



Report of the Ohio Independent Evaluator

2012 Ohio Efficiency Programs

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FINAL REPORT



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Executive Summary

Introduction

In April 2010, the Public Utilities Commission of Ohio (PUCO) chose the Evergreen Economics team¹ to serve as the Independent Evaluator to assist in the review and monitoring of the Ohio electric utilities' energy efficiency program evaluation.² The programs reviewed include those of American Electric Power Ohio (AEP Ohio),³ Dayton Power and Light Company (DP&L), Duke Energy Ohio (Duke Energy),⁴ and FirstEnergy.⁵

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

¹ The Independent Evaluator team consists of staff from the following companies: Evergreen Economics, Itron, Inc., Michaels Energy, 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 Ohio utilities are required to propose energy efficiency plans and file annual status reports with the PUCO per the 2009 PUCO rules for implementing the Ohio law adopted in 2008 that established an Energy Efficiency Resource Standard with energy savings goals for electric utilities and that allows for cost recovery and decoupling. Each annual status report (called a Portfolio Status Report) must include a compliance demonstration and a program performance assessment (including a description of all transmission and distribution infrastructure improvements and an evaluation, measurement, and verification report, along with recommendations for the future of the programs). A more detailed discussion of these rules and legislation is presented in the Introduction of this report.

³ AEP Ohio had two operating companies in 2012, Columbus Southern Power Company (CSP) and Ohio Power Company (OPCo). As of December 31, 2011, CSP merged with OPCo, with OPCo as the surviving entity.

⁴ Although there are Duke Energy companies in other states, in this report unless otherwise noted, "Duke Energy" refers specifically to Duke Energy Ohio.

⁵ 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, these three are referred to collectively as FirstEnergy or Companies, where noted.

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 third verification report produced by the Evergreen Economics team in its capacity as Independent Evaluator for the PUCO, and covers the 2012 energy efficiency program year (Program Year (PY) 2012). PY2012 verification activities include a review of the Portfolio Status Report and related evaluation research reports filed by the utilities. Additionally, the energy savings reported for each program were verified by reviewing an extract of each utility's program participant database and replicating the savings amounts included in the applicable Portfolio Status Report. In an ongoing effort to standardize reporting across utilities, we continued to develop templates for program evaluation plans and evaluation reports. Lastly, we fielded an independent participant phone survey to collect information on program participation for each utility.

Key Findings and Recommendations

There are several overarching findings from the review of the 2012 Portfolio Status 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 reviewed were generally of high quality and conformed to the standard practices of the evaluation industry.
- **Participants are generally satisfied with their program experience.** Evaluations that included 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.

Our review of the impact estimates and evaluation reports identified issues that will affect the determination of energy savings that can be counted toward Ohio utility requirements. These issues and related recommendations are summarized below and addressed again in the discussions of the individual utility evaluation reports. Note that some of these recommendations were also made as part of the 2011 Independent Evaluator report.

1. Properly account for participation in other efficiency programs when evaluating audit and home energy comparison program savings. 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 peer group 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 savings from measures installed via a rebate program are more appropriately claimed for the rebate program, utilities often will not claim savings from an audit-style program to avoid double counting. If savings are to be claimed from the audit or energy comparison program, they should be limited to savings resulting from behavior changes directly attributable to the audit or energy comparison program rather than from rebated installed measures.

Estimating energy savings attributable to these types of programs is challenging at best, and typically, a fixed effects billing regression is utilized to control for various influences that may be affecting energy use. We make several recommendations throughout this report based on the specific model

used by each utility. A critical issue for these models is controlling for participation in utility rebate programs. Since savings for rebated measures are attributed to the applicable rebate program, not controlling for these effects in the billing regression model will result in double counting the savings and over-estimating those attributable to the audit or home comparison program.⁶

2. Have evaluators select control groups for home energy comparison programs. The selection of a proper control group is essential for estimating impacts of home energy comparison programs. The control group must be matched on key aspects that might affect energy use (e.g., house type and location). In addition, the rates of participation in other rebate programs must also be examined in both the pre-program and post-program periods. In particular, differences in other efficiency program participation rates prior to the start of the home energy comparison program can have a significant impact on results.

To avoid a possible conflict of interest, we recommend that the utilities adopt industry best practice and have the evaluation teams (rather than the program implementer) make the random selection of the treatment and control groups for all energy comparison programs.⁷

3. Do not use store ‘shelf surveys’ to estimate wattages for removed bulbs replaced by CFLs. We do not believe that store shelf surveys are an appropriate method for determining the wattage of bulbs replaced by CFLs. Stores will need to carry a wider range of bulbs and wattages to cover both residential and commercial installations, as well as different lamp types and lighting applications. As a consequence, the distribution of the wattages of the bulbs stocked in stores will likely differ substantially from the wattages where residential customers are typically installing CFLs, as stores are attempting to serve a much wider market than that targeted by a residential CFL program. It is also not possible to determine from a shelf survey the types of bulbs and wattages that are actually being purchased, and the average wattage for purchased bulbs will likely differ significantly from the average observed on the shelf once the volume of purchases is taken into account. For these reasons, we recommend that a participant phone survey (rather than a shelf survey) be used to collect information on the wattages of replaced bulbs when calculating CFL savings.

4. Provide additional detail on research methods and results in the evaluation reports. In several instances during our review, there was not enough detail provided in the evaluation report to understand how the final energy savings estimates were derived. Examples of additional detail that is sometimes missing includes descriptions of variables used in regression models, equations used for calculating savings, customer survey data, and full citations for key references. During our discussions with the utilities on these reports, the utilities provided additional details that helped resolve these issues. Rather than continue to work on these issues behind the scenes with the utilities, we have

⁶ We have found in other jurisdictions that the effect on savings can be significant, as evidenced by a recent evaluation by Evergreen Economics of the Opower program in Hawaii, a home energy comparison program similar to those being offered in Ohio. The Hawaii Opower program implementer initially claimed that alternative program participants had been removed from the savings calculations, but upon review, it was found that these customers were still in the dataset used to estimate impacts. When Evergreen controlled for these customers in the fixed effects billing regression, estimated savings decreased by 38 percent.

⁷ State and Local Energy Efficiency Action Network, prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations* (2012), 22-23. <http://behavioranalytics.lbl.gov>.

chosen to leave these comments regarding the lack of critical information in our review of the evaluation reports to emphasize the level of detail that should be provided. We believe that the requested detail is the minimum amount required to meet the industry standard for a comprehensive evaluation report, and does not involve including proprietary or confidential customer information. Additionally, the requested level of detail will allow other interested stakeholders—those that do not have the benefit of requesting additional information from the utilities—to gain a complete understanding of the evaluation methods.

In addition to these overarching recommendations, Table 1 summarizes the individual recommendations by utility and includes the page number in the report where additional detail can be found.

Table 1: PY2012 Independent Evaluator Recommendations by Utility

Utility	Recommendation	Page (#)
AEP Ohio	Adjust claimed savings to account for CFLs that replace existing CFLs.	17
AEP Ohio	Have the evaluation team (rather than the program implementer) select the treatment and control groups for the Home Energy Report program.	17
AEP Ohio	Account for participation in other efficiency programs in the Home Energy Report billing regression models.	18
AEP Ohio	Provide additional detail on energy savings calculations in the evaluation reports where requested.	18
DP&L	Use participant surveys rather than store shelf surveys to determine baseline wattages for CFLs.	24
Duke Energy	Adjust billing model specifications as recommended.	37
Duke Energy	Account for participation in other Duke Energy programs in the audit and home energy comparison program billing regression models.	38
Duke Energy	Use data on Ohio customers (rather than customer data from other states) to support Duke Ohio evaluation research.	38
FirstEnergy	Include results from completed participant surveys in the evaluation reports.	50
FirstEnergy	Adjust CFL baseline to include fewer 100-watt incandescents.	50
FirstEnergy	Explain discrepancies between the <i>ex ante</i> and <i>ex post</i> values.	51
FirstEnergy	Adjust billing regression model as recommended for the Home Energy Analyzer Program.	51
FirstEnergy	Provide additional detail on evaluation methods.	51

Performance Summary by Utility

The energy savings reported for each program were verified by reviewing an extract of each utility's program participant database and replicating the savings amounts included in the applicable Portfolio Status Report. Both reported and verified energy and demand savings amounts are compared to the benchmarks mandated by O.R.C §4928.66(A)(1)(a) and O.R.C §4928.66(A)(1)(b) in Table 2.

Table 2: PY2012 Benchmark, Reported, and Verified Savings by Utility

Program	Benchmark <i>Ex Ante</i> Energy Savings (MWh)	Benchmark <i>Demand</i> Savings (MW)	Reported <i>Ex Ante</i> Energy Savings (MWh)	Reported <i>Demand</i> Savings (MW)	Verified <i>Energy</i> Savings (MWh)	Verified <i>Demand</i> Savings (MW)
AEP	340,720	66.2	570,963	82.0	570,442	81.7
DP&L	111,139	20.7	186,526	52.4	185,297	52.3
Duke Energy	167,149	33.2	257,767	50.2	257,767	50.2
First Energy	417,309	84.6	434,640	184.7	434,641	184.5

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.⁸ The Independent Evaluator team consists of staff from the following companies:

- Evergreen Economics⁹
- Itron, Inc.
- Michaels Energy
- Phil Willems / PWP

The programs reviewed include those of the following Ohio utilities:

- American Electric Power Ohio (AEP Ohio)¹⁰
- Dayton Power and Light Company (DP&L)
- Duke Energy Ohio (Duke Energy)¹¹
- FirstEnergy¹²

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:

⁸ Ohio utilities are required to propose energy efficiency plans and file annual status reports with the PUCO per the 2009 PUCO rules for implementing the Ohio law adopted in 2008 that established an Energy Efficiency Resource Standard with energy savings goals for electric utilities and that allows for cost recovery and decoupling. Each annual status report (called a Portfolio Status Report) must include a compliance demonstration and a program performance assessment (including a description of all transmission and distribution infrastructure improvements and an evaluation, measurement, and verification report, along with recommendations for the future of the programs). A more detailed discussion of these rules and legislation is presented in the following section of this Introduction.

⁹ 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 contractor was transferred from ECONorthwest to Evergreen Economics in March 2012.

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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 third verification report produced by the Evergreen Economics team in its capacity as the PUCO Independent Evaluator and covers the 2012 energy efficiency program year. In addition to the verification activities conducted for this report, we fielded a participant survey to collect information on program participation. The results of this survey are presented in the second half of this report.

Ohio Energy Efficiency Regulatory Background

Ohio Power Company, Duke Energy of Ohio, the Dayton Power and Light Company, Toledo Edison, Ohio Edison, and Cleveland Electric Illuminating Company (electric utilities)¹³ are public utilities as defined in Section 4905.02 of the Ohio Revised Code.¹⁴ 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),¹⁵ which became effective on July 31, 2008. Among the provisions of SB 221 was the requirement in Section 4928.66, Revised Code,¹⁶ 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

¹³American Electric Power operates in Ohio as the Ohio Power Company. FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company, Ohio Edison Company, and The Toledo Edison Company.

¹⁴Ohio General Assembly, Ohio Revised Code. (Ohio, Amended by 129th General Assembly Effective Date June 11, 2012). Chapter 4905.02. <http://codes.ohio.gov/orc/4905.02>

¹⁵Am. 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

¹⁶Ohio General Assembly, Ohio Revised Code. (Ohio, Amended by 129th General Assembly Effective Date September 10, 2012). Chapter 4928.66. <http://codes.ohio.gov/orc/4928.66>

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.

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.).¹⁷ 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.)

¹⁷Ohio General Assembly, Ohio Administrative Code. (Ohio, Effective Date December 10, 2009). Chapter 4901: 1-39. <http://codes.ohio.gov/oac/4901%3A1-39>

- 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)(I), O.A.C.)
- By the fifteenth of May 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 is the verification of the Ohio utilities PY2012 reported savings. This was accomplished through a review of the Portfolio Status Reports and related evaluation research reports filed by the utilities for both years. These activities also involved verifying the reported savings by reviewing an extract of each utility's participant database and replicating the savings amounts claimed in the Portfolio Status Reports. In an effort to standardize reporting across utilities, we also developed templates for both the evaluation plan and evaluation reports submitted by the utilities each year.

To minimize duplication of evaluation research activities, we relied as much as possible on the evaluation activities of the utilities and their contractors. For example, by reviewing and approving customer phone surveys planned by the Ohio utilities, we reduced the need to conduct separate customer surveys, also reducing possible customer dissatisfaction due to being subjected to multiple surveys addressing the same topics. By reviewing the evaluation plans, analysis methods, and data collection instruments prior to their implementation, as well as conducting ride-alongs for utility evaluation site visits, we have more confidence in evaluation results, as we are able to provide input as the methods were being developed. This is in contrast to a less collaborative process by which we would only see results after evaluations were completed and consequently would only be able to recommend changes retroactively.

Key Findings and Recommendations

There are several overarching findings from our review of the 2012 Portfolio Status Reports and 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 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.** Evaluations that included 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.

Our review of the impact estimates and evaluation reports identified issues that will affect the determination of energy savings that can be counted toward Ohio utility requirements. These issues and related recommendations are summarized below and addressed again in the discussions of the individual utility evaluation reports.

1. Properly account for participation in other efficiency programs when evaluating audit and home energy comparison program savings. 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 savings from measures installed via a rebate program are more appropriately claimed for the rebate program, utilities often will not claim savings from an audit-style program to avoid double counting. If savings are to be claimed from the audit or energy comparison program, they should be limited to savings resulting from behavior changes directly attributable to the audit or energy comparison program rather than from rebated installed measures.

Estimating energy savings attributable to these types of programs is challenging at best, and typically a fixed effects billing regression is utilized to control for various influences that may be affecting energy use. We make several recommendations throughout this report based on the specific model used by each utility. A critical issue for these models is controlling for participation in utility rebate programs. Since savings for rebated measures are attributed to the applicable rebate program, not controlling for these effects in the billing regression model will result in double counting the savings and over-estimating those attributable to the audit or home comparison program.¹⁸

2. Have evaluators select control groups for home energy comparison programs. The selection of a proper control group is essential for estimating impacts of home energy comparison programs. The control group must be matched on key aspects that might affect energy use (e.g., house type and location). In addition, the rates of participation in other rebate programs must also be examined in both the pre-program and post-program periods. In particular, differences in alternative program participation prior to the start of the home energy comparison program can have a significant impact on results.

¹⁸ We have found in other jurisdictions that the effect on savings can be significant, as evidenced by a recent evaluation by Evergreen Economics of the Opower program in Hawaii, a home energy comparison program similar to those being offered in Ohio. The Hawaii Opower program implementer initially claimed that alternative program participants had been removed from the savings calculations, but upon review, it was found that these customers were still in the dataset used to estimate impacts. When Evergreen controlled for these customers in the fixed effects billing regression, estimated savings decreased by 38 percent.

To avoid a possible conflict of interest, we recommend that the utilities adopt industry best practice and have the evaluation teams (rather than the program implementer) make the random selection of the treatment and control groups for all energy comparison programs.¹⁹

3. Do not use store ‘shelf surveys’ to estimate wattages for removed bulbs replaced by CFLs. We do not believe that store shelf surveys are an appropriate method for determining the wattage of bulbs replaced by CFLs. Stores will need to carry a wider range of bulbs and wattages to cover both residential and commercial installations, as well as different lamp types and lighting applications. As a consequence, the distribution of the wattages of the bulbs stocked in stores will likely differ substantially from the wattages where residential customers are typically installing CFLs, as stores are attempting to serve a much wider market than that targeted by a residential CFL program. It is also not possible to determine from a shelf survey the types of bulbs and wattages that are actually being purchased, and the average wattage for purchased bulbs will likely differ significantly from the average observed on the shelf once the volume of purchases is taken into account. For these reasons, we recommend that a participant phone survey (rather than a shelf survey) be used to collect information on the wattages of replaced bulbs when calculating CFL savings.

4. Provide additional detail on research methods and results in the evaluation reports. In several instances during our review, there was not enough detail provided in the evaluation report to understand how the final energy savings estimates were derived. Examples of additional detail that is sometimes missing includes descriptions of variables used in regression models, equations used for calculating savings, customer survey data, and full citations for key references. During our discussions with the utilities on these reports, the utilities provided additional details that helped resolve these issues. Rather than continue to work on these issues behind the scenes with the utilities, we have chosen to leave these comments regarding the lack of critical information in our review of the evaluation reports to emphasize the level of detail that should be provided. We believe that the requested detail is the minimum amount required to meet the industry standard for a comprehensive evaluation report, and does not involve including proprietary or confidential customer information. Additionally, the requested level of detail will allow other interested stakeholders—those that do not have the benefit of requesting additional information from the utilities—to gain a complete understanding of the evaluation methods.

Report Structure

The remainder of this report is organized as follows. A more detailed discussion of the individual utility savings claims is found in the next chapter. Following this is a presentation of the results of the participant phone survey fielded by the Independent Evaluator team in 2013 for customers participating in the PY2012 programs.

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

¹⁹ State and Local Energy Efficiency Action Network, 22-23.

Review of Utility-Reported Savings

This chapter presents an overview of the review of the Portfolio Status Reports and supporting evaluation reports for each utility for PY2012.

As discussed above, the Independent Evaluator sought to avoid duplicating activities within the scope of the evaluation contractors, to the extent practicable. Emphasis was placed on reviewing evaluation plans, analysis methods, and data collection instruments prior to their implementation, as well as ride-alongs to monitor evaluation site visits. These activities provide the Independent Evaluator confidence in the related results, and reduce the need to replicate evaluation activities for the purposes of verification. This also avoids possible customer dissatisfaction due to multiple surveys or site visits addressing the same topics.

2012 was the third year in which the Ohio utilities were provided with a template for both the evaluation plan and the evaluation report they were expected to follow. These templates are provided as Appendix E to this report. Utilities generally adhered to these templates, increasing the level of consistency in reporting across the utilities. The Independent Evaluator verified the 2012 savings reported in the Portfolio Status Reports by analyzing an extract of each utility participant database containing information on customers who received a rebate from the utility. A brief process evaluation was also conducted via phone survey for a small sample of program participants for each utility.

In all these activities, the utilities and their evaluators were very cooperative and willing to coordinate with us.

In the remainder of this chapter, the annual savings reported by each utility for PY2012 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 for savings calculations and evaluation research.

AEP Ohio

On May 15, 2013, AEP Ohio submitted its 2012 Portfolio Status Report to the PUCO. The report includes a Compliance Demonstration, a Program Performance Assessment and the 2012 Benchmark Report. Assessments of each of AEP Ohio's PY2012 residential and non-residential energy efficiency programs include a discussion of implementation strategy, customer targets, staffing, marketing, and customer service, as well as impact and process evaluations²⁰ prepared by the third-party independent program evaluator, Navigant Consulting, Inc.

²⁰ An impact evaluation refers to the calculation of actual savings from installed measures, while a process evaluation refers to an assessment of the efficacy with which the program was delivered to customers.

2012 AEP Ohio Reported Savings and Evaluation Research

AEP Ohio implemented seven residential and five non-residential energy efficiency programs in 2012,²¹ including:

Residential Sector

- Efficient Products (CFL, LED and Appliance Rebates)
- Appliance Recycling
- e3smart™
- In-Home Energy (Home Retrofit)
- Community Assistance Program (Community Assistance)
- ENERGY STAR® New Homes (New Home)
- Home Energy Report (Behavioral Change)

Non-residential Sector

- Prescriptive
- Custom
- Express
- Self Direct
- New Construction
- Demand Response (Mercantile Commitment of Resources; Interruptible Tariff)

According to the Portfolio Status Report and the attached Navigant evaluation reports,²² AEP Ohio exceeded the annual energy efficiency benchmarks for 2012 by 230,263 MWh and 323.5 MW. The TRC Benefit Cost Ratio of the utility portfolio is reported as 1.8 using the TRC test; nearly all of the programs included in the AEP Ohio Portfolio Plan as submitted to the PUCO were cost-effective. Only the In-Home Energy (TRC=0.8), Community Assistance (TRC=0.6), and ENERGY STAR New Homes (TRC=0.4) programs were not cost-effective.

The Independent Evaluator used AEP Ohio's participant database²³ for its PY2012 programs to replicate the kWh savings reported in the utility's 2012 Portfolio Status Report. Savings were successfully replicated, to within an acceptable margin of error, for all programs. Results of the savings replication are shown in Table 3.

²¹ Utilities are also required to report all transmission and distribution infrastructure improvements in their Portfolio Status Reports. In 2012, AEP Ohio completed 28 distribution improvement projects and 24 transmission projects.

²² AEP's Portfolio Status Report and the Navigant evaluation reports are all included in the document *2012 Portfolio Status Report of Energy Efficiency and Peak Demand Response Programs* filed with the PUCO on May 15, 2013.

²³ The participant database contains information on all customers who received incentives through a program. In most cases, this includes contact information for each participant as well as incentive amounts, measures installed, and the expected savings from installation of those measures.

