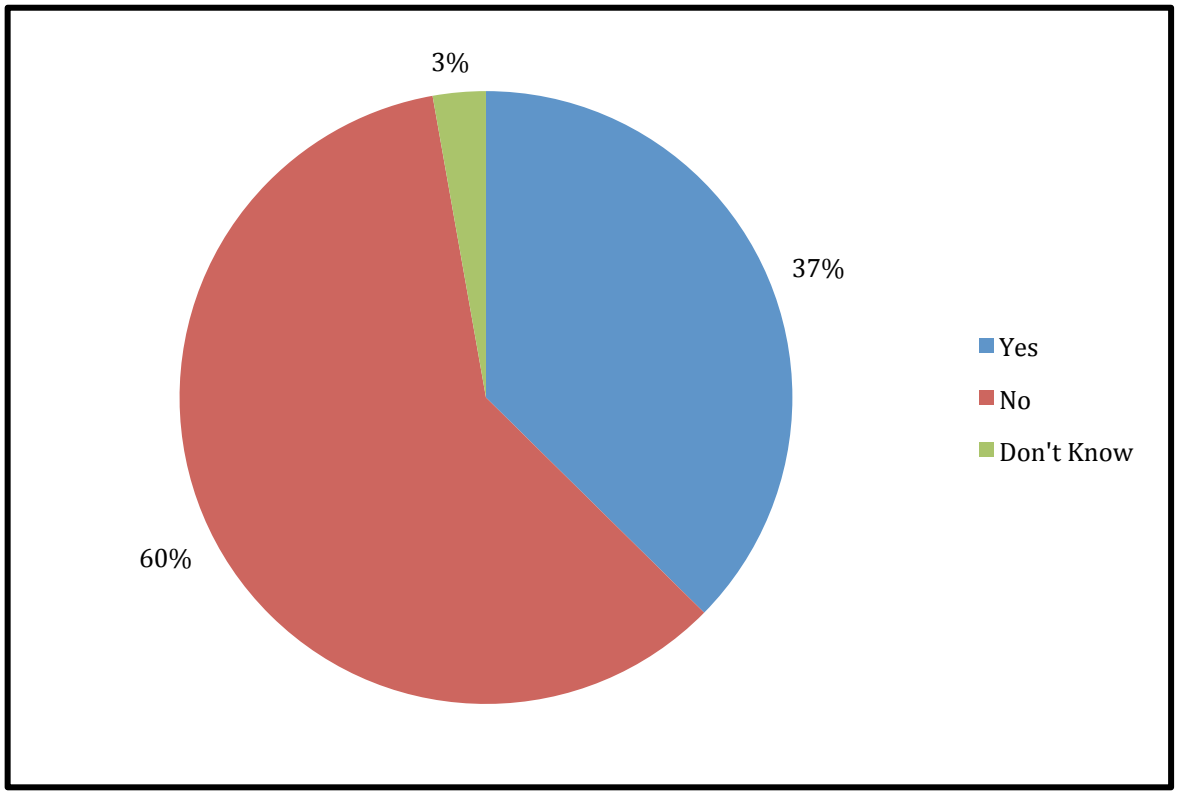
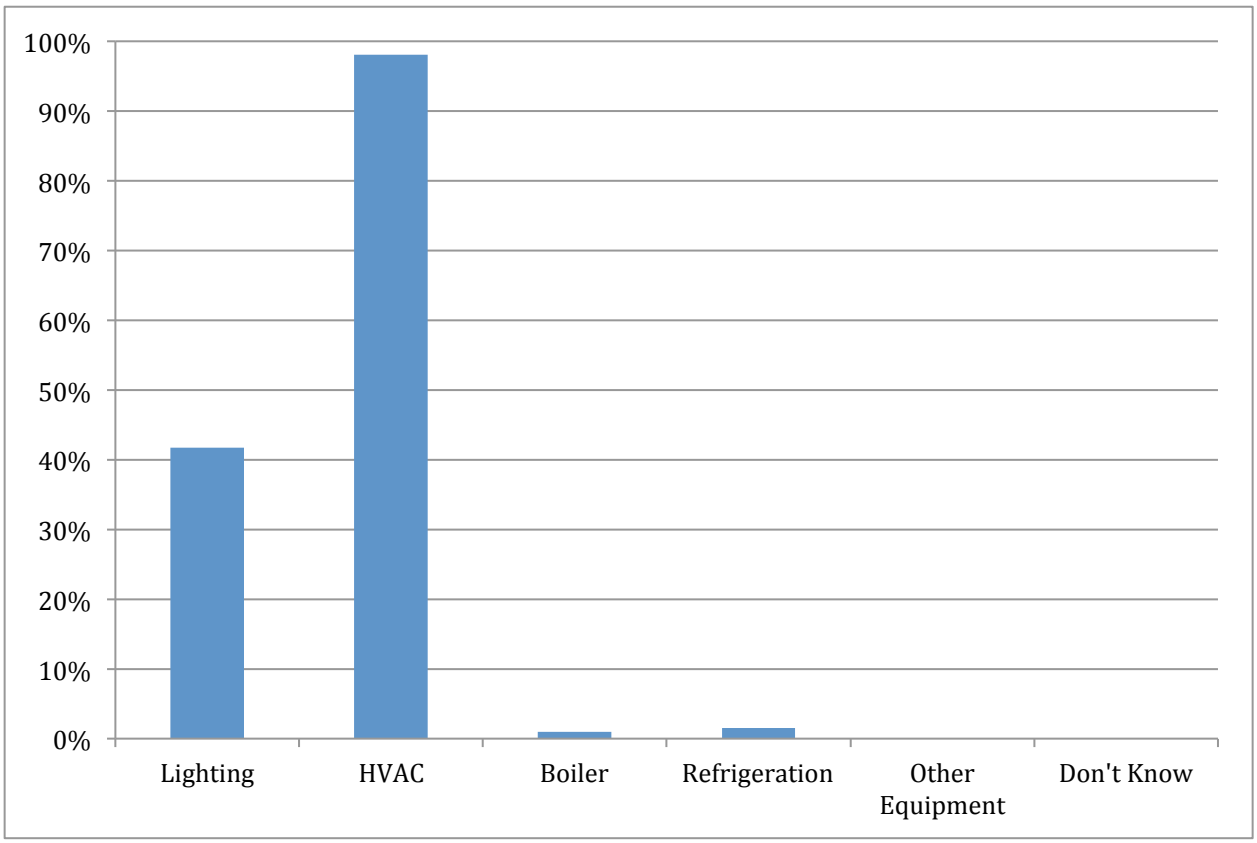


Figure 50: Equipment Controlled by EMS in Non-residential Ohio Buildings



Summary: Key Findings and Recommendations

As with the residential baseline survey, the primary purpose of the non-residential baseline survey was to collect benchmarking data on market conditions, particularly with respect to attitudes and awareness toward energy efficiency among business customers. The survey fielded in 2010 represents a static picture of the market at that time, which is especially useful for utilities with nascent programs. We recommend that the same baseline survey be fielded again in a few years to determine how general attitudes toward efficiency have changed due to these programs.

Summary: Report of the Ohio Independent Evaluator, Volume I: Main Report, electronically filed by Raymond W. Strom on behalf of PUCO Staff