Table 3: AEP Ohio PY2012 Reported and Verified Savings by Program

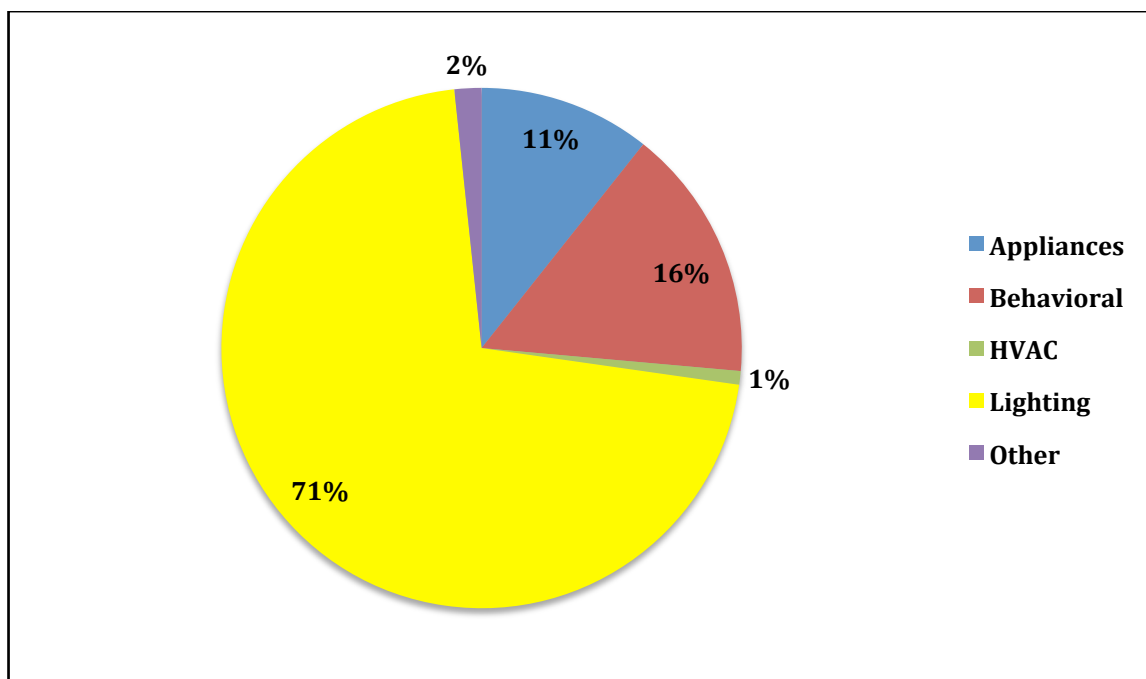
Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Reported <i>Demand</i> Savings (MW)	Verified <i>Ex Ante</i> Energy Savings (MWh)	Verified <i>Demand</i> Savings (MW)
Residential Programs				
Products (Efficient Products)	229,929	20.7	229,393	20.4
Recycling (Appliance Recycling)	27,254	3.8	27,254	3.8
Energy Conservation Kits: Schools (e3smart)	6,084	0.8	6,084	0.8
Residential Retrofit (In-Home Energy)	8,251	1.2	8,266	1.2
Low Income (Community Assistance)	11,554	1.1	11,552	1.1
Residential New Construction (ENERGY STAR® New Homes)	2,177	0.6	2,177	0.6
Behavioral (Home Energy Report)	53,174	6.9	53,174	6.9
Residential Total	338,423	35.1	337,901	34.8
Non-residential Programs				
Prescriptive (Prescriptive)	142,331	30.2	142,331	30.2
Custom (Custom)	25,979	3.4	25,979	3.4
Express Install	9,043	2.3	9,043	2.2
Self Direct (Self Direct)	35,882	5.7	35,882	5.7
New Construction (Business New Construction)	19,305	5.3	19,305	5.3
Non-residential Total	232,540	46.9	232,541	46.9
Grand Total	570,963	82.0	570,442	81.7

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.

Residential results are shown in Figure 1 and indicate that the majority of savings (71 percent) came from CFLs distributed through the Efficient Products and In-Home Energy programs. Savings attributed to the behavioral modification program make up a further 16 percent of sector savings. New appliances and appliance recycling combine to contribute a further 11 percent of sector savings. 1 percent of savings is attributable to the HVAC end use, and all other measures are considered

together as the “Other” end use. These include home energy kits distributed through the *e³smartSM* program, and residential new construction.

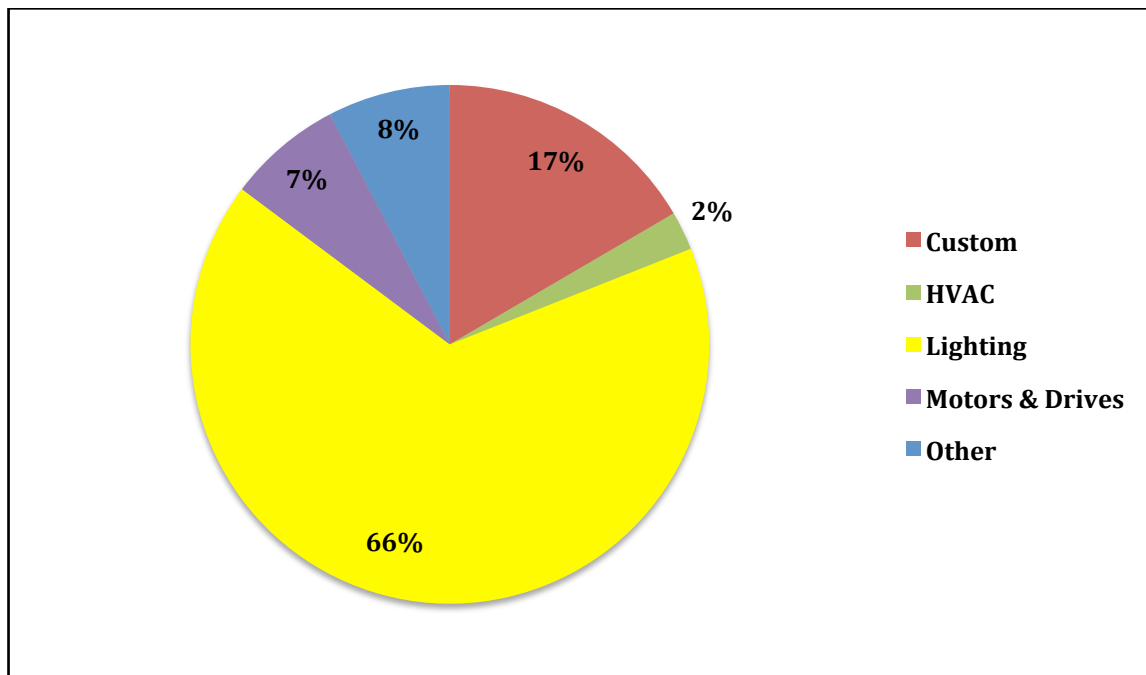
Figure 1: AEP Ohio Share of PY2012 Residential Savings by End Use/Measure



Note: “Other” includes measures of unknown or miscellaneous end uses.

Results for the non-residential sector, presented in Figure 2, show that lighting is also the primary source of savings (66 percent) for this sector, followed by custom projects (17 percent). A variety of other end uses such as HVAC, motors and drives, new construction, and other miscellaneous end uses account for the remaining 17 percent.

Figure 2: AEP Ohio Share of PY2012 Non-residential Savings by End Use/Measure



Note: “Other” includes measures of unknown or miscellaneous end uses.

The reliance on lighting measures to achieve both residential and non-residential savings is common, particularly with newer energy efficiency programs. The expectation would be that lighting measures would also receive the most attention in the utility evaluation work.

Table 4 shows what type of evaluation each of AEP Ohio’s 2012 programs received. As demonstrated in this table, coverage across programs was comprehensive, with each program receiving both a process and impact evaluation.

Table 4: AEP Ohio PY2012 Savings and Evaluation Activities by Program

Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Products (Efficient Products)	229,929	✓	✓
Recycling (Appliance Recycling)	27,254	✓	✓
Energy Conservation Kits: Schools (e3smart)	6,084	✓	✓
Residential Retrofit (In Home Energy)	8,251	✓	✓
Low Income (Community Assistance)	11,554	✓	✓
Residential New Construction (ENERGY STAR® New Homes)	2,177	✓	✓
Behavioral (Home Energy Report)	53,174	✓	✓
Non-residential Programs			
Prescriptive (Prescriptive)	142,331	✓	✓
Custom (Custom)	25,979	✓	✓
Express Install	9,043	✓	
Self Direct (Self Direct)	35,882	✓	✓
New Construction (Business New Construction)	19,305	✓	✓

The following section provides a summary and assessment of the evaluation research undertaken by AEP Ohio and its evaluator, Navigant Consulting.

Independent Evaluator Assessment of AEP Ohio PY2012 Reported Savings and Evaluation

In general, we found the PY2012 AEP Ohio evaluation reports to be thorough and consistent with standard evaluation practices for the types of programs covered. As discussed above, we were able to replicate the reported savings for each of AEP Ohio's 2012 programs, based on analysis of the participant database.

The evaluation methods were determined to be consistent with the approved evaluation plans developed prior to the start of the 2012 evaluation work. Based on the consistency with evaluation plans, reviews of plans and survey instruments, along with site visit ride-alongs conducted during the analysis period, we have a high level of confidence in the overall 2012 evaluation findings. However, we disagree with some of the analysis methods that were implemented, and the associated results. These are discussed in the following sections.

Impact Evaluation Reported Savings Assessment

The 2012 AEP Ohio evaluation team conducted an impact evaluation for each of the 2012 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 PY2012 program savings. Specific issues for individual reports are listed below by report title and with a reference to the specific appendix to the AEP Ohio 2012 Portfolio Status Report in which each evaluation report can be found.

- CFL baseline assumptions.** A common issue that cuts across several programs (notably the Efficient Products and the In-Home Energy programs) is the assumption of what types of bulbs CFLs are replacing. This is an important parameter, as CFLs (and LEDs using the same savings assumptions) account for 71 percent of AEP's residential sector savings. From the evaluation reports, it appears that AEP Ohio is making the same assumptions for PY2012 replacements that were made in PY2011. In both cases, it is assumed that CFLs are only replacing incandescent bulbs. In PY2011, Navigant's evaluation research showed that at least some of the new CFLs were replacing existing CFLs rather than incandescents. From the PY2011 Navigant survey, customers reported that 14 percent of installed CFLs replaced existing CFLs, and the impact of this finding on savings could be significant.

Given that the same method is being used again in PY2012, we are repeating our earlier recommendation that a blended baseline be adopted that reflects a mix of existing lamps. In this case, the mix can be determined from the survey data, with 14 percent assumed to be CFLs and 86 percent assumed to be incandescent bulbs.

- PY2012 Evaluation Report - In-Home Energy Program (2012 Portfolio Status Report Appendix E)**

In addition to the CFL baseline issue discussed above, we have a few notes and recommendations regarding how energy savings are estimated for other individual measures provided in this program.

Kitchen and Bathroom Faucet Aerators.

Per Home Versus Per Measure Impact. The impact algorithm for aerators is designed to be applied per *household*, not per aerator. That is, the algorithm assumes all kitchen/bathroom sink water use is treated with the measure. Thus, a home with two bathroom sinks that receives two aerators would expect the same impact as a home with one bathroom sink that received one aerator. The home with two sinks/two aerators should have half the household impact applied to each aerator—or 11.3 kWh. Further, a home that has two bathroom sinks and installs one aerator should receive 50 percent of the per home impact value. The report assumes that each aerator has the same effect on total faucet use, regardless of the number of aerators or sinks present. The impact should be calculated per home, not per aerator.

Kitchen Versus Bathroom Aerators. The impact algorithm shows that bathroom retrofit makes up 35 percent of faucet hot water use, while kitchen sink retrofit is 65 percent of faucet use. These figures imply kitchen aerator retrofit is 1.9 times the impact of a bathroom sink retrofit. There is no distinction between kitchen and

bathroom measures or installation locations. We suggest that the evaluator consider installation location and that this information be collected in future survey work.

Low Flow Showerheads

Per Home Versus Per Measure Impact. The impact algorithm for showerheads is constructed to be applied per *household*, not per showerhead. That is, the algorithm assumes all shower-related water use is treated with the measure. Thus, a home with two showers that receives two showerheads would expect the same impact as a home with one shower that received one showerhead. The report assumes that each showerhead has the same effect on total water use, regardless of the number of showers present. The impact should be per home, not per showerhead.

LED Nightlight. There is no presentation of the LED nightlight algorithm. Although there are questions on the survey related to whether the nightlight replaced another nightlight or not, there is no clear reporting of the outcome of these questions or how the impact is derived.

Energy Kits. The kits include one kitchen and one bathroom aerator, but the impact is based on full retrofit, which, for multiple bathrooms/sinks and/or multiple kitchen sinks, will not be accurate.

- **PY2012 Evaluation Report – ENERGY STAR New Homes Program (2012 Portfolio Status Report Appendix G)**

Model documentation. Only a single paragraph is provided that describes in general terms what impact analysis was done for this program. There is virtually no discussion of what was actually done to adjust the *ex ante* impacts to produce the *ex post* results; the final impacts are simply listed in a table with no additional details regarding the analysis. Because of the lack of detail on the analysis methods, we are unable to determine if it was appropriate for this program. Consequently, we do not recommend that the results of this analysis be used to determine energy savings in future program years.

- **PY2012 Evaluation Report – Home Energy Reports Program (2012 Portfolio Status Report Appendix H)**

For the Home Energy Reports (HER) program, the same fixed effects model specification is used as in PY2011 to estimate energy impacts. We have been in discussions with the Navigant evaluation team over the past year and are in general agreement on their model specification. There are several aspects of the impact analysis for this program that were raised in PY2011 that are relevant for PY2012:

Control group selection. We recommend that Navigant select the treatment and control group rather than the program implementer, as this will eliminate any concerns about a conflict of interest. In the current analysis, there are significant differences in usage between the first year and second year treatment and control groups; there are also differences in monthly energy consumption for several months between the treatment and control group. These differences are acknowledged in the report, but not explained. These types of anomalies raise questions as to the validity of the treatment and control group selection process when

the implementer rather than the evaluation team (or some other independent party) does the selection.

Participation in other efficiency programs. The report does a good job of explaining how any increase in participation in other AEP programs in the post-installation period are subtracted out from the HER impact estimates to avoid double counting. As we have discussed in this report and in our PY2011 report, it is also important to examine if there are any participation differences in the pre-installation period between the treatment and control group, as differences in participation rates in the pre-program period can have a significant effect on estimated program savings. This is less of an issue in PY2012 as only the Appliance Recycling program existed prior to the HER program being implemented. This will be an important issue moving forward, however, and the comparison analysis between the treatment and control groups should include an examination of participation patterns prior to the HER program implementation period.

Weather variables. We believe that there may be significant weather-related influences on energy savings and recommend that weather variables be added to the regression model. Navigant maintains that these weather influences are already being captured through the control group. Our experience has shown that the weather can influence participant households differently, and adding weather variables into the model should at least be explored.

- **PY2012 Evaluation Report – Custom Program (2012 Portfolio Status Report Appendix J)**

Sample Size. Navigant had projected completion of 15 on-site verification visits based on an expected participation of 282 projects; however, due to lower participation (approximately 180 projects), only three on-site visits were conducted this year. The planned PJM-related monitoring was also dropped for custom projects. While participation was certainly lower, it is difficult to justify a decrease in sample from 15 to three without a more detailed explanation.

Impact analysis documentation. Based on the evaluation report, it appears that many of the evaluated projects had some sort of desk review completed. However, there is no detail provided as to what was done in these reviews or why changes were made to the *ex ante* savings values for the projects reviewed. While we understand that customer information needs to be protected, at least some details on the projects and related analysis (e.g., measures installed, adjustments made and reasons for adjustments) needs to be provided in the report so that an independent reviewer (either the Independent Evaluator or stakeholder) can understand what analysis was done for this program. Overall, the impact analysis section is essentially missing in this report.

- **PY2012 Evaluation Report – Self-Direct Program (2012 Portfolio Status Report Appendix K)**

Documentation. Like the custom program, the evaluation of the self-direct program also suffers from a lack of detail provided on what was actually done. The report states that 30 projects were evaluated via desk review with a subset of 23 projects undergoing on-site

verification, and a metering of lighting measures at 5 projects. Again, however, it is not clear what was done beyond this to develop the final savings estimates. More detailed documentation is needed in future evaluations.

- **PY2012 Evaluation Report – Express Program for Small Business (2012 Portfolio Status Report Appendix M)**

Lighting measure differentiation. Navigant notes that 84 percent of energy savings (*ex ante*) are derived from T-5 and T-8 fixture retrofits. Given this fact, it would be helpful to distinguish what proportion of these energy savings are from T-5 and T-8 fixtures instead of grouping the two types of fixtures together. Additionally, it is unclear why the realization rates are not disaggregated by lighting measure type. Measures such as occupancy sensors and exit signs presumably behave quite differently than T-5 and T-8 retrofits, and therefore separate realization rates should be calculated.

On-site verification. On-site inspection took place at 20 sites, and the inspections covered verification of measure installation, measure counts and operating hours. The sample was not a purely random sample as sites were selected based on geography so that more sites could be visited at a lower cost. The results of the 20 on-sites are currently not presented in the report, presumably because they were not representative due to the sampling approach. In the future, we recommend that findings from these types of on-site inspections be discussed in the evaluation report even if they are not used directly in the energy savings calculations, as they may provide useful insights for future implementation and evaluation activities.

- **PY2012 Evaluation Report – Transmission and Distribution and Internal System Efficiency Improvements Program (2012 Portfolio Status Report Appendix O)**

This report presents the results of Navigant’s review of the AEP Ohio’s savings claims for its Transmission and Distribution and Internal System Efficiency improvements. The report concludes with Navigant agreeing that AEP Ohio’s savings estimation methods are sound. However, there are instances where additional detail and supporting documentation should be provided so that the methods can be assessed. A savings algorithm is provided and the estimated savings for 52 projects using this algorithm is included, but it would be helpful to provide the individual calculations for each project. Additionally, on page 4 the report states the equation has been “vetted and accepted within the utility industry for decades” and that the equation coefficients are “derived using methods outlined in published industry literature”.²⁴ These references are inadequate for documenting the calculation methods; full report citations should be provided.

Independent Evaluator Assessment of AEP Ohio 2012 Mercantile Program Reported Savings and Evaluation

As part of the AEP Ohio mercantile savings analysis, the Independent Evaluator team conducted a series of mercantile on-site visits in 2013. Based on the information collected during these on-sites

²⁴ Note that we compared the equations used with those included in the Draft TRM and they are not entirely consistent.

and reviewing the program documentation, the *ex post* savings were calculated for these customers, as shown in Table 5. The largest discrepancies occur due to the use of an incorrect baseline control method being chosen in the analysis. The analyses in these cases were custom calculations, completed by the customer or their representative. This occurred in five of the 19 projects evaluated. Four of the sites evaluated were no longer utilizing the efficient equipment that was incented, and three projects used incorrect specifications for the efficient equipment. Peak kW savings were claimed for Customer 12, but demand savings for that project only occur during the winter, so this is unlikely to affect the system peak. The overall realization rate was 83 percent for kWh and 90 percent for kW.

Table 5: AEP Ohio 2012 Mercantile *Ex Post* Savings Analysis

Project	Realization Rate		Reason for change
	kWh	kW	
Customer 1	51%	54%	Incorrect Baseline Control Method
Customer 2	100%	100%	
Customer 3	69%	180%	Incorrect Baseline Control Method
Customer 4	70%	100%	Equipment not functioning
Customer 5	100%	100%	
Customer 6	74%	66%	Incorrect Baseline Control Method, Equipment no longer in place
Customer 7	100%	100%	
Customer 8	67%	100%	Incorrect Baseline Control Method, Incorrect equipment specifications
Customer 9	100%	100%	
Customer 10	100%	100%	
Customer 11	152%	118%	Incorrect equipment specifications
Customer 12	100%	31%	Incorrect value used for peak kW
Customer 13	100%	100%	
Customer 14	100%	100%	
Customer 15	100%	100%	
Customer 16	100%	100%	
Customer 17	88%	80%	Equipment no longer in place
Customer 18	228%	12%	Incorrect equipment specifications
Customer 19	253%	148%	Incorrect baseline control method and hours of operation
Overall	83%	90%	

Independent Evaluator Recommendations for AEP Ohio

Based on our review of the 2012 AEP Ohio Portfolio Status Report and associated evaluation research, we make the following recommendations.

Recommendation #1: Adjust claimed savings to account for CFLs that replace existing CFLs.

The Efficient Product program claims savings for installed CFLs that replace existing CFLs as if they were replacing standard incandescent bulbs. In the 2011 evaluation (which is used for many of the impact parameters in 2012), surveyed participants reported that 14 percent of installed CFLs replaced existing CFLs. Since these customers had already installed CFLs, presumably with no incentive, it does not seem reasonable to take savings compared to an incandescent baseline, at least in full. We recommend that savings be adjusted in future years to account for a mix of existing CFLs and incandescents in the baseline.

Recommendation #2: The evaluation team should select the treatment and control groups for the Home Energy Report program evaluations. As noted above, recommended best practice for the evaluation of behavioral programs is to have the evaluator (rather than the implementation

contractor) select the treatment and control groups to avoid a potential conflict of interest. Additional tests should also be conducted to ensure that the treatment and control groups are properly matched, with the methods and results discussed in more detail in the evaluation report.

Recommendation #3: Participation in other efficiency programs must be controlled for in the Home Energy Report billing models. The current analysis does a good job of controlling for this in the post-participation period, but we recommend that the cross-program participation also be accounted for in the pre-participation period, as this can have a significant effect on the billing regression results.

Recommendation #4: Provide additional detail on energy savings calculations in the evaluation reports. As noted above, there are some instances where there is insufficient information presented on how the energy savings calculations were performed. In particular, this was an issue in the reports for the Custom, Self-Direct, ENERGY STAR Homes, and Transmission and Distribution programs. While customer-specific information should not be expected in the reports, more detail on the impact analysis methods should be included so that an independent reviewer can understand how the energy savings values were derived. Future evaluation reports should provide sufficient detail so that an independent assessment of the analysis methods can be conducted.

Dayton Power and Light (DP&L)

The 2012 DP&L Portfolio Status Report (submitted to the PUCO on May 15, 2013) includes a Compliance Demonstration, a Program Performance Assessment and the 2012 Benchmark Report. The Compliance Demonstration includes an update to DP&L's initial benchmark report, a comparison of applicable benchmarks to actual energy savings and peak demand reductions, and an affidavit regarding statutory compliance. For each program, there is discussion of implementation strategy, customer targets, staffing, marketing, and customer service. Evaluation reports for each program prepared by DP&L's evaluation contractor, the Cadmus Group, Inc. (Cadmus), are included as appendices.

2012 DP&L Reported Savings and Evaluation Research

According to DP&L's 2012 Portfolio Status Report, the utility implemented the following six residential and three non-residential programs in 2012:

Residential Sector

- Residential Lighting (Lighting; CFLs)
- Residential Heating and Cooling Rebate (HVAC Rebates)
- Residential Certified HVAC Tune-Up (HVAC Diagnostic & Tune Up)
- Residential Appliance Recycling (Appliance Recycling)
- Residential Low Income Affordability (Low Income)
- Residential Be3 Smart - Ohio Energy Project²⁵ (Education, Awareness Building & Market Transformation)

²⁵ The Ohio Energy Project (<http://www.ohioenergy.org/>), an energy education organization, delivered and facilitated the educational program for DP&L.

Non-residential Sector

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

According to the 2012 Portfolio Status Report (including the Cadmus evaluation reports), while not all individual programs met their benchmarks, DP&L exceeded the cumulative annual energy efficiency benchmarks for PY2012 by 325,475 MWh and 89.7 MW. The TRC Benefit Cost Ratio of the utility portfolio is reported as 1.5. Using the TRC test, the majority of programs included in the DP&L Portfolio Plan as submitted to the PUCO were cost-effective. Programs that were not cost effective include the HVAC Diagnostic & Tune-Up program (TRC 0.3), the Heating and Cooling Rebate program (TRC 0.4), and the Low Income Weatherization program (TRC 0.3).

The Independent Evaluator used DP&L's participant database for its PY2012 programs to replicate the kWh savings claims reported in the Portfolio Status Report. Data were available for all programs except the School Education program, which provided savings calculations but limited participant contact information (supplying contact information was voluntary for this program). In general, the participant tracking data were clean and sufficiently robust, and there were no significant issues in replicating the savings reported in the Portfolio Status Report. It is also noted in the Portfolio Status Report that 335,122 MWh of excess energy savings achievement from PY2012 were banked for the following year.

The results of the savings replication are shown in Table 6.

Table 6: DP&L PY2012 Reported and Verified Savings by Program

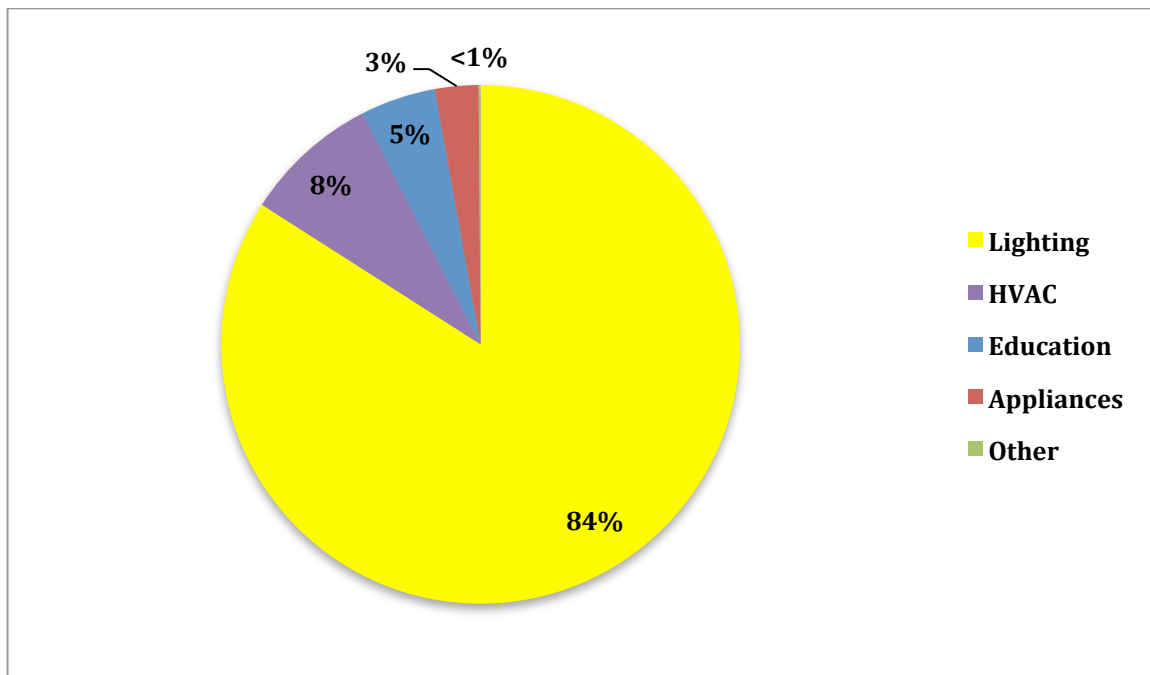
Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Verified <i>Demand</i> Savings (MW)	Verified <i>Ex Ante</i> Energy Savings (MWh)	Verified <i>Demand</i> Savings (MW)
Residential Programs				
Lighting (CFL)	80,677	9.7	80,866	9.7
Heating and Cooling Rebate	7,035	2.2	7,035	2.2
HVAC Diagnostic & Tune Up	1,095	0.2	1,097	0.2
Appliance Recycling	2,213	0.4	2,213	0.4
Be3 Smart Education	4,544	0.3	4,545	0.3
Low Income Affordability	900	0.2	852	0.1
Residential Total	96,464	12.9	96,607	12.8
Non-residential Programs				
Prescriptive Rebates	71,554	13.7	70,749	14.1
Custom Rebates	12,993	2.3	12,427	1.9
Mercantile Customer Commitments	5,515	23.4	5,515	23.4
Non-residential Total	90,062	39.5	88,690	39.5
Grand Total	186,526	52.4	185,297	52.3

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 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. The results of this analysis are shown in Figure 3 and Figure 4. For the residential sector, the vast majority of savings (84 percent) comes from CFLs distributed through either the Lighting program or the Low Income program. HVAC measures contribute an additional 8 percent, while the remainder consisted of measures distributed through the Education program, appliances and “Other” measures such as building envelope improvements, and water heating measures.

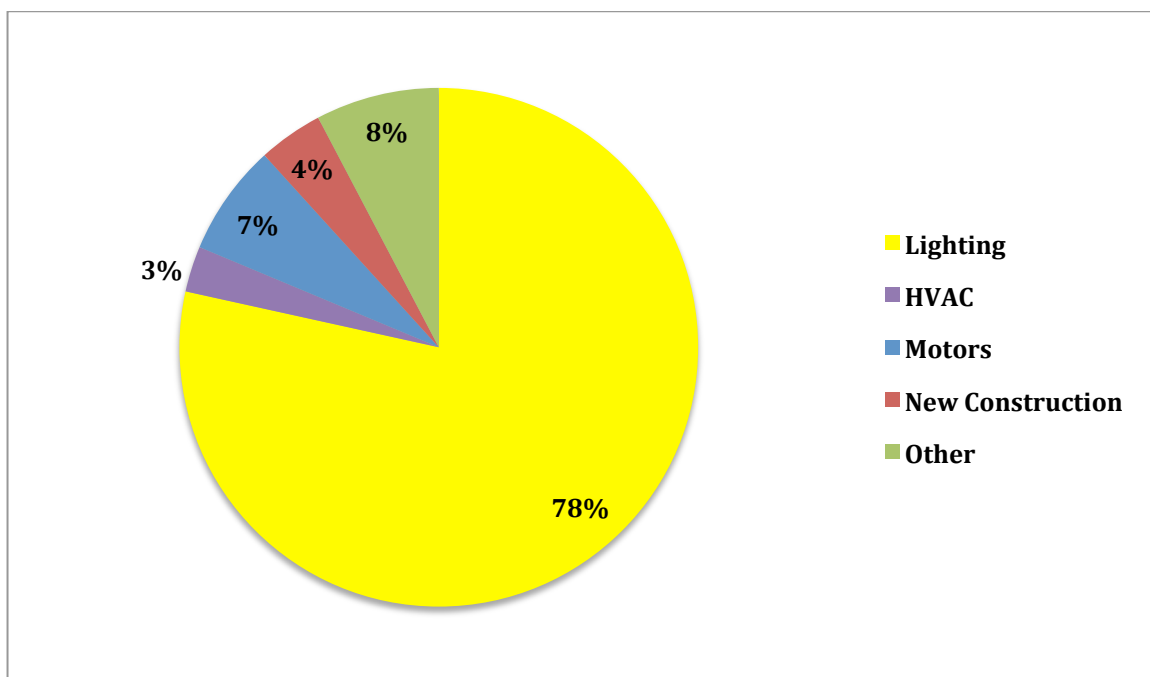
For the non-residential sector, lighting is the primary source of savings (78 percent) followed by miscellaneous other end uses and measures (8 percent), motors (7 percent), new construction projects (4 percent), and HVAC (3 percent).

Figure 3: DP&L Share of PY2012 Residential Savings by End Use/Measure



Note: "Other" includes Building Envelope, and additional miscellaneous measures.

Figure 4: DP&L Share of PY2012 Non-residential Savings by End Use/Measure



Note: "Other" includes Building Envelope, Compressed Air, and additional miscellaneous measures.

Cadmus conducted both a process and impact evaluation for each of the DP&L PY2012 programs, as shown in Table 7 below, with the following exceptions. There was no process evaluation of the Residential Lighting and Heating and Cooling Rebate programs, and there was neither an impact evaluation nor process evaluation of the Mercantile Customer Commitments program.

Table 7: DP&L PY2012 Evaluation Activities by Program

	Reported <i>Ex Ante</i> Energy Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Lighting (CFL)	80,677	✓	
Heating and Cooling Rebate	7,035	✓	
HVAC Diagnostic & Tune Up	1,095	✓	
Appliance Recycling	2,213	✓	✓
Be3 Smart Education	4,544	✓	✓
Low Income Affordability	900	✓	✓
Non-residential Programs			
Prescriptive Rebates	71,554	✓	✓
Custom Rebates	12,993	✓	✓
Mercantile Customer Commitments	5,515		

Independent Evaluator Assessment of DP&L PY2012 Reported Savings and Evaluation Research

The Independent Evaluator review of the PY2012 savings claims was conducted through a review of the 2012 evaluation reports, completed by Cadmus.²⁶ Areas reviewed include assessment of the quality of the report in terms of completeness, appropriateness of the evaluation methods, and the credibility of the savings results.

Overall, DP&L provided all the information required in the Independent Evaluator's evaluation report template. Required tables were included in the proper formats. Participation counts and *ex ante* savings estimates at the measure level were included for each program and are in the desired format. Gross savings calculations at the measure level for each program are also reported and the evaluation methods employed are identified in each case. Variations from original plans or cases where deviations from the Ohio TRM occurred have also been adequately documented.

In general, we found that the Cadmus evaluation report adheres to industry best practices for evaluating DP&L's program offerings. The report is comprehensive and provides the details necessary to rely on the savings estimates provided. We have a high level of confidence in this evaluation

²⁶ The Cadmus Group, *2012 Evaluation Measurement and Verification Report*. (Prepared for the Dayton Power & Light Company. May 15, 2013).

research and do not have any specific recommendations for changes to DP&L's 2012 reported savings.

It appears that DP&L's energy and demand savings calculations were based mainly on the 2010 Draft Ohio TRM. Exceptions were made for measures not included in the TRM where prior evaluations resulted in alternative savings numbers or, in a few documented cases, where DP&L felt it had estimates that were more reliable than the TRM. Appendix D to the Cadmus report provides the energy savings calculation sources for the measures in each of DP&L's programs.

Based on the evaluation methodologies utilized, the evaluation savings estimates appear to be reliable. In cases where various methodologies were considered, detailed information was provided to back up the methodology chosen. In the majority of cases, the Ohio TRM value was used, unless the measure estimate was not available or there were improved evaluation findings to back up the new estimate.

One issue of note is that the evaluator, Cadmus, used a Watt multiplier of 3.25 for 23 watt CFL installations. The justification given for the selection of 100 watt bulbs as the default replacement for 23 watt CFLs is that they are being stocked by stores in DP&L service territory. Even so, without further justification, it is unclear why 100 watt bulbs are being used rather than a lower wattage bulb. As we have mentioned at the beginning of this report, we do not believe that store shelf survey information should be used to adjust CFL baseline wattage assumptions.

Based on the tracking data, approximately 5 percent of CFLs went into commercial installations. Therefore, DP&L removed 5 percent of CFL savings and shifted them to the nonresidential prescriptive program. While this may not affect the residential lighting program greatly, the differences in hours of operation for residential and commercial buildings will greatly affect the savings for those CFLs. Without further documentation, it is not clear how this discrepancy is being handled. It may be more accurate to recalculate savings using the quantity and type of bulbs shifted over, and hours of operation and other factors for commercial buildings from the Ohio TRM.

Appendix D (Energy and Demand Savings Calculation Sources) of Cadmus' 2012 DP&L evaluation report does a very good job of highlighting the methodologies used and describing variations from the Ohio Draft TRM. Based on our review, it appears that all of the methodology choices made are reasonable and justifiable.

Final savings for DP&L's 2012 efforts were estimated at 186,526 MWh and 52.4 MW. Based on the evaluation methodologies utilized, these estimates appear to be reliable.

Independent Evaluator Assessment of DP&L Ohio 2012 Mercantile Program Reported Savings and Evaluation

As part of the DP&L mercantile savings analysis, the Independent Evaluator team conducted a series of mercantile on-site visits in 2013. 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. There were only a few mercantile customers for DP&L; consequently, a smaller sample of five projects was chosen for additional on-site review. Of the five projects visited, there were two that resulted in adjustments to savings. The equipment count for Customer 1 did not match the values provided in the project documentation. Some of the equipment installed for Customer 3

had been overridden, and thus is no longer providing energy savings. The overall realization rate was 92 percent for kWh and 97 percent for kW.

Table 8: DP&L 2012 Mercantile *Ex Post* Savings Analysis

Project	Realization Rate		Reason for change
	kWh	kW	
Customer 1	87%	84%	Different equipment count
Customer 2	100%	100%	
Customer 3	88%	100%	Equipment not functioning
Customer 4	100%	100%	
Customer 5	100%	100%	
Overall	92%	97%	

Independent Evaluator Recommendations for DP&L

Based on our review of the 2012 DP&L Portfolio Status Reports and associated evaluation research, we have only one recommendation for future evaluation work.

Recommendation #1: Use participant phone surveys rather than store shelf surveys to determine baseline wattages for CFLs. As discussed at the beginning of this report, we do not believe that shelf surveys are an appropriate method for determining the wattage of bulbs replaced by CFLs. The distribution the wattages of the bulbs stocked in stores will likely differ substantially from the wattages in the sockets where residential customers are typically installing CFLs due to the fact that stores are attempting to serve a much wider market than that targeted by a residential CFL program. It is also not possible to determine from a shelf survey the types of bulbs and wattages that are actually being purchased, and the average wattage for purchased bulbs will also differ significantly from the average observed on the shelf once the volume of purchases is taken into account. For these reasons, we recommend that a participant phone survey be used instead to estimate baseline wattages for CFLs.

Duke Energy Ohio

On May 15, 2013, Duke Energy submitted its 2012 Portfolio Status Report to the PUCO. The report includes a Compliance Demonstration, a Program Performance Assessment, and the 2012 Benchmark Report. Assessments of the Duke Energy residential and non-residential energy efficiency program evaluation reports submitted in the 2012 Portfolio Status Report includes a discussion of implementation strategy, customer targets, staffing, marketing, and customer service, as well as impact and process evaluations prepared by the third-party independent program evaluator, TecMarket Works (TecMarket).

PY2012 Duke Energy Reported Savings and Evaluation Research

Duke Energy's PY2012 portfolio comprises the following residential and non-residential programs:

Residential Sector

- Energy Efficiency Education Program for Schools
- Residential Energy Assessments

- Home Energy Comparison Report
 - Home Energy House Call
- Residential Smart \$aver® CFL Program
- Residential Smart \$aver® HVAC Program
- Demand Response
 - Power Manager
 - PowerShare Generators

Non-residential Sector

- Non-Residential Smart \$aver® Prescriptive Program
- Non-Residential Smart \$aver® Custom Program
- Mercantile Self-Direct Rebates
- Demand Response: PowerShare

According to the Portfolio Status Report and the attached TecMarket evaluation reports, Duke Energy exceeded the annual energy efficiency benchmarks for 2012. Using the TRC test, all of the programs included in the Duke Energy Portfolio Plan as submitted to the PUCO were cost-effective.

The Independent Evaluator used the Duke Energy participant database for its PY2012 programs to replicate the kWh savings reported in the Portfolio Status Report. We were able to replicate all PY2012 reported savings (up to a rounding error). The results of the savings replication are shown in Table 9.

Table 9: Duke Energy PY2012 Reported and Verified Savings by Program

Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Reported Demand Savings (MW)	Verified <i>Ex Ante</i> Energy Savings (MWh)	Verified Demand Savings (MW)
Residential Programs				
Energy Efficiency Education for Schools ("Get Energy Smart" Program)	1,149	0.1	1,149	0.1
Home Energy House Call (HEHC)	4,740	0.7	4,740	0.7
Home Energy Comparison Report (HECR)	42,397	15.1	42,397	15.1
Smart \$aver® CFL	76,961	8.5	76,961	8.5
Smart \$aver® HVAC	5,877	1.6	5,877	1.6
Residential Total	131,124	26.0	131,124	26.0
Non-residential Programs				
Smart \$aver® Prescriptive	54,214	11.0	54,214	11.0
Smart \$aver® Custom	24,904	2.8	24,904	2.8
Mercantile Self Direct Rebates	47,524	9.1	47,524	9.1
Non-residential Total	126,642	24.2	126,642	24.2
Grand Total	257,767	50.2	257,767	50.2

In addition to replicating Duke Energy's PY2012 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 inform future evaluation work.

Within the residential and non-residential sectors, we examined which measures and end uses contribute to the PY2012 reported savings; these results are shown in Figure 5 and Figure 6. For the residential sector, 59 percent of the savings came from lighting programs. An additional 36 percent savings was achieved through Duke Energy's behavioral programs, the Home Energy House Call and Home Energy Comparison Report. HVAC measures accounted for the remaining 4 percent of savings.

For the non-residential sector, 42 percent of achieved savings came from lighting measures, primarily T8s. An additional 22 percent resulted from HVAC measures, and 21 percent from other miscellaneous measures. The remaining energy savings are attributable to motors and whole building retrofits.

Figure 5: Duke Energy Share of PY2012 Residential Savings by End Use/Measure

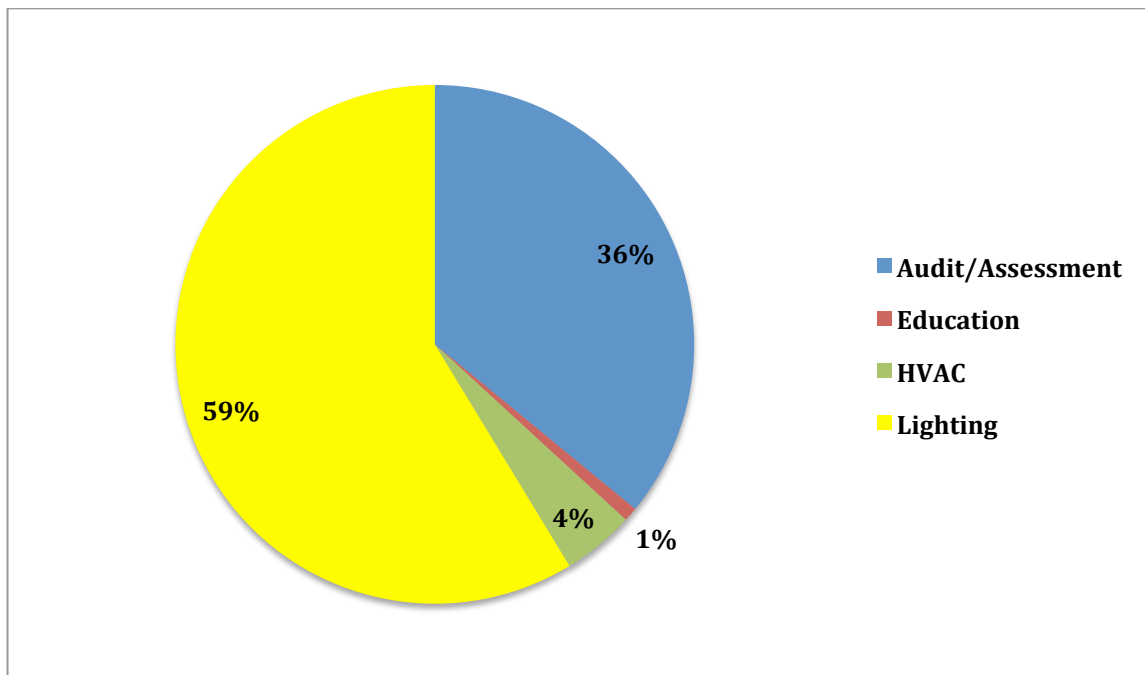
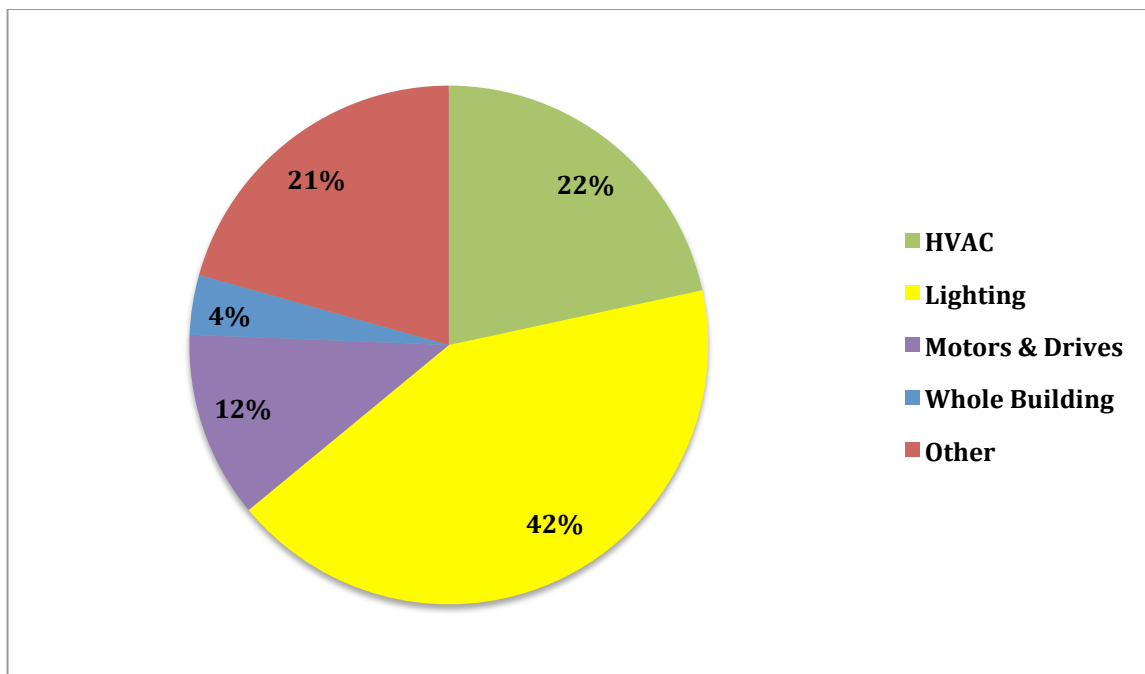


Figure 6: Duke Energy Share of PY2012 Non-residential Savings by End Use/Measure



Note: "Other" includes Building Envelope, Energy Recovery, PowerShare, Wireless Controls, and other miscellaneous measures.

Table 10 shows what type of evaluation (i.e., impact or process) each of Duke's programs received in support of the 2012 Portfolio Status Report. Note that some of these programs were addressed in evaluation reports completed prior to 2012. As in previous program years, TecMarket developed separate reports to address individual programs; these studies were included as separate appendices to Duke Energy's 2012 Portfolio Status Report.

Table 10: Duke Energy PY2012 Evaluation Activities by Program

Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Impact Evaluation	Process Evaluation
Residential			
Energy Efficiency Education for Schools ("Get Energy Smart" Program)	1,149	✓	✓
Home Energy House Call (HEHC)	4,740	✓	✓
Home Energy Comparison Report (HECR)	42,397	✓	✓
Smart Saver® CFL	76,961	✓	✓
Smart Saver® HVAC	5,877	✓	
Non-residential			
Smart Saver® Prescriptive	54,214		✓
Smart Saver® Custom	24,904	✓	
Mercantile Self Direct Rebates	47,524		

The following section provides a summary of the evaluation research undertaken by Duke Energy and its third-party evaluator, TecMarket Works, followed by an assessment of the evaluation and a discussion of the Independent Evaluator evaluation activities for these same programs. The Independent Evaluator team also reviewed survey instruments and participated in ride-alongs for on-site work, which helped increase our confidence in the overall evaluation.

Independent Evaluator Assessment of Duke Energy PY2012 Reported Savings and Evaluation Research

The section begins with a discussion of overarching issues that cut across several or many 2012 evaluation reports. In some cases, we identify areas where the evaluation report and/or impact analysis are unclear or findings are not adequately supported. In some extreme instances, we recommend that the evaluation results not be used to set *ex ante* savings values for these programs in future years.

The overarching issues are followed by a discussion of specific issues for individual evaluation reports. These discussions are organized by report title and include a reference to the specific appendix of the 2012 Portfolio Status Report where the full evaluation report can be found. Many of the evaluation reports continue to have problems similar to those previously identified in reviews of the PY2009/2010 and PY2011 evaluations. Those issues are highlighted, and were particularly frequent for evaluation reports involving estimating savings from audits and home energy comparison reports.

We recognize that the first Independent Evaluator report was filed on August 29, 2012 and the Commission ruled on our recommendations in August of 2013, after the PY2012 Portfolios Status reports were filed. However, most of these same issues were reiterated to TecMarket as part of the ongoing review of phone surveys, draft reports, and discussions of analysis methods prior to 2012. These conversations have been ongoing since the beginning of the Independent Evaluator contract, and we believe this has provided ample time for the recommendations to be incorporated into the PY2012 evaluation reports.

Overarching issues affecting several reports are discussed below.

Data from outside Ohio. In the first Independent Evaluator Report covering PY2009/10, we made the recommendation that only data from Ohio customers should be used in the Duke Ohio evaluations. This recommendation was later accepted by the PUCO in its review of the PY2009/2010 Independent Evaluator report.²⁷

Despite this, some of the Duke Ohio 2012 evaluations are still relying on data collected from outside Ohio from Duke programs implemented in other states. While some allowance should be made for what is realistically feasible (as acknowledged in the Commission ruling on the PY2009/10 Independent Evaluator report), there has been no justification provided in the current evaluation reports describing why using these data are necessary or if these programs and participant populations are similar enough to Ohio to justify their use. We reiterate again our strong recommendation that only Ohio data be used to support the Duke Ohio evaluation research.

Billing regression model detail. In all cases where a billing regression is used to estimate savings, the raw model results are included in an appendix to the evaluation report. The results, however, do not include any discussion of how the variables are defined or in some cases what the variable labels mean. As noted below, we have questions on why certain variables are included in some models, but it is not possible to provide any additional assessment. In the future, we recommend that TecMarket provide complete definitions for all variables used in billing regressions, which is considered standard practice for the evaluation industry. It is also unclear if any data screening has been done to improve the model results. Some data cleaning (such as removing outlier observations) is common practice with billing regression models, and any data cleaning steps need to be clearly explained. Note that TecMarket has since indicated that it intends to comply with this recommendation beginning in 2014.

Use of non-participant comparison group in billing regressions. In billing regression models, sometimes a comparison group of non-participants is used to account for external, non-program factors that may affect energy use. In some cases, a 'rolling sample' is used so that the pre-installation billing period of one participant group can be used as a comparison group for a set of participants from an earlier year. For example, the pre-installation billing data for participants in 2013 might be used as a control for participants in 2012. The rationale here is that participants in 2013 will be fairly similar to participants in 2012 in terms of customer and building characteristics and therefore using them as a comparison is appropriate. When properly designed, the comparison group should account for external effects (such as economic conditions and other factors that are not already accounted for in the model). The control group may also provide an estimate of net impacts, since a properly

²⁷ PUCO Finding And Order on the PY2009/10 Independent Evaluator Report, page 14. Full document: <http://dis.puc.state.oh.us/DocumentRecord.aspx?DocID=a505fb9a-8c81-42d5-8ea4-edf0e4849294>.

designed control group should provide a measure of installations that could be considered as free riders.

When adding these types of non-participant comparison groups, it is important to do some analysis to confirm that the comparison group is reasonably well matched to the participant group. This is particularly true when the control group is made up of pre-installation participants from a subsequent program year, as there is some possibility that program participation cohorts evolve over time and do not provide the similarities needed for robust control group. It is also critical to ensure that there are sufficient billing data from the comparison group for each month of the analysis. Even if this is done properly, the use of the comparison group does not address the issue of controlling for cross participation in other efficiency programs (this issue is discussed more below).

Several of the Duke impact evaluation reports rely on using a non-participant comparison group, but in all cases it appears that the results have been misinterpreted. In each case where a billing regression is used, the same explanatory text is provided. We have reproduced several statements here so that several errors can be corrected. Additional details on the instances where these occur are provided in the discussions of the individual reports.

In several instances, the TecMarket reports state that “the sample acts as its own control group”. This statement may be true if:

- key characteristics of participants across the analysis period are stable;
- there are sufficient billing data points available for the participant and control group for each month (or analysis period) included in the billing regression; and
- the pre- and post-installation periods are sufficiently long to support robust estimation.

Additionally, the rolling sample method is discussed in the Uniform Methods Project (UMP),²⁸ which is a project sponsored by the US Department of Energy and designed to provide consistent guidance on evaluation methods that reflect industry best practices. As discussed in the UMP, when a rolling sample is used in a billing regression, it is imperative that each month in the sample has an adequate mix of both participant and non-participant billing data. For a monthly regression model, ideally the data period will include 12 months of pre-participation and 12 months of post-installation data.²⁹ Ultimately, this is the purpose of the design that uses participants from a future year in a billing analysis of the current evaluation year—all of the months of the future participants can be used as a monthly control for the current participant cohort.

Given these guidelines, the billing model documentation provided in the reports does not provide sufficient discussion or evidence that the data underlying the billing regression analyses meet these criteria. It appears likely that the analysis periods are limited and do not provide sufficient length for the pre-installation and post-installation periods, and that some months included in the billing regressions are not populated with sufficient numbers of comparison group data points. Regardless of the length of the analysis period, each month in the analysis dataset needs to have an appropriate amount of both participant and non-participant observations in order for the results to be considered as net impacts, as asserted in the TecMarket reports.

²⁸ The complete UMP can be found at <http://energy.gov/eere/energy-efficiency-savings-protocols>.

²⁹ Uniform Methods Project, *Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*, pp. 10-11.

In response to a draft version of this report, TecMarket asserted that the key criterion in assessing the billing models (and the adequacy of the number of months of data used) should be whether or not the model provides estimates that are statistically significant. This is fundamentally incorrect—the key criterion should be whether or not the model produces unbiased estimates of the parameters of interest. A regression coefficient estimate can be both statistically significant and biased at the same time, and if the coefficient is used to calculate energy savings, then the bias can become a critical concern as it produces inaccurate impact estimates. In the example cited previously in this report regarding the estimate of Opower savings in Hawaii, the coefficient estimates from both models were statistically significant, but the estimate from the model that did not control for participation in other efficiency programs was also biased. When the biased estimate was used to estimate energy savings, the result was an estimate that overstated savings by almost 40 percent due to the bias, even though the coefficient estimate was also statistically different from zero.

Controlling for participation in other efficiency programs. The TecMarket reports suggest that using a control group automatically accounts for cross program participation in other Duke efficiency programs. The basis for this assertion is that participants and control groups have the same propensity to install high efficiency equipment through other Duke programs. However, this is clearly not the case for information and education-based programs, such as Opower and Duke’s similar Home Energy Comparison Report, as well as audits. The effects of information and education programs are directly related to the propensity to adopt measures, both rebated and non-rebated.

A natural outcome of these programs is to encourage customers to participate in other utility rebate programs where they can install energy efficient measures. If this cross-program participation occurs, then the savings obtained from the installed equipment will already be accounted for in the savings for the rebate program and therefore must be subtracted from the estimated savings from the audit or peer comparison program. This recommendation was made by the Independent Evaluator in both the PY2009/10 and PY2011 reports and is reiterated again at the beginning of our current report. As discussed above, despite the fact that the PY2009/10 report was filed in 2012, this issue has been raised with TecMarket multiple times prior to that date and we believe that there has been sufficient time for this recommendation to be adopted for the PY2012 evaluation.

For example, consider a customer that participates in an audit program and then subsequently adopts a recommended efficient measure through a second program for which they received a rebate. A billing regression model estimating audit program impacts must control for the savings afforded by the rebated measure, otherwise the model will measure those savings as attributable to the audit and double count the savings.

Not only is control for cross-program participation imperative for information and education programs, it is also critical for the correct measurement of impact from incentive programs. Consider the effects of participant spillover, where participants are motivated by their program experience to adopt additional efficiency measures beyond those adopted initially through the primary efficiency program. The effects of spillover are also expressed through the adoption of efficient measures through other rebate programs, yielding an increased propensity among participants to cross-participate in other Duke programs. Thus, the TecMarket reports’ assertion that use of a control group negates the need to manage cross-program participation is incorrect. Cross-program participation must be carefully controlled for to avoid double-counting impact for information, education and rebate programs.

The issues related to proper specification of the billing regression models have become especially important for the Duke Ohio programs, as the savings from the audit programs have increased sharply from the earlier years. As shown in Figure 5, savings from the audit programs (which include the audit program Home Energy House Call and the peer comparison program Home Energy Comparison) now account for 36 percent of the residential sector savings, compared with just 13 percent from PY2011. The Home Energy Comparison Report has moved from a Pilot Program to a fully commercialized program, which accounts for a significant portion of the increase in the residential sector savings. The Home Energy House Call program is less than 4 percent of the savings in the residential sector, as can be calculated from the values in Table 9.

Some of this increase was due to the change in the *ex ante* savings estimate used for the Home Energy House Call, a change we find both unsubstantiated and unreasonable. In 2012, the savings value is on average 2,147 kWh annually per household, up from 821 kWh in 2010. The substantial change in *ex ante* savings is based on 2011 evaluation research results. As we indicated in our PY2011 Independent Evaluator Report, the 2011 research results are based on a mis-specified billing regression model that produced an estimate that is at least 10 times higher than what is normally observed for these types of programs, even when the effects of energy education are factored in. Impact estimates typically range from 1 to 2 percent of annual consumption, while the Duke estimate is closer to 15 percent. It is simply not credible to believe that this type of program will result in an average reduction of 15 percent in home energy use. For these reasons in our 2011 report, we recommended that this estimate not be used to determine future impacts for this program. We strongly reiterate that recommendation again.

Omitted variable bias. Another incorrect assertion made in the TecMarket reports is that the use of monthly indicator variables will automatically correct for omitted variable bias. The use of monthly indicator variables may mitigate omitted variable bias for those effects that are correlated with monthly time trends. Other omitted effects (such as changes to buildings, occupancy, or households) cannot be controlled for using monthly trend variables, as they are not seasonally related. The customer-specific intercept terms will help mitigate some of these factors, but the specification itself will not entirely eliminate the potential for omitted variable bias.

Additional comments on the specific program evaluation reports are included below.

- **Evaluation of the 2009-2011 Smart Saver Non-Residential Custom Incentive Program in Ohio: Results of an Impact Evaluation (2012 Portfolio Status Report Appendix D)**

Snapback and Persistence. The evaluation report includes some editorializing on the issue of “snapback”, which is the term for when the installation of a new energy efficient measure results in an increase in energy use due to the equipment. The text includes several broad and unsupported statements such as “There has yet to be an evaluation conducted of an energy efficiency program that has reliably documented a snapback effect” and “Studies of snapback based on the last 20-plus years of California's well-funded and aggressive energy efficiency portfolio demonstrate that snapback does not exist” (page 10). These statements are out of place in this report, and if they are to be included must be accompanied by supporting references.

These statements conflict with statements made in two other TecMarket reports for Duke where snapback is provided as a possible explanation of the evaluation results. In the

evaluation of the Duke HVAC Program, the following is used as a possible explanation of low realization rates:

In practice, the addition of a new energy efficient system results in a decline in the cost of heating and cooling, so it is reasonable to assume that some customers will increase their heating/cooling. (Page 21).

- **Impact Evaluation and Review of the 2011 PowerShare Program in Ohio (2012 Portfolio Status Report Appendix F)**

This appendix is a brief memo (13 pages) summarizing TecMarket’s review of the analysis methods that Duke uses to estimate demand response impacts for its PowerShare program. This review generally agrees with the methods that Duke uses, although there are five different calculation methods used and it is not clear which methods are applied to which situations. While a brief description of each method is provided, there is not enough detail to allow an independent assessment of the potential benefits and drawbacks.

Absent additional information, we recommend that Duke use the methods that are required for claiming demand impacts for PJM or MISO, which are two of the five methods included in this report. These methods have been thoroughly vetted by external reviewers and therefore should produce reliable and generally accepted estimates of demand savings for these customers.

- **Process and Impact Evaluation of Duke Energy’s Residential Smart \$aver Property Manager CFLs in Ohio (2012 Portfolio Status Report Appendix G)**

The evaluation results are based in part on interviews with property managers in several states. Since there were only five property managers interviewed in Ohio, these results were combined with interviews in North and South Carolina to boost the sample size. While the report states that the programs are implemented similarly in each state, there is no evidence provided in the report that the types of participating properties or tenants are similar across states. For these reasons, it is not clear that adding these additional sample points outside the state provides any significant benefit to the evaluation. We reiterate again that the Ohio evaluation research should be limited to Ohio customers.

For the Ohio properties, the In Service Rate (ISR) for the CFLs is estimated at 98.7 percent, which is higher than typically observed for CFL programs. Page 68 of the report provides information on how this rate was calculated. The five Ohio property owners received a combined total of 8,760 CFLs based on program shipping records. Based on CFL shipment records to the property owners, it was estimated that 8,649 were actually installed, which yields an ISR of 98.7 percent. Given the large number of bulbs involved (over 625 per property manager), relying on shipment records or a self-report phone survey of property owners cannot be expected to yield accurate installation rates for these bulbs. Additionally, the property manager interviews indicate that (prior to participation) 24 percent of the time, bulb replacement is considered the tenant’s responsibility (page 29).

The ISR of 98.7 percent is also in contrast with other phone survey responses provided in the report. On page 31, the survey indicates that 26 percent of property managers did not install

all of the bulbs received (Figure 5 in the evaluation report). For the CFLs not installed, those CFLs were put into storage 15 percent of the time. An additional 25 percent were included in an “Other” and “Don’t Know” response category while 48 percent of the uninstalled CFLs were returned to the program. Taken together, these findings suggest an installation rate considerably lower than 98.7 percent. Absent better information, we recommend that the ISR of 86 percent from the Draft Ohio TRM be used for this program.

- **Process and Impact Evaluation of the Energy Efficiency for Schools Program (The National Theatre for Children (NTC)) in Ohio (2012 Portfolio Status Report Appendix H)**

The issues relating to billing regression described previously are also relevant for this program. The billing regression results are included in an appendix, but none of the variables are defined. There is also no discussion of any data screening or cleaning that may have been done to the analysis sample prior to modeling.

There are a series of variables (HEHC, PER, LI) included in the model that may be designed to indicate participation in other Duke efficiency programs, but these variables are not defined. It is also unclear if they are monthly indicator variables representing months of participation, or rather indicators for households that also participated in these programs at some point during the analysis period. If the latter, then these variables will be perfectly collinear with the household-specific indicator variables and therefore will not be adding any additional explanatory power to the model. However, since these variables are not defined anywhere in the report, it is unclear if this is an issue.

The billing regression claims to use a rolling sample that will control for activities done outside the program that might affect energy consumption. The information provided in Appendix J on the number of observations for both participants and non-participants in each month indicates that there is not sufficient data for the non-participants to be considered an adequate comparison group. For the rolling sample to actually control for non-program influences, each month of the analysis period needs to have a significant number of observations of both participant and non-participant billing data. Of the 14 months in the analysis period, there are only four months with a significant amount of non-participant data overlapped in months with participant data.

The information provided in the report also indicates that there are likely insufficient post-installation billing data. From the table and related text, the participation period ends in August 2012, and the analysis was conducted in Nov/Dec 2012, leaving only a few (3-4) months for post-installation data to accrue. At a minimum, we would like to have at least six months of post-installation data, with 12 months of data ideal in both the pre-installation and post-installation program (as recommended in the UMP) to capture seasonal variation across months. This analysis only has 14 months of data total, and it is unclear why at least more pre-installation data were not included in the analysis dataset. While the resulting model estimates are statistically significant, they may still be biased due to the lack of sufficient monthly observations in the post-installation period, and consequently, the model may be capturing influences other than the effects of the program.

The text in the report states that participation in other Duke efficiency programs is accounted for (page 11), but it is unclear exactly how this was accomplished (none of the regression variable names are defined, for instance). As discussed above, the fixed effects model using a comparison group of non-participants is not sufficient for controlling for participation in other programs. Given the lack of discussion in the report, it appears that cross-program participation is not controlled for in the analysis, which will result in an overestimation of energy savings if the Schools program results in significant participation in other Duke efficiency programs.

There is also an erroneous statement discussing other biases. Again on page 15, the statement “The participant responses are self-reports and therefore may be affected by self-selection bias, false response bias or positive result bias. If these biases are present, the savings achieved can be expected to be higher than those reported in the impact evaluation” is not accurate. We do not know the direction of the bias and in this case, it is more likely to have the opposite effect of that claimed. In this case, self selection and positive response bias are likely to overstate the savings from the program, as those with little or no savings are less likely to respond to the survey. It is therefore not appropriate to interpret the impact estimate as a conservative estimate of savings.

In our prior review of this program in the PY2011 Independent Evaluator Report, we recommended that the previous billing regression results not be used to estimate savings for this program, due to similar modeling issues that are present again for PY2012. Instead, we recommended that savings be calculated using the engineering estimates of savings combined with the self-reported installation rates from the participant survey. We reiterate that recommendation here, as we do not believe that the billing regression model is providing reliable results due to the problems discussed. The average savings estimated from the billing regression is 237 kWh, which is unrealistically high given the measures being provided and the installation rates observed from the phone surveys. In contrast, the savings using the engineering method are provided in Table 40 of the report and are approximately 174 kWh on average per household. We recommend that this engineering number be used to calculate savings for future years of this program, rather than the kWh savings estimates obtained from the billing regression.

- **Process and Impact Evaluation of the Residential Energy Assessments Program in Ohio (2012 Portfolio Status Report Appendix I)**

The same issues discussed for the billing regressions in the other programs also pertain to this report. The billing regression results are provided in an appendix, but none of the variables are defined. Some of the variables seem to represent characteristics of the home, which will not vary over the analysis period. If this is the case, then they will be perfectly collinear with the household-specific constant terms used in the fixed effects model and therefore are not adding any explanatory power to the model. But it is not possible to know for sure without understanding how each of the variables is defined.

The report states that a rolling sample is used, but there is no additional information provided on how well the comparison group is actually mapped to the participant group. Again, the use of a rolling sample is appropriate in cases where an adequate number of both participant and non-participant observations are available for each month. There is also no information

provided on how many participant and non-participant observations are actually available each month, so it is unclear if the sample is actually providing an adequate amount of non-participant observations throughout the entire analysis period. As discussed earlier, the UMP describes the importance of using a comparison group that is appropriately designed to fit the participant sample and provides guidance on how to adjust the comparison group if needed to improve the match with the participant monthly data.³⁰

Since the model descriptive text for this report is essentially the same as that used in the other reports, there is no explanation of whether or not participation in other Duke efficiency programs is addressed. As we have noted previously, using a fixed effects model with a rolling sample is not sufficient for controlling for participation in other efficiency programs, and if the cross-participation is not accounted for, the model will then overestimate savings attributable to the program.

The model combines data from several states—Ohio, plus Kentucky, North Carolina and South Carolina. As we have recommended previously, we would like to have only Ohio data used to develop the Ohio energy savings estimates. While this can be addressed in the model if the variables are properly constructed, it is unclear if this was done in this model as variable definitions are not included in the report. There are two variables labeled “MW” and “SE”, which may be representing the Midwest and Southeast regions, in which case Ohio and Kentucky are combined.

- **Evaluation of the 2009-2010 Residential Smart Saver HVAC Program in Ohio (2012 Portfolio Status Report Appendix J)**

As with the billing regression models in the other TecMarket reports, there is not enough detail provided on the billing regression model results in Appendix A. The variables are not defined and there is no discussion of any data cleaning steps that may have been conducted. Additionally, Table 13 in the report indicates that there are two different savings estimates based on SEER levels, but only one variable is used in the billing regression. How the single estimate from the billing regression model is used to create two different savings values is not explained in the report.

In addition to the lack of detail on the models, there are several statements in this report that overstate the robustness of the billing regression models used for estimating HVAC energy savings for this program. The text on page 8 includes the following two statements:

“The specification of the model used in the billing analysis was designed specifically to avoid the potential of omitted variable bias by including monthly variables that capture any non-program effects that affect energy usage. The model did not correct for self-selection bias because there is no reason to as long as the program remains voluntary.”

Both of these statements are inaccurate. It is possible that the inclusion of monthly indicator variables may control for some omitted variables, but only those that are highly correlated with months (e.g., seasonal effects). Other factors such as changes that occur to the building

³⁰ See Uniform Methods Project, *Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*, pp. 10-12.

during the analysis period are not controlled for with this method and may result in omitted variable bias if these changes are affecting energy use. As discussed previously, the voluntary programs are those that have the greatest potential for self-selection bias, as their voluntary nature increases the likelihood that there will be fundamental differences between the participant and non-participant populations.

Independent Evaluator Assessment of Duke Energy Ohio 2012 Mercantile Program Reported Savings and Evaluation

As part of the Duke mercantile savings analysis, the Independent Evaluator team conducted a series of mercantile on-site visits in 2013. Based on the information collected during these on-sites and upon reviewing the program documentation, we calculated the *ex post* savings for these customers, as shown in Table 11. Of the 20 projects evaluated, five of the savings values reported did not match the savings shown in the project documentation. In addition, two of the projects were found to have different equipment counts than shown in the project documentation, and one project was calculated using incorrect equipment specifications. The overall realization rate was 92 percent for kWh and 85 percent for kW.

Table 11: Duke 2012 Mercantile *Ex Post* Savings Analysis

Project	Realization Rate		Reason for change
	kWh	kW	
Customer 1	81%	46%	Database tracking error
Customer 2	100%	100%	
Customer 3	100%	100%	
Customer 4	95%	94%	Database tracking error
Customer 5	73%	-195%	
Customer 6	100%	100%	Different equipment count
Customer 7	100%	100%	
Customer 8	100%	100%	
Customer 9	99%	100%	
Customer 10	100%	100%	
Customer 11	100%	100%	
Customer 12	100%	100%	
Customer 13	100%	100%	
Customer 14	100%	100%	
Customer 15	20%	63%	Database tracking error
Customer 16	100%	100%	
Customer 17	100%	100%	Incorrect equipment specifications
Customer 18	139%	161%	
Customer 19	100%	103%	
Customer 20	61%	61%	Different equipment count
Overall	92%	85%	

Independent Evaluator Recommendations for Duke Energy Ohio

Based on our review of the PY2012 Duke Energy Ohio Portfolio Status Report and associated evaluation research, we make the following recommendations.

Recommendation #1: Adjust billing model specifications as recommended. Several programs rely on billing regression models to estimate savings, and we have raised concerns here and in

previous reports regarding model specifications and the lack of detail provided. In some instances, we have recommended that the model results not be used to calculate impacts for future program years. We recommend that our proposed changes be implemented so that more robust and believable estimates can be obtained from these models.

Recommendation #2: Participation in other Duke Energy programs must be accounted for in audit and home energy comparison programs. This issue has been raised in our prior reports and discussions with Duke’s evaluation team and is reiterated again for PY2012. For all programs that are designed to encourage customers to adopt efficiency measures, the potential for participating in other programs (and therefore double counting savings) must be explicitly addressed and included in the evaluation reports. If billing models are used to estimate impacts for these programs, then alternative program participation must be accounted for by either including a variable that controls for this effect, or excluding these customers from the billing analysis sample. If alternative program participation is not addressed, then the model may be subject to omitted variable bias that will bias upward the estimates of the audit or home energy comparison program. Using a fixed effects model specification and a rolling sample of participants is not enough to correct for this problem.

Recommendation #3: Use data on Ohio customers to support Duke Ohio evaluation research. This recommendation was made in our PY2009/10 report and was confirmed by PUCO in its review of that report. There has been no justification provided in the PY2012 Duke Ohio evaluation reports describing why including data from other states is necessary or if these programs and participant populations are similar enough to Ohio to justify their use. We strongly urge that future evaluations use Ohio customer data rather than information on customers and programs in other states.

FirstEnergy Ohio Operating Companies

As noted above, FirstEnergy has three Ohio operating companies, The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (OE), and The Toledo Edison Company (TE), (collectively “FirstEnergy” or “Companies” where noted).

The Companies’ 2010 Portfolio Status Report was hampered by the fact that the Companies’ Energy Efficiency and Peak Demand Reduction Plans (EEPDR Plans) had not yet been approved by the PUCO, and therefore there were no program results from approved EEPDR Plans to address for the established reporting period.

In 2011, the Commission concluded that, based on R. C. § 4928.66(A)(2)(b), Ohio Edison’s request for amendments to its 2010 energy efficiency and peak demand reduction benchmarks to actual levels achieved during 2010 should be granted due to regulatory reasons beyond its control, provided that the company met the cumulative energy savings mandated by statute by 2012.

On May 15, 2013, FirstEnergy submitted its 2012 Portfolio Status Report³¹ to the PUCO. The report includes a Compliance Demonstration and a Program Performance Assessment. Assessments of each of FirstEnergy’s PY2012 residential and non-residential energy efficiency programs include a discussion of implementation strategy, customer targets, staffing, marketing, and customer service, as

³¹ ADM Associates, Inc. *Energy Efficiency & Peak Demand Reduction Program Portfolio Status Report*. (Prepared for FirstEnergy Service Company. May 15, 2013).

well as impact and process evaluations prepared by the Companies' third-party independent program evaluator, ADM Associates, Inc. (ADM).

PY2012 FirstEnergy Ohio Reported Savings and Evaluation Research

FirstEnergy's PY2012 portfolio consists of the following residential and non-residential programs:

Residential Sector

- Residential Sector Appliance Turn-In Program
- CFL Program
- Community Connections (Low-Income Weatherization)
- Energy Efficient Products Program
- Home Energy Analyzer (Telephone and Online Audits)
- New Construction
- Residential Energy Audits

Non-residential Sector

- Mercantile Customer Program
- Commercial and Industrial (C&I) Energy Efficiency Incentive Programs
- Interruptible Demand Reduction

According to the Portfolio Status Report and the attached ADM evaluation reports, FirstEnergy exceeded the annual energy efficiency benchmarks for 2012 by 509,149 MWh and 237.39 MW when both approved and pending³² programs were included. The TRC Benefit Cost Ratio of the utility portfolios is reported as 2.2 for Ohio Edison, 2.0 for CEI and 2.8 for Toledo Edison. Using the TRC test, the majority of the programs included in the FirstEnergy Portfolio Plan as submitted to the PUCO were cost-effective. Programs that were not cost effective for any of the FirstEnergy utilities include the Residential Energy Audit program, the Low Income Community Connections program, and the Government Lighting program.

The FirstEnergy participant tracking database was not yet fully implemented in PY2012. The Independent Evaluator used the program participation data included in the tracking database or else provided by the implementation contractors and utilized by ADM for its verification activities to replicate the kWh savings reported in the Portfolio Status Report. In general, the participant tracking data were clean and sufficiently robust, and there were no significant issues in replicating savings. The results of the replication exercise are shown in Table 12.

³² Portions of the Mercantile Customer program and the Transmission and Distribution program were still pending PUCO approval at the time of the PY2012 evaluation.

Table 12: FirstEnergy PY2012 Reported and Verified Savings by Program

Program	Reported <i>Ex Ante</i> Energy Savings (MWh)	Reported <i>Demand</i> Savings (MW)	Verified <i>Ex Ante</i> Energy Savings (MWh)	Verified <i>Demand</i> Savings (MW)
Residential Programs				
Appliance Turn-In Program	11,798	2.1	11,798	2.1
Compact Fluorescent Lamp (CFL) Program	62,070	10.2	62,070	10.2
Community Connections	6,317	0.9	6,317	0.8
Direct Load Control	105		105	
Energy Efficient Products Program	3,217	0.8	3,217	0.8
Home Energy Analyzer	4,543	0.9	4,542	0.9
New Construction	3,377	0.4	3,377	0.4
Residential Energy Audit	1,454	0.5	1,454	0.4
Residential Total	92,776	15.8	92,775	15.6
Non-residential Programs				
Mercantile Customer Program	118,272	17.0	118,270	17.0
C&I Energy Efficiency Incentive Programs	223,592	34.6	223,596	34.6
Non-residential Total	341,864	51.5	341,866	51.5
Grand Total	434,640	67.4	434,641	67.2

In addition to replicating FirstEnergy PY2012 reported savings, the participant data 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 help determine evaluation priorities in future years.

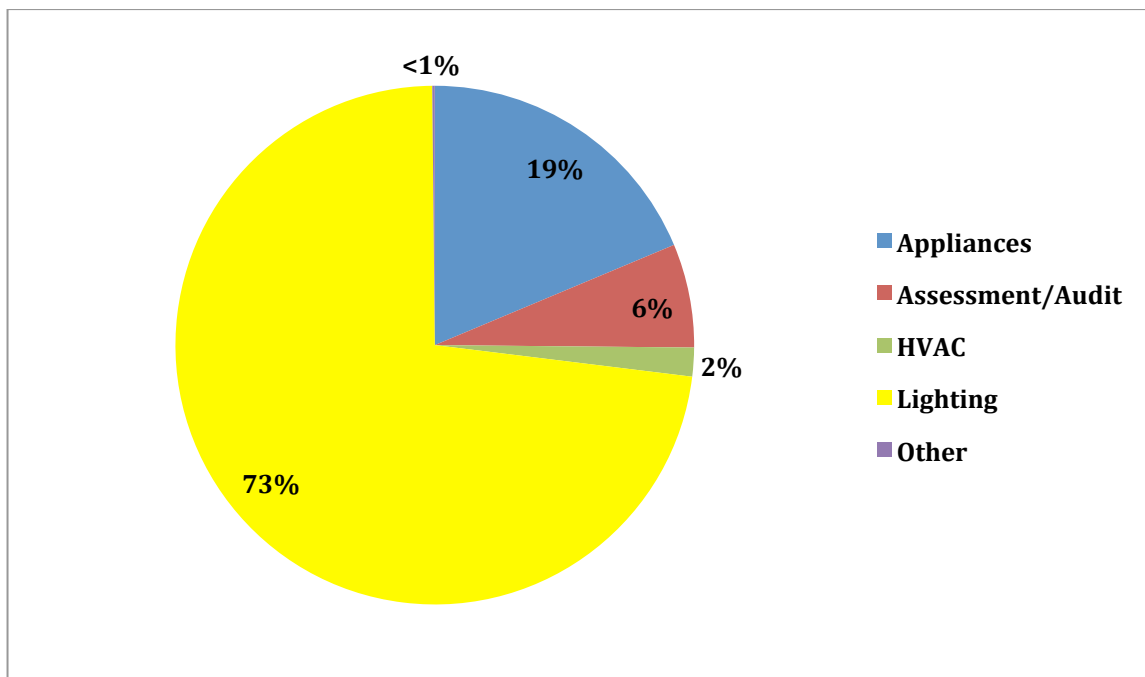
Within each sector, we examined which measures and end uses were contributing to reported savings to the extent possible with the FirstEnergy participant data. The results of this analysis are shown in Figure 7 and Figure 8.

For the residential sector, the vast majority of savings (73 percent) came from CFLs distributed through either the CFL Program or the Low Income Community Connections Program. Appliances accounted for an additional 19 percent of savings, and the remaining 8 percent of savings came from energy audits, HVAC measures, and other miscellaneous measures.

For the non-residential sector, lighting was also the primary source of savings (71 percent) followed custom measures (7 percent) and motors (7 percent). New construction projects made up 4 percent

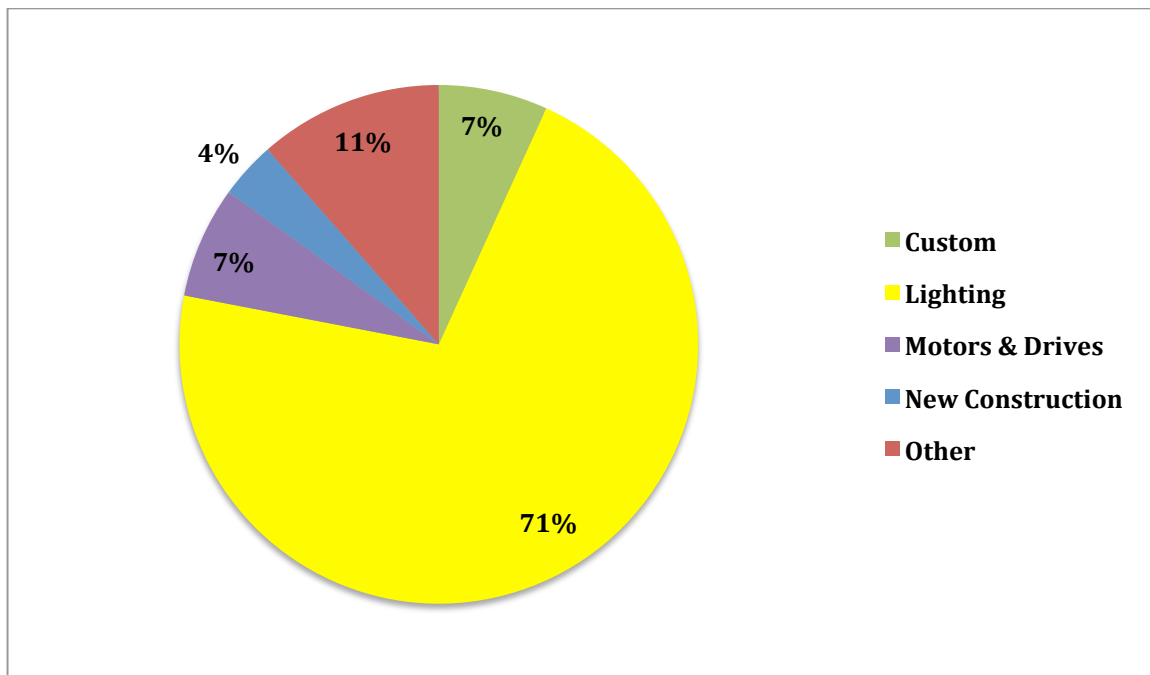
of savings with the remaining 11 percent of savings attributable to other end uses (appliances, building envelope, EMS, energy recovery, refrigeration, and other miscellaneous measures).

Figure 7: FirstEnergy Share of PY2012 Residential Savings by End Use/Measure



Note: "Other" includes Building Envelope, Water Heating, and additional miscellaneous measures.

Figure 8: FirstEnergy Share of PY2012 Non-residential Savings by End Use/Measure



Note: “Other” includes Appliances, Building Envelope, EMS, Energy Recovery, Refrigeration, and additional miscellaneous measures.

ADM completed impact evaluations for each of the PY2012 programs, and process evaluations for eight of the nine programs, as shown in Table 13. A process evaluation was not completed for the CFL program as 2012 was the last year of the program operations in that format.

Table 13: FirstEnergy PY2012 Evaluation Activities by Program

	Reported <i>Ex Ante</i> Energy Savings (MWh)	Impact Evaluation	Process Evaluation
Residential Programs			
Appliance Turn-In Program	11,798	✓	✓
Compact Fluorescent Lamp (CFL) Program	62,070	✓	
Community Connections	6,317	✓	✓
Direct Load Control	105	✓	✓
Energy Efficient Products Program	3,217	✓	✓
Home Energy Analyzer	4,543	✓	✓
New Construction	3,377	✓	✓
Residential Energy Audit	1,454	✓	✓
Non-residential Programs			
Mercantile Customer Program	118,272	✓	✓
C&I Energy Efficiency Incentive Programs	223,592	✓	✓

Independent Evaluator Assessment of the FirstEnergy PY2012 Reported Savings and Evaluation

In general, the evaluations are of high quality and use accepted data collection and analysis techniques. Moreover, the evaluation plans approved by the SEW were generally followed. Most of the comments on these reports focus on the documentation (or lack thereof) for some of the savings calculations and adjustments. In particular, reasons for the difference between *ex ante* and *ex post* savings are often not fully documented when the *ex post* values are based on engineering calculations. In some other cases, our comments identify areas where participant phone surveys were completed but the results were not included in the evaluation report.

Overall, the format and content of the reports adhered to the Outline for Ohio Utilities Program Evaluation Reports provided to the utilities by the Independent Evaluator (and provided as Appendix E hereto). With a few exceptions, noted below, the reports also followed the evaluation plans reviewed and approved by the Independent Evaluator.

Specific issues with the FirstEnergy evaluation reports are discussed below by report title, with a reference to the specific appendix to the FirstEnergy 2012 Portfolio Status Report in which each study can be found.

- **EM&V Report: 2012 Residential Direct Load Control Program (2012 Portfolio Status Report Appendix B)**

Use of regression analysis to establish baseline. In the last paragraph on page 14, ADM states that the weather-sensitive model is an auto-regressive model because included as an explanatory variable is the “previous hour’s predicted usage.” In fact, the autoregressive model (AR1) should contain the actual value of the dependent variable (CAC unit’s power)

from the previous period, not the predicted value. Conversations with FirstEnergy indicate that this may simply be a mistake in the report rather than a modeling issue.

We did not find the results from the AR1 model estimated by ADM in the evaluation report and, therefore, we cannot comment on the estimates of demand or kWh savings the evaluator developed based on the results of the model. More detail on both the model results and how they are used to estimate impacts should be included in the evaluation report.

- **EM&V Report: 2012 Appliance Turn-in Program Impact and Process Evaluation Report (2012 Portfolio Status Report Appendix C)**

Percentage of working units recycled. The ADM evaluation survey found that 13 percent of recycled refrigerators (n=150) and 21 percent of freezers (n=83) were not in use or were used part-time; this compares to the Independent Evaluator survey's findings (n=93) of 32 percent not in use and 3 percent broken (refrigerator and freezer combined). We are not questioning the validity of the evaluation survey results, since the differences may be attributable to the difference in how the questions were worded between the two surveys. We also note that the difference in the percentages of appliances that were not in use when recycled is statistically significant in the Independent Evaluator survey. This may warrant additional investigation in future evaluations.

- **EM&V Report: Evaluation of 2012 Energy Efficient Products Program (2012 Portfolio Status Report Appendix D)**

No Participant Surveys. The Evaluation Plan approved by the Independent Evaluator specified that "There will be online and phone surveys used to verify customer receipt of the rebates for the various measures indicated in the Honeywell databases, to determine how customers became aware of the program, and to assess customer satisfaction with the products purchased." However, no participant survey results were reported, meaning that several of the evaluation objectives set forth in the Evaluation Plan were not addressed; e.g., "5. To what extent are customers satisfied with the products rebated? 6. To what extent are customers satisfied with the Program and the rebate process." Conversations with FirstEnergy confirmed that these surveys were fielded but that the results were not included in the evaluation report. In the future, we recommend that the results from all surveys that are conducted as part of the evaluation plan be included in the evaluation reports.

No Explanation for Realization Rate of 1.24. The impact evaluation used a "count and deem" approach, so that no detailed engineering calculations were required. As such, the realization rate of 1.24 raises the question of why *ex post* savings were so much greater than the *ex ante* savings claimed by FirstEnergy. The report does not provide a discussion of reasons for the greater *ex post* savings overall, nor does it examine the realization rate by measure type to investigate whether *ex ante* values should perhaps be modified for future program years.

- **EM&V Report: Evaluation of 2012 Residential Energy Audit Program (2012 Portfolio Status Report Appendix E)**

No Participant Survey Results. The introduction to this report identified several process research questions for which customer survey results would be needed, including:

- How do customers proceed in completing recommended retrofit jobs? What choices do they make in financing retrofit jobs?
- What are the estimated costs of completed retrofit projects?
- To what extent are customers satisfied with the Program?

In addition, the description of impact methods states that “A telephone survey of customers was conducted to determine in-service rates (ISR) for the various CFL measures installed and to estimate annual CFL hours of operation.” In fact, the survey instrument presented as an appendix to the report only asks whether the customer recalls having CFLs directly installed; it does not ask what wattage CFLs were installed, whether the CFLs are still installed, where they were installed, or how many hours day they operate—all of which would be necessary to estimate ISR and annual hours of operation.³³ Moreover, no results are presented showing what percentage of respondents recall receiving different measures.

To address the first two process objectives listed above, the survey did ask respondents about their decision to pursue retrofit projects and the cost of those projects, but no such results were presented in the report. Furthermore, while the questions about customer satisfaction did use a 1 to 5 scale with categorical responses, the categories (very dissatisfied, dissatisfied, neutral, satisfied, very satisfied) did not match the recommended categories (very dissatisfied, somewhat dissatisfied, neither satisfied nor dissatisfied, somewhat satisfied and very satisfied.) The point is moot, however, since no customer satisfaction results were presented in the evaluation report. Conversations with FirstEnergy indicate that these questions were asked in the phone survey but were not included in the evaluation report. As noted above, we recommend that the results from all surveys that are conducted as part of the evaluation plan be included in the evaluation reports. At a minimum, phone survey results should be included that address specific research objectives that FirstEnergy includes in their evaluation plans.

No Explanation for Realization Rates. The impact evaluation found a kWh realization rate of .92 and a kW realization rate of .49, but did not address why the kW realization rate was so much lower. In addition, per unit savings seem to vary across CFL types, with 20 Watt CFLs that replaced 75 Watt incandescent bulbs having a higher per-bulb savings (From tables 5-1 and 5-2, 4,417 bulbs and 295,564 kWh of savings, or 70 kWh/bulb) than 25 Watt CFLs (3,213 bulbs for 170,397 kWh, or 53 kWh/bulb). There may well be a good explanation (e.g., 20 Watt CFLs are installed in places where they have longer operating hours) but the differences were not explained or noted in the report.

³³ Note that these survey instruments were reviewed by the Independent Evaluator team prior to being fielded and we had the opportunity to provide comments. It was not apparent during the review, however, that this survey would be relied upon to calculate the ISR and operating hours. If this had been known, the Independent Evaluator team would have recommended that additional questions be included to collect the necessary information to calculate these parameters.

- **EM&V Report: Evaluation of 2012 Home Energy Analyzer (HEA) Program (2012 Portfolio Status Report Appendix F)**

Modeling Methodology. ADM estimates separate fixed effects billing regression models for each of the four different audit types and for a non-participant comparison group. Between the four different participant groups, there are 20,065 households; however the four regressions were estimated using only slightly more than half of this total. ADM describes the screening steps that were taken prior to the analysis, however they provide no information on how many participants were expunged from the data based on each criterion.

ADM used the estimated coefficients from the regression models to compute average daily kWh savings per household for each of the four audit types. However, ADM applied the estimated regression results incorrectly, which resulted in higher estimates of kWh savings than are warranted from the regression results. Specifically, they used only the “... coefficients of interest that were significant at the 90% confidence level...”. This is an incorrect application of the prediction equation developed from the regression model. The correct application of the estimated prediction equation is to use all estimated coefficients from the model—regardless of whether the coefficient is statistically significant or not.

Based on our recalculation of Tables 5-3, 5-6, and 5-7 in the evaluation report, we estimated total electrical savings of 4,478,102 kWh and total demand savings of 1,365 kW, a reduction of approximately 20 percent from the results presented in the evaluation report.

Control group comparison tests. In our review of ADM’s 2012 Evaluation Plan for this program, we recommended that some analysis results be presented in the final evaluation report that compared the treatment and control groups for this program. This recommendation was made so that we could have confidence that the control and treatment groups were appropriately matched on key variables such as energy use and participation in other FirstEnergy efficiency programs. Despite our recommendation, this information was not provided in the report and therefore we cannot determine if the control and treatment groups are appropriately matched.

Until the issues raised above are addressed, we do not recommend that the results of this evaluation be used to calculate savings for future years of this program.

- **2012 Compact Fluorescent Lamp Distribution Program Impact Evaluation (2012 Portfolio Status Report Appendix G)**

Baseline Wattages. Page 6 of this report states that “Through an extensive study of retail stores, ADM determined that the 100 watt incandescent bulb was available throughout 2012 so the delta watts multiplier of 3.25, used in 2011 was suggested for *ex ante* calculations.” As the Independent Evaluator noted in the review of the 2011 evaluation reports, the results of that evaluation provided compelling evidence that the baseline wattages assumed for the CFL program are too high and result in an overestimation of savings for this program (although timing of the 2011 Independent Evaluator Report precluded the Companies from including recommendations in the 2012 reports). Specifically, the results of the telephone survey, presented in the process evaluation section of the 2011 report, stated that 62 percent of

program CFLs replaced 75 watt or smaller incandescent bulbs. These results should have been used rather than the 3.25 delta watts multiplier. This point (that 23 watt bulbs should not be assumed to exclusively replace 100 watt incandescent bulbs) was made repeatedly in the Independent Evaluator comments on the Evaluation Plan for the 2012 CFL Distribution Program, in which ADM was responsive and used to calculate the ex post values.

Not surprisingly, the results of the participant survey for the current evaluation again showed that the 23 watt CFLs distributed through the program are not used to replace only 100 watt bulbs, but on average replaced 75 watt rather than 100 watt bulbs. This was a primary cause for the realization rate on kWh savings for the program of .66.

- **2012 Community Connections Program Impact and Process Evaluation Report (2012 Portfolio Status Report Appendix H)**

Installation Rates. For CFLs installed through the Community Connections Program, the impact evaluation uses the assumed installation rate (ISR) of .81 specified in the TRM. However, customer survey results indicate that only 72 percent of CFLs provided to customers were installed and in use. (p. 23: “Approximately 72 percent of CFLs that were received by program participants were installed at the time of the phone survey.”) It would have been reasonable to update the *ex post* savings values using this number.

Baseline Wattages. The fact that 100 watt incandescent bulbs were available at 75 percent of stores does not mean that all 23 watt CFLs would replace 100 watt incandescent lamps, particularly for low income consumers who would be unlikely to travel to other stores if they go to one of the 25 percent of stores that do not stock the 100 watt bulbs. So the full 3.25 delta watts multiplier is not justified on that basis. On the other hand, it seems reasonable to assume that installation contractors would be trained to replace only 100 watt incandescent lamps with CFLs greater than 20 watts, so the higher delta would be appropriate for this program for this year.

- **2012 Residential New Construction Program Impact and Process Evaluation Report (2012 Portfolio Status Report Appendix I)**

Process Evaluation Goals. The report states that “The goal of the process evaluation component will be to determine how effective the program is in terms of customer satisfaction, builder and home buyer awareness, and stakeholder interaction.” Among the other researchable questions were “What were the most common measures installed to meet program eligibility guidelines? Which installed measures have the greatest homebuyer perceived value and the least homebuyer perceived value? And which individual measure types are generating the greatest kW savings?” None of these questions appear to have been answered by the report. Follow up conversations with FirstEnergy indicate that a homebuyer survey, which was reviewed by the Independent Evaluator team, was fielded, but the results were not included in the evaluation report. As with the other programs discussed above, we recommend that results from the participant surveys be included in the evaluation reports, particularly those phone survey results that address key process evaluation objectives.

Net Program Impacts. We recognize that net impacts were not part of the evaluation scope, but results of the builder interviews suggest a potentially high level of free ridership. Page 5-5

of the process evaluation findings states that “The four builders who produced more than 100 homes per year, along with the custom builders we spoke to, stated they are already building to ENERGY STAR® Version 3.0 standards as part of their business model. The program did not influence their decision to do so.”

- **2012 Evaluation of EnergySaveOhio Commercial and Industrial Energy Efficiency Incentive Programs (2012 Portfolio Status Report Appendix J)**

Realization Rates. While there is a useful breakdown of realization rates across all three programs by business/building type, there is no comparable comparison of realization rates for different measure categories. Moreover, there is no discussion of why realization rates vary; an analysis by measure (lighting, HVAC, shell, motors and drives) might provide insight into the factors responsible for ex post savings that are greater (or less) than the *ex ante* values.

Motors Baseline. The report states that “If the motor replacement is for normal replacement, the baseline efficiency is established as the efficiency of a new, standard efficiency motor. However, in cases of early replacement, the efficiency of the old motor is used for the length of the remaining life.” It is not clear what baseline is used for new motors (i.e., what is a “standard efficiency” motor when NEMA premium is largely considered standard practice). Similarly, it is unclear in the report what expected RUL (remaining useful life) values were used in calculating the Annualized Savings for all cases where the existing equipment was used as the baseline. More detail on these issues should be included in the evaluation report.

- **Evaluation of EnergySaveOhio Mercantile Customer Program (2012 Portfolio Status Report Appendix K)**

Role of Program Staff and Administrator Organizations. The 2012 Evaluation Plan for the Mercantile program made reference to staff interviews, administrator input and trade ally interviews, but only participant survey results were reported in the Evaluation Report. While the results of the participant surveys in the process evaluation reveal that customers are very satisfied with the administrator organization they worked with, it would have been valuable to interview representatives of the administrator organizations to understand their perceptions of the program, their marketing approaches and their role in calculating savings for the customer program applications.

- **Review of Demand Response Attributes Program (2011 Portfolio Status Report Appendix L)**

This appendix was a one-page summary of the Demand Response Attributes Program. In this memo, it is stated that ADM reviewed the demand response savings calculations and confirmed the MW resource calculations. However, no details on these calculations are provided in the report; even the basic equation used to estimate impacts is omitted. Given the lack of information, it is not possible to conduct an independent confirmation that the savings calculation methods are valid. Additional details should be provided in future evaluations of this program so that some independent verification can be conducted.

- **FirstEnergy Application for Approval of Transmission and Distribution Projects.** Along with its Portfolio Status Update report, FirstEnergy also submitted an application to the PUCO for several transmission and distribution improvement projects. The application provides the formula for calculating the expected savings, along with a list of the projects and the total savings expected from each. In a future evaluation of this program, we recommend that the savings calculations for each of the individual projects be included so they can be reviewed by the Independent Evaluator team.

Independent Evaluator Assessment of FirstEnergy Ohio 2012 Mercantile Program Reported Savings and Evaluation

As part of the FirstEnergy mercantile savings analysis, the Independent Evaluator team conducted a series of mercantile on-site visits in 2013. Based on the information collected during these on-sites and upon reviewing the program documentation, we calculated the *ex post* savings for these customers as shown in Table 14. Savings adjustments were made to the projects for several reasons. Two projects were calculated using an incorrect baseline control method and five projects were calculated using an incorrect operating profile or incorrect operating hours. The equipment quantities in the project documentation did not match the quantities actually installed in three of the projects, and the equipment specification documents did not reflect what was actually installed in two other projects. Interactive effects were not included in two projects, which increased the savings for those projects. In two cases, an incentive was provided for backup equipment; in one case, the equipment installed replaced the exact same equipment; and in six cases, the incented equipment was no longer in use. The calculation methodology used was incorrect for Customer 4 and Customer 7. Customer 11 claimed savings for a project that had no associated cost. The savings claimed for Customer 17 appears to be the baseline energy usage, and not the correct savings value. There also appears to be a tracking error for Customer 17, as the savings calculations do not match the tracking database values. The overall realization rate (that is, the ratio of the evaluated *ex post* savings to the claimed *ex ante* savings) was 70 percent for kWh and 81 percent for kW.

Table 14: FirstEnergy 2012 Mercantile *Ex Post* Savings Analysis

Project	Realization Rate		Reason for change
	kWh	kW	
Customer 1	49%	48%	Incorrect operating profile and baseline control method
Customer 2	40%	82%	Incorrect baseline, hours of use, and equipment specifications, backup equipment incented
Customer 3	93%	93%	Incorrect hours of operation
Customer 4	36%	36%	Incorrect Calculation methodology
Customer 5	98%	100%	Equipment no longer in use
Customer 6	56%	53%	Backup equipment incented, equipment no longer in use, incorrect operating profile
Customer 7	74%	74%	Incorrect Calculation methodology
Customer 8	100%	100%	
Customer 9	118%	180%	Interactive effects not accounted for
Customer 10	110%	167%	Interactive effects not accounted for, different equipment count
Customer 11	69%	0%	Equipment not functioning, equipment replaced like equipment, project with no cost incented
Customer 12	100%	100%	
Customer 13	99%	99%	Different equipment count
Customer 14	137%	100%	Tracking error
Customer 15	87%	88%	Different equipment count
Customer 16	100%	100%	
Customer 17	53%	48%	Baseline use reported as savings
Customer 18	31%	0%	Equipment not installed, incorrect operating hours and specifications
Customer 19	81%	87%	Equipment not installed
Customer 20	64%	94%	Equipment not installed
Overall	70%	81%	

Independent Evaluator Recommendations for FirstEnergy

Based on our review of the 2012 FirstEnergy Portfolio Status Report and associated evaluation research, we make the following recommendations.

Recommendation #1: Include results from completed participant surveys that are included in Evaluation Plans. Several of the evaluations (Energy Efficient Products, Residential Audits, Residential New Construction) did not report the results of participant surveys that were fielded as part of the program evaluation plan. We recommend that results from completed surveys be included in the evaluation reports. At a minimum, survey results that address key evaluation objectives should be reported and discussed. Ideally, an appendix would include tabular results from all phone surveys conducted as part of the evaluation.

Recommendation #2: Adjust CFL baseline to include fewer 100 watt incandescents. Note that this recommendation was also made after our review of the 2011 Portfolio Status Report (although timing precluded the Companies from incorporating those recommendations for PY2012), and that results of last year's evaluation showed that 75 percent of CFLs replaced 75 watt or smaller incandescent bulbs. As noted above, because the CFL program distributes 23 watt exclusively, we do not believe it is realistic to assume that every 23 watt CFL is replacing a 100 watt incandescent, and this assumption results in a significant (and, in our opinion, unrealistic) effect on the savings estimate for this measure. We recommend that future calculations use a baseline that assumes a distribution of lamp wattages for the baseline, with the distribution determined by a phone survey of FirstEnergy customers installing CFLs rather than by a shelf survey.

Recommendation #3: Explain discrepancies between the *ex ante* and *ex post* values. In some evaluations, it is unclear where the difference between *ex ante* and *ex post* savings arises. Simply ascribing this to “project-specific” factors as was done in the Commercial and Industrial and Mercantile program evaluation reports limits the effectiveness of evaluation results in helping to update *ex ante* values. In the future, we recommend, where possible, the inclusion of a section describing the reasons for the difference between *ex ante* and *ex post* savings—not just a plot of *ex ante* and *ex post* savings by project size.

Recommendation #4: Correct model deficiencies for the Home Energy Analyzer Program. The savings calculation needs to be corrected so that all of the relevant regression variables are used. We also recommend that tests be conducted that can confirm that the control groups are matched appropriately. We recommend that these results not be used to calculate savings for future program years until these issues are corrected.

Recommendation #5: Provide additional detail on evaluation methods. As noted for several programs (e.g., Direct Load Control, Efficient Products, Commercial and Industrial Efficiency, Demand Response, Transmission and Distribution), additional detail on the analysis methods should be included in the evaluation reports. While this information may be available through follow up discussions with FirstEnergy, we strongly recommend that this information be included in the evaluation report (with customer information redacted as needed). This will allow reviewers (particularly those stakeholders that do not have the benefit of requesting additional information from FirstEnergy) to conduct an independent review and ultimately allow for a greater confidence in the results.

Participant Survey Results

A separate component of the Independent Evaluator responsibilities is to conduct a limited process evaluation. For the review of the PY2012 programs, this involved conducting residential and non-residential participant phone surveys for selected programs offered by AEP Ohio, DP&L, Duke Energy, and FirstEnergy. The programs included in this effort are some of the largest contributors to the utilities' reported PY2012 savings and for which customer contact information (including names and phone numbers) was available. A survey of appliance recycling participants was added this year. Results for this effort are reported separately in the report.

The residential programs covered in the participant surveys include:

- AEP Ohio Efficient Products Appliances Program;
- DP&L HVAC Rebates Program;
- Duke Energy Save-a-Watt (SAW) Smart \$aver Residential Program;
- FirstEnergy Energy Efficient Products Program.

The design of these programs improves residential home energy efficiency through the installation of energy efficient refrigerators, freezers, dehumidifiers, water heaters, clothes washers, surge protectors, new HVAC equipment, and replacement or tune-ups of inefficient HVAC equipment.

The residential appliance recycling programs covered in the participant surveys are:

- AEP Ohio Residential Appliance Recycling Program;
- DP&L Residential Appliance Recycling Program;
- FirstEnergy Appliance Turn-In Program.

These programs allow residential customers to recycle old refrigerators, freezers, and room air conditioners for the payment of an incentive as long as the units being recycled are in working condition.

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

- AEP Ohio Prescriptive Program;
- DP&L Non-Residential Prescriptive Rebates Program;
- Duke Energy Save-a-Watt (SAW) Smart \$aver Prescriptive Program; and
- FirstEnergy EnergySave Ohio Commercial & Industrial Programs.

These non-residential programs provide rebates for a variety of measures. The research team focused its surveying efforts 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 lamps and fixtures, LED exit signs, CFLs, and CFL fixtures. Other measures rebated by the non-residential programs and included in the survey are HVAC, motors, heat pumps, and variable frequency drives.

Data Collection and Methodology

Itron collected phone survey data using its Computer Assisted Telephone Interviewing (CATI) Center located in Berkeley, California. Data collection for the participant surveys occurred from late-June through September 2013. All customer contact information came from utility supplied data on their participating customers for each program.

Quotas were established for each program. The quotas were set large enough to ensure that results would be reliable for each utility. A total of 1,263 surveys were conducted across the Ohio utilities entire set of energy efficiency programs. Due to budgetary constraints, the evaluation team did not attempt to survey participants from every program, but rather focused the surveys on programs with significant participation and reported savings.

Quotas by residential program are shown in Table 15 and sum to 500 surveys across the four programs included in the residential participant study. The research team surveyed 507 residential customers across the programs, thereby surpassing the quota. The quota for the three appliance recycling programs for which surveys were implemented was 300. As Table 16 shows, this quota was also surpassed. The non-residential survey quota was 450 across four programs and, as shown in Table 17, the quota was met. Table 15, Table 16, and Table 17 also show the proportion of surveys completed by program included in each of the three survey efforts.

Table 15: Distribution of Residential Participant Surveys by Program

Program	Quota	Completed Surveys	Percent of Total
AEP Ohio Efficient Products	100	100	20%
DP&L HVAC Rebates Program	100	103	20%
Duke Energy SAW Smart \$aver Residential Program	200	202	40%
FirstEnergy Energy Efficient Products Program	100	102	20%
Total	500	507	100%

Table 16: Distribution of Appliance Recycling Participant Surveys by Program

Program	Quota	Completed Surveys	Percent of Total
AEP Ohio Residential Appliance Recycling Program	100	102	33%
DP&L Residential Appliance Recycling Program	100	101	33%
FirstEnergy Appliance Turn-In Program	100	103	34%
Total	300	306	100%

Table 17: Distribution of Non-residential Participant Surveys by Program

Program	Quota	Completed Surveys	Percent of Total
AEP Ohio Prescriptive Program	200	200	44%
DP&L Non-Residential Prescriptive Rebates Program	75	75	17%
Duke Energy SAW Smart \$aver Prescriptive Program	75	75	17%
FirstEnergy EnergySave Ohio Commercial & Industrial Programs	100	100	22%
Total	450	450	100%*\

Topics covered in the participant surveys include verification of participation, program awareness, motivations for participation, barriers to participation, and level of participant satisfaction with program implementation and delivery. The residential and non-residential surveys also included free ridership questions and a battery of questions to clarify these customers' decision-making processes and the extent to which program benefits influenced their decision to purchase new energy efficient equipment and/or perform tune-ups on HVAC equipment.

Residential Participant Survey Results

A summary of the overall residential participant survey findings is presented below. Unless a particular program is identified, findings are discussed in general terms for all programs. Cases of significant differences across programs are noted in the discussion. All program-specific findings for each survey question are included in an Appendix to this report. It should be noted that results presented for sub samples have not been tested for robustness and are included to show trends in customer awareness, participation and satisfaction. They are not necessarily statistically reliable due to small sample sizes.

Confirmation of Participation

The residential participant survey first asked respondents whether they recall the purchase of measures for which they received rebates through the Ohio utility programs. One hundred percent of respondents recalled receiving a rebate for the purchase of energy efficient equipment and therefore were able to confirm their participation (see Table 18).³⁴ Respondents were also asked if the equipment for which they received rebates was still installed in their homes. Virtually all participants indicated that their energy efficient measures were still installed (close to 99 percent across the four programs).

³⁴ Approximately 2% of residential survey respondents recalled participation, but stated that they installed a different quantity than the amount recorded in the utility tracking databases.

Table 18: Verification of Participation in Residential Rebate Programs

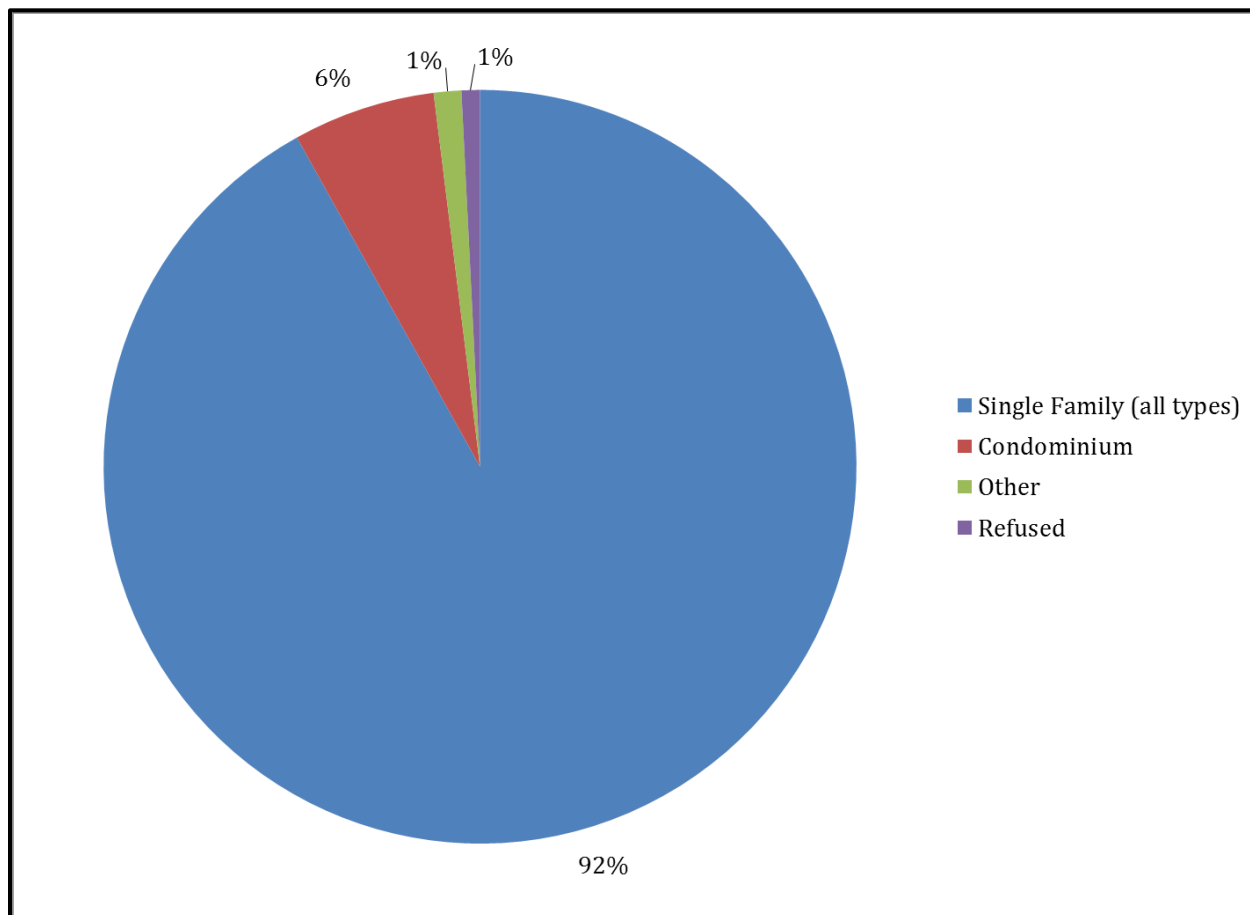
Verification of Participation	All	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Yes	98%	100%	91%	100%	99%
Yes, but a different qty.	2%	0%	9%	0%	1%
No	0%	0%	0%	0%	0%
n	507	102	103	202	102

Demographics

All surveyed participants were asked about their home types. On average, across the four programs, approximately 92 percent live in single-family homes, most of which are detached, as illustrated in Figure 9. Another 6 percent live in condominiums. Virtually all participants who were surveyed stated that they own the homes in which they live (over 97 percent). Since the home ownership rate in Ohio is approximately 70 percent according to Census data³⁵, this suggests that rental units may be underserved by the Ohio utility programs.

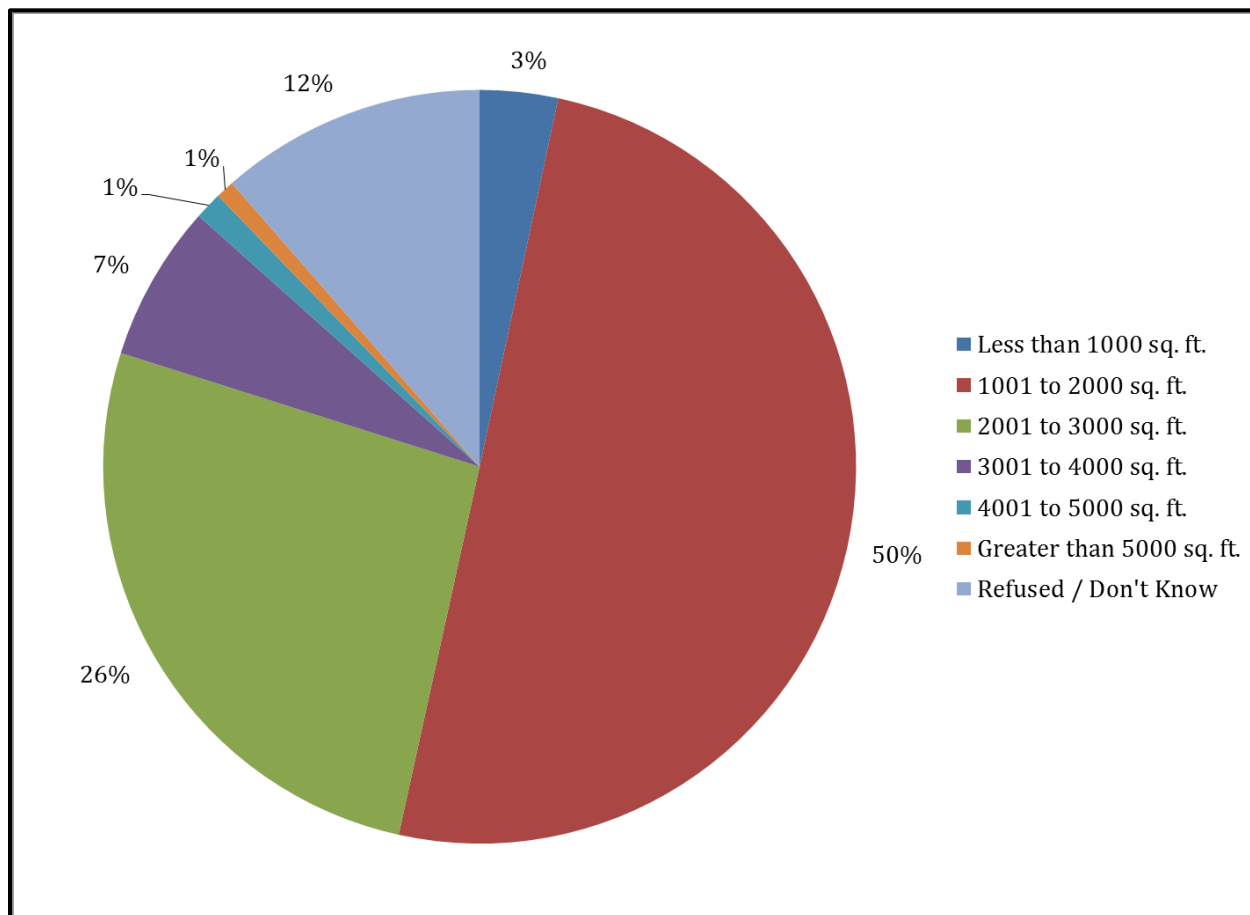
³⁵ <http://quickfacts.census.gov/qfd/states/39000.html>

Figure 9: Home Types Represented by Ohio Residential Program Participant Surveys (n=507)



As shown in Figure 10, 53 percent of respondents state their homes are 2,000 square feet or less. Another 26 percent of participants reside in homes that are between 2,001 and 3,000 square feet in size. Homes greater than 3,000 square feet make up less than 10 percent of all residences in Ohio based on the survey findings. This type of information provides some context regarding the types of residential structures into which participants are installing rebated energy efficient measures.

Figure 10: Home Sizes Represented by Ohio Residential Program Participant Surveys (n=507)



Program Awareness

The survey next asked participants how they first heard of the programs in which they participated. As shown in Figure 11, close to 70 percent of the residential participants in the AEP Ohio Efficient Products program learned of the programs from retailers or salespeople in stores. Retailers were a first source of information about FirstEnergy's Energy Efficient Products program for about 30 percent of the participants of this particular program. However, the primary source of awareness for Duke's Residential Smart \$aver program and DP&L's HVAC rebate program were contractors and installers. In fact, almost 60 percent of the participants of Duke's program first learned of it through contractors and/or installers, while 47 percent of DP&L's participants heard about this utility's program through this source. Detailed findings for each of the programs are presented in Table 19.

Figure 11: First Source of Information about Residential Rebate Programs

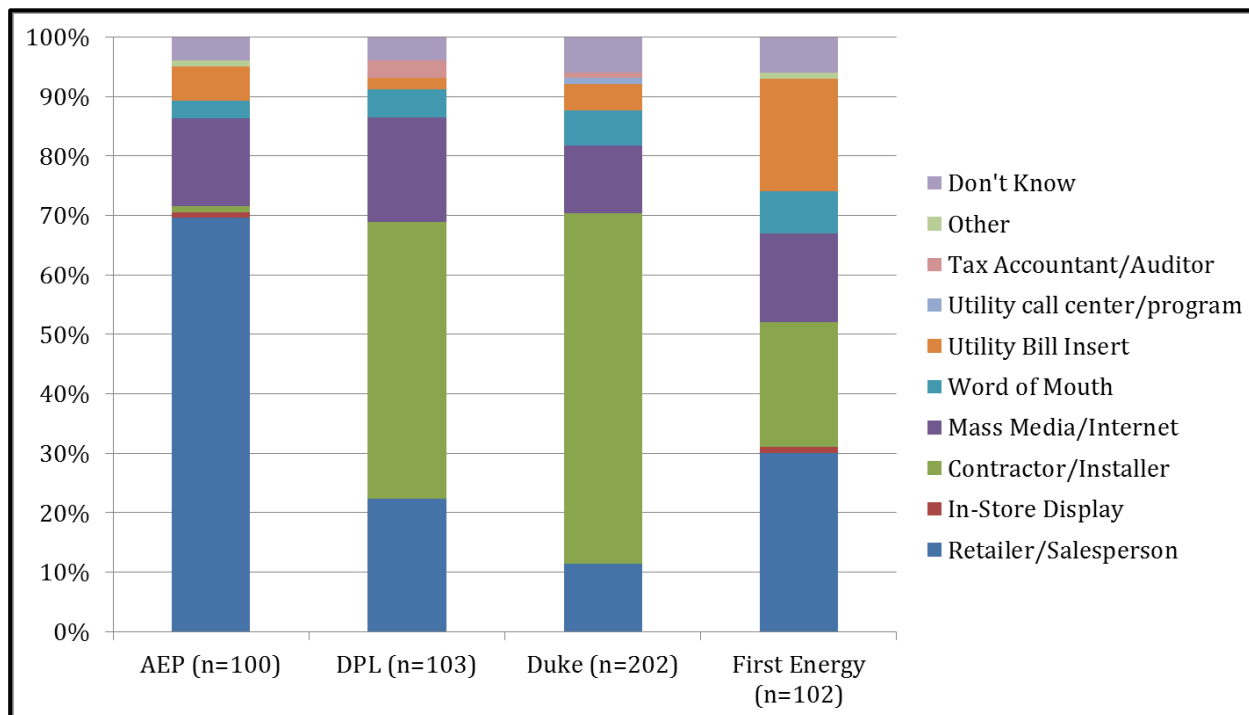


Table 19: First Source of Information about Residential Rebate Programs*

First Source of Program Awareness	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Retailer/Salesperson	70%	22%	11%	30%
Contractor/Installer	1%	47%	59%	21%
Mass Media/Internet	15%	17%	11%	15%
Word of Mouth	3%	5%	6%	7%
Utility Bill Insert	6%	2%	4%	19%
Utility call center/program	0%	0%	1%	0%
Tax Accountant/Auditor	0%	3%	1%	0%
In-Store Display	1%	0%	0%	1%
Other	1%	0%	0%	1%
Don't Know	4%	4%	6%	6%
n	100	103	202	102

*Total percentages may not sum to 100% due to rounding.

Participants were also asked who completed the applications to receive rebates for the purchases of energy efficient measures through each of the programs. As shown in Figure 12, an overwhelming majority of the participants of AEP Ohio's and FirstEnergy's Energy Efficient Products programs completed their own applications (81 percent and 80 percent, respectively). Applications submitted by the participants of DP&L's and Duke Energy's two programs were completed mostly by contractors, with only about 30% by the participants themselves. This makes sense since DP&L's and Duke's programs provided rebates solely for HVAC equipment and it is common for contractors to take it upon themselves to complete these rebate applications for their customers.

Figure 12 shows the proportion of respondents who filled out their own applications, had them filled out by contractors, or had them filled out by other means (or, as a few participants stated, did not have an application to fill out at all) across each of the four programs.

Figure 12: Who Filled Out Rebate Application for Residential Programs?

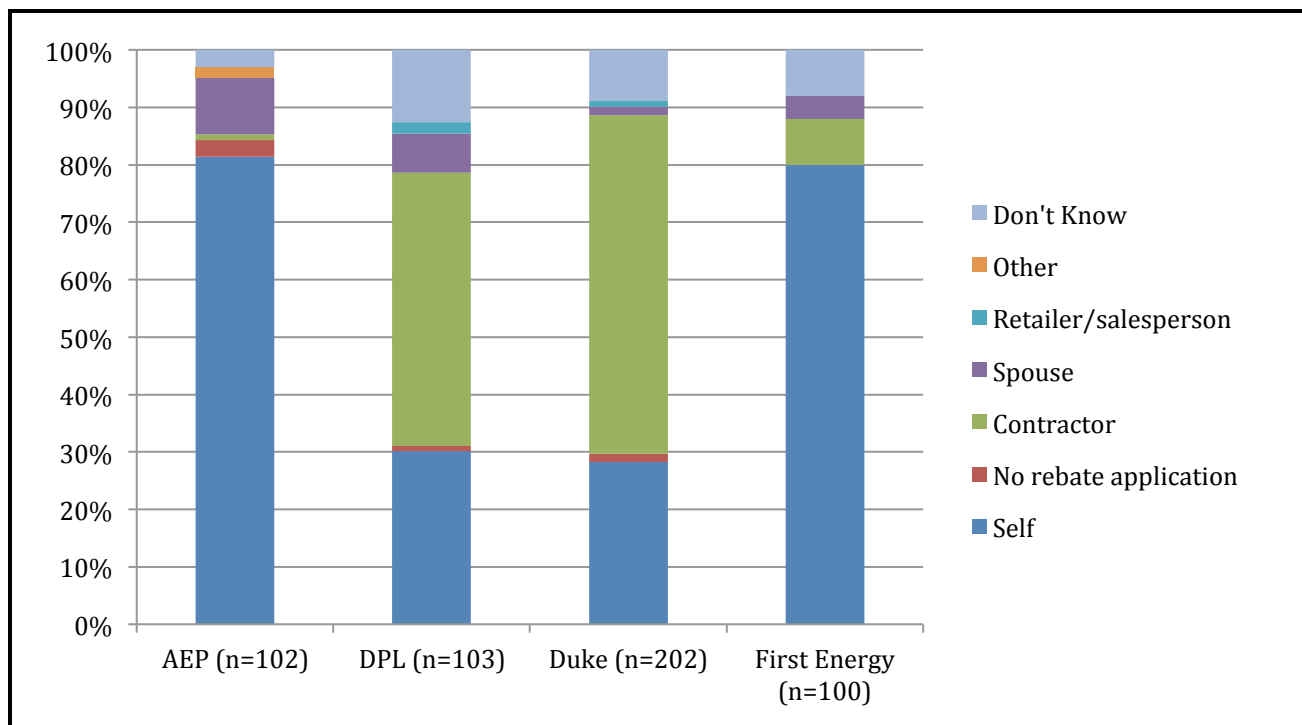


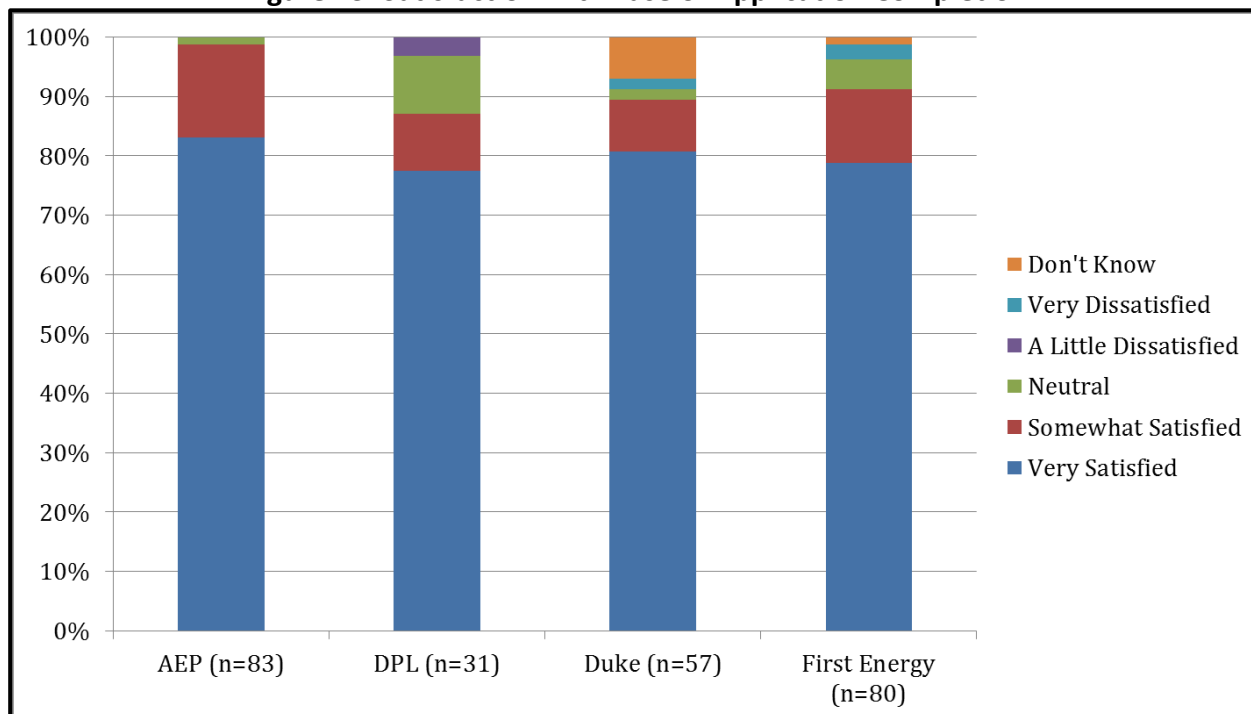
Table 20: Who Filled Out Rebate Application for Residential Programs*

Who completed the rebate application?	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Self	81%	30%	28%	80%
No rebate application	3%	1%	1%	0%
Contractor	1%	48%	59%	8%
Spouse	10%	7%	1%	4%
Retailer/salesperson	0%	2%	1%	0%
Other	2%	0%	0%	0%
Don't Know	3%	13%	9%	8%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

The 251 participants who filled out their own applications were then asked how satisfied they were with the ease of filling out the application. As Figure 13 shows, satisfaction levels were quite high, with 85 percent or more participants stating that they were somewhat to very satisfied with how easy it was to complete program applications. In fact, more than three out of every four participants indicated they were very satisfied across each of the programs. Simplicity of the application process often eliminates a potential barrier that sometimes deters residential customers from participating in a program.

Figure 13: Satisfaction with Ease of Application Completion



Experience with HVAC Contractors

Participants who purchased rebated HVAC measures were asked a series of questions about their experience with the contractors who installed the equipment. HVAC equipment was rebated by three of the four programs that were included in this participant survey. Certain programs are geared specifically towards the sale of HVAC equipment; therefore all the participants in these programs were asked these contractor-related questions. All the rebates provided by AEP Ohio and most of those from FirstEnergy were for energy efficient appliances so the questions related to HVAC contractors were not asked of these participants.

HVAC program participants were asked whether or not their contractor informed them of the availability of a rebate. These participants were also asked if their contractor made a recommendation to purchase a higher efficiency measure over measures of a standard efficiency level. In this case, answers varied across the programs. A majority of participants (with the exception of those in the FirstEnergy's Energy Efficient Products program) did receive a recommendation to purchase HVAC equipment that was higher than standard efficiency (see Figure 14). The percentage of participants who did receive this recommendation is equal to 59 percent for DP&L participants and 67 percent of the HVAC participants of Duke's program. Only a third of FirstEnergy's participants received this same recommendation.

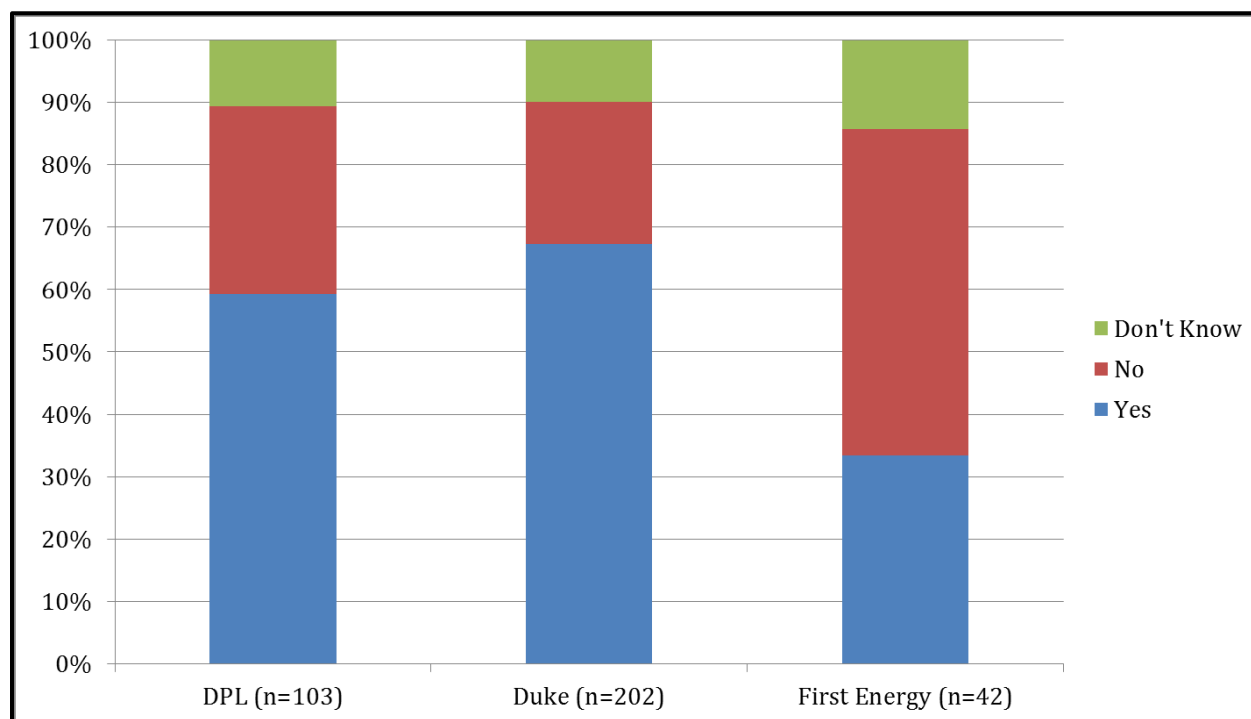


Table 21 presents the proportion of participants who did and did not receive these recommendations from contractors.

Figure 14: Contractor Recommended Higher Efficiency HVAC Equipment

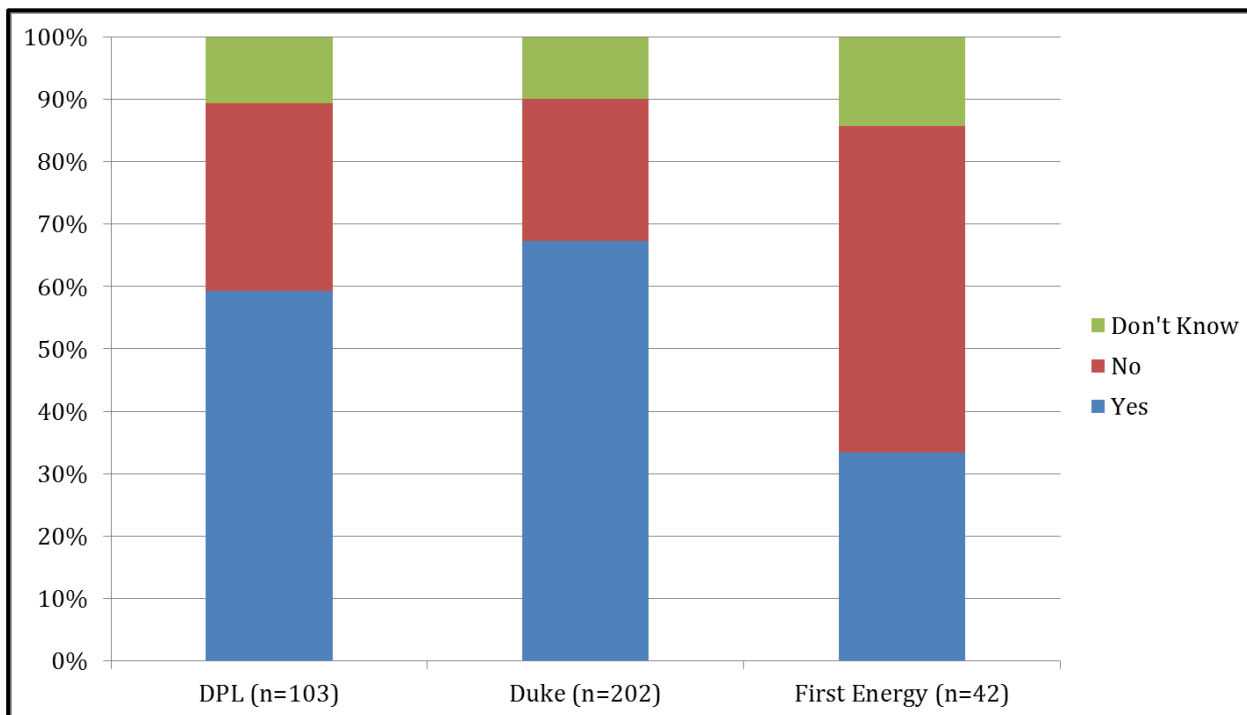


Table 21: Contractor Recommended Higher Efficiency HVAC Equipment*

Contractor recommended purchase of higher efficiency equipment?	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Yes	59%	67%	33%
No	30%	23%	52%
Don't Know	11%	10%	14%
n	103	202	42

*Total percentages may not sum to 100% due to rounding.

Next, participants who purchased HVAC program-qualifying measures were asked how satisfied they were with the contractor who installed the equipment. An overwhelming majority of participants in these three programs were very satisfied with the contractors who made the installations (see Figure 15). Note that HVAC measures were not a part of AEP Ohio's Efficient Products program, so none of these participants were asked this question. The percentage of very satisfied participants was equal

to 81 of the surveyed FirstEnergy participants and 89 percent of Duke's program participants.

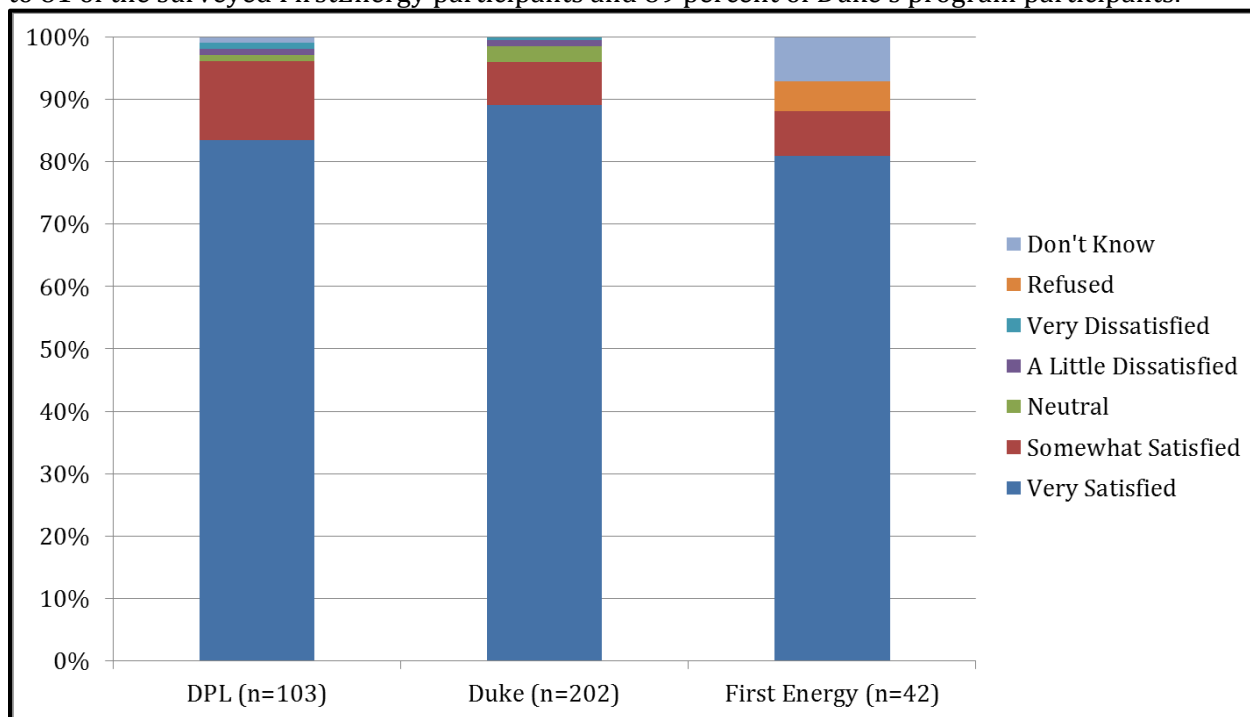


Table 22 presents the satisfaction ratings given by participants for the HVAC contractors who installed their equipment.

Figure 15: Satisfaction with Contractor Who Installed HVAC Equipment

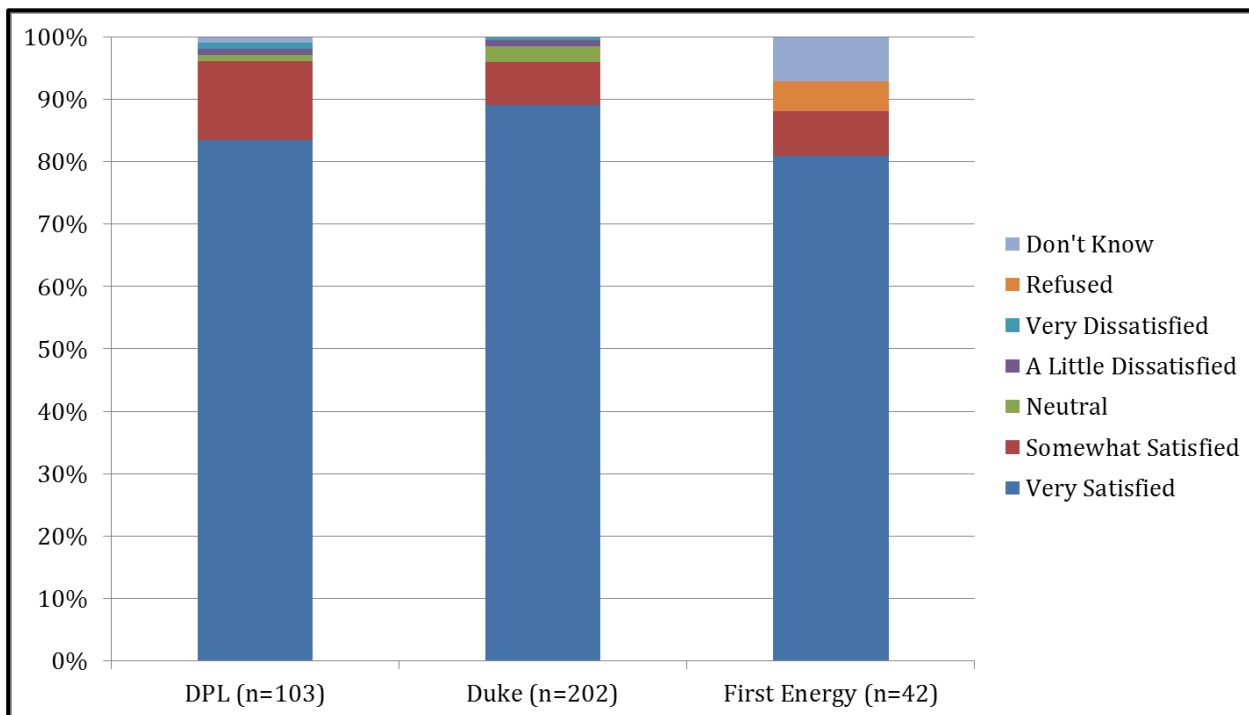


Table 22: Satisfaction with Contractor Who Installed HVAC Equipment*

Satisfaction with contractor who installed HVAC equipment	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Very Satisfied	83%	89%	81%
Somewhat Satisfied	13%	7%	7%
Neutral	1%	2%	0%
A Little Dissatisfied	1%	1%	0%
Very Dissatisfied	1%	0%	0%
Refused	0%	0%	5%
Don't Know	1%	0%	7%
n	103	202	42

*Total percentages may not sum to 100% due to rounding.

Barriers to Participation

A variety of barriers are encountered by customers who purchase energy efficient equipment. This section presents participants' assessments of the magnitude of certain barriers, including their knowledge about ways they can save energy in their homes, the importance of saving energy, the effect of budget constraints on their purchasing decisions, and the difficulty of gaining expertise about energy efficient measures.

To get a sense of how familiar Ohio utility customers are about ways they can save energy in their homes, program participants were asked to rate their level of knowledge regarding this issue. As Figure 16 shows, a majority of customers feel they are somewhat knowledgeable (57 to 63 percent), with a sizeable proportion also saying they are very knowledgeable (35 to 42 percent) about ways they can save energy. Customers were then asked if energy efficiency was considered a high, medium, low, or not a priority when they make purchases of appliances, heating and cooling equipment, and other purchases (such as lighting and electronics). An overwhelming majority of participants across all of the programs noted that energy efficiency is a high priority to them as

Table 23 shows. Based on customer responses to these questions, their understanding of energy efficiency and their commitment to it do not appear to be barriers to program participation.

Figure 16: Level of Knowledge About Saving Energy in the Home

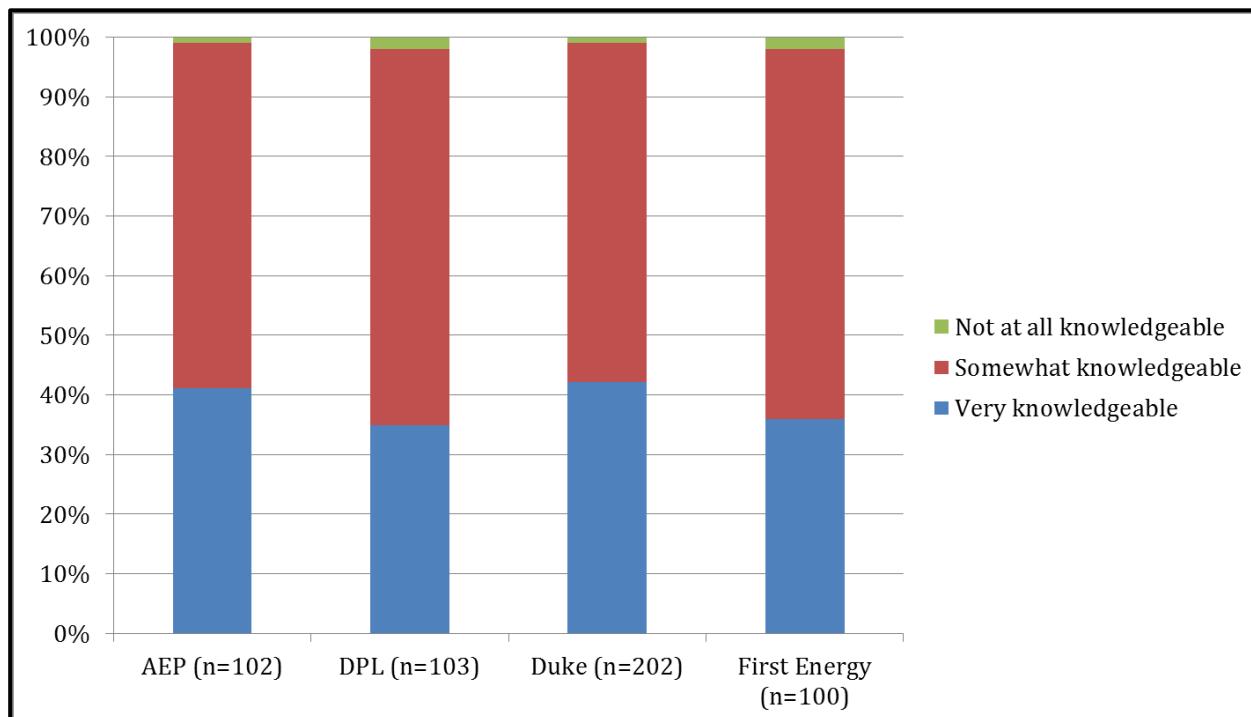


Table 23: Priority of Energy Efficiency When Purchasing Appliances, HVAC, or Other Measures*

Priority Level of EE in equipment purchases	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart \$aver Residential	FirstEnergy Energy Efficient Products
High Priority	61%	68%	67%	70%
Medium Priority	34%	27%	29%	23%
Low Priority	3%	3%	3%	2%
Not a Priority	2%	2%	0%	3%
Refused	0%	0%	0%	2%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Respondents were also asked how much of an obstacle budget constraints are to making investments in energy efficient equipment. Figure 17 shows that answers do not deviate much across the programs, leading to the conclusion that financial barriers are viewed similarly regardless of the type of energy efficient equipment being purchased. Results show that between 20 to 25 percent of participants claim budget constraints are a large obstacle. The majority of participants consider this a medium-sized obstacle, ranging from 44 to 49 percent. Detailed findings across the programs are also shown in Table 24.

Figure 17: Budget Constraint as an Obstacle to Making Investments in Residential EE Equipment

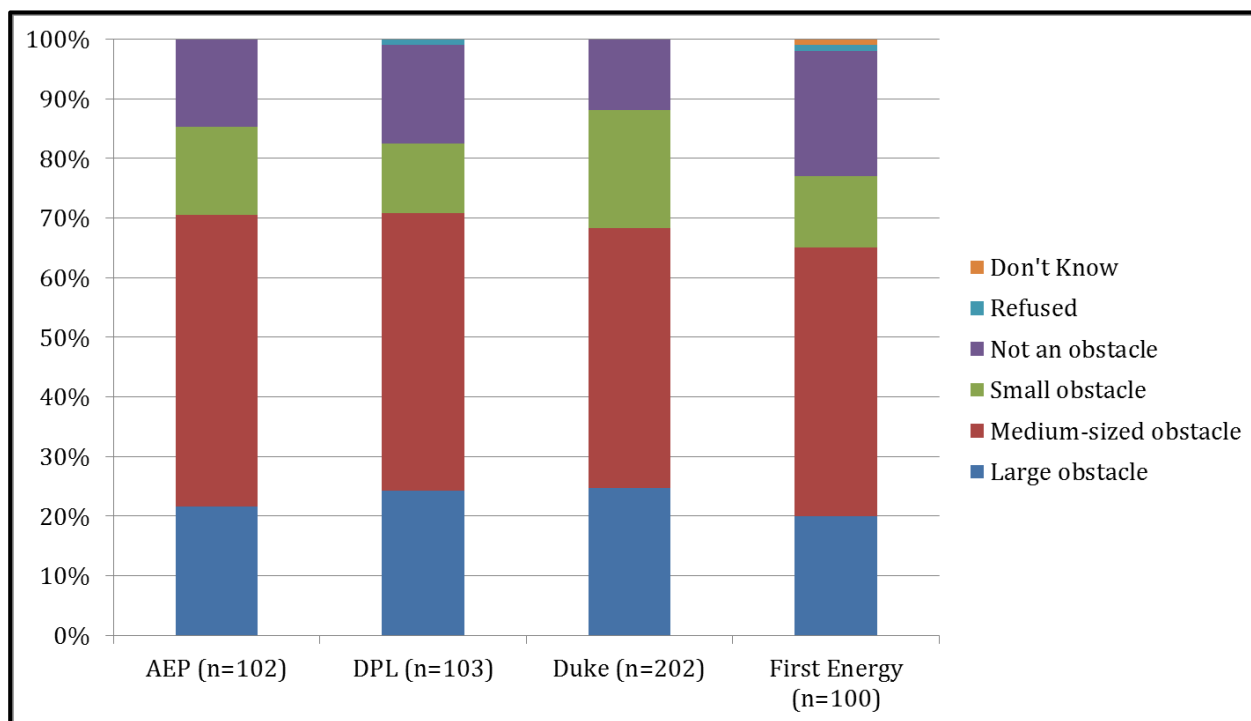


Table 24: Budget Constraint as an Obstacle to Making Investments in Residential EE Equipment *

Budget Constraints as an Obstacle	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart \$aver Residential	FirstEnergy Energy Efficient Products
Large obstacle	22%	24%	25%	20%
Medium obstacle	49%	47%	44%	45%
Small obstacle	15%	12%	20%	12%
Not an obstacle	15%	17%	12%	21%
Refused	0%	1%	0%	1%
Don't Know	0%	0%	0%	1%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Participants were also asked about whether they think gaining the expertise necessary to buy energy efficient appliances or heating and cooling equipment is an obstacle in making the purchase. Based on the limited number of responses, sampled participants seem to consider this less of an obstacle than budget constraints (see Figure 18 and

Table 25 compared to Figure 17 and Table 24). Only between 9 and 16 percent consider this a large obstacle while 28 to 43 percent of the participants across the programs describe it as a medium-sized obstacle. About one-third of the participants stated that it is not an obstacle at all. While fewer respondents seem to consider gaining expertise as a smaller obstacle than budget constraints, it is important to note that this is still an obstacle since 37 to 53 percent called gaining expertise a medium to large obstacle in making investments in energy efficient equipment. This report does make a comparison across these barriers; however the limited number of responses does not allow us to state with reliability that these differences are statistically significant.

Figure 18: Gaining Expertise as an Obstacle to Making Investments in Residential EE Equipment

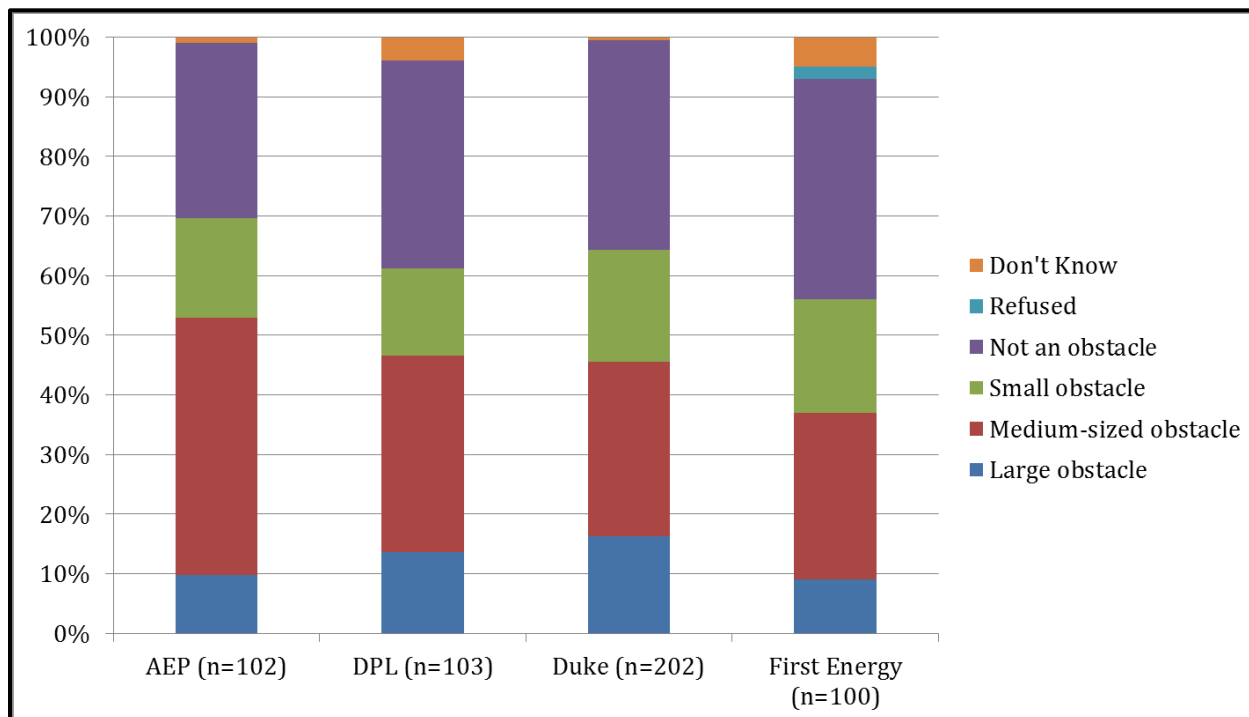


Table 25: Gaining Expertise as an Obstacle to Making Investments in Residential EE Equipment*

Gaining Expertise as an Obstacle	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart \$aver Residential	FirstEnergy Energy Efficient Products
Large obstacle	10%	14%	16%	9%
Medium obstacle	43%	33%	29%	28%
Small obstacle	17%	15%	19%	19%
Not an obstacle	29%	35%	35%	37%
Refused/Don't Know	1%	4%	0%	7%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Program Satisfaction

Participants were asked a series of questions to determine their levels of satisfaction with various aspects of the programs in which they participated. Questions about customer satisfaction with the rebate amount received, length of time it took to receive their rebate, the energy efficient equipment purchased, and the utility program overall were asked of participants.

First, respondents were asked about their level of satisfaction with the amount of the rebate they received. The results show a high level of satisfaction with this program attribute as can be seen in Figure 19 and Table 26. Over 80 percent of participants across the programs stated that they are somewhat or very satisfied with the rebate amount received for their purchases of program qualifying equipment. Five percent or less of residential participants across the programs noted that they were very dissatisfied with the amount of the rebate.

Figure 19: Satisfaction with Rebate Amount Received

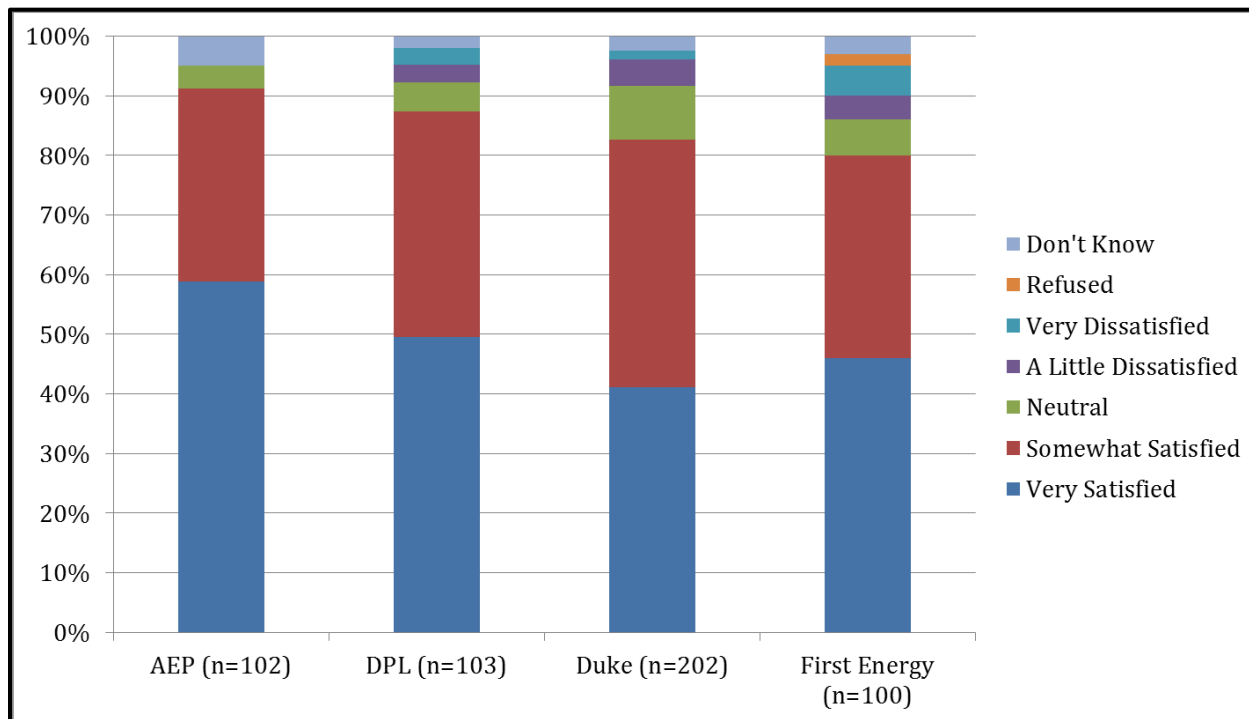


Table 26: Satisfaction with Rebate Amount Received*

Satisfaction with Rebate Amount	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Very Satisfied	59%	50%	41%	46%
Somewhat Satisfied	32%	38%	42%	34%
Neutral	4%	5%	9%	6%
A Little Dissatisfied	0%	3%	4%	4%
Very Dissatisfied	0%	3%	1%	5%
Refused	0%	0%	0%	2%
Don't Know	5%	2%	2%	3%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Customers who filled out and submitted their own rebate applications were asked how long it took to receive their checks. On average, 79 percent of the limited number of participants who did submit their own rebate applications (n=166) stated that they received their rebate checks within eight weeks of the date they submitted their application. All respondents were then asked if they were satisfied with the length of time it took to receive their rebates and as Figure 20 and

Table 27 show, between 73 and 95 percent stated that they were somewhat or very satisfied. The only notable difference across the programs is that over 10 percent of participants of the First Energy Efficient Products program stated they were very dissatisfied with how long it took to receive rebates. Note that this sub-sample of participants is not large and therefore these results have not been tested for robustness. They are presented instead to show trends in satisfaction and possible areas for improvements.

Figure 20: Satisfaction with Length of Time to Receive Rebate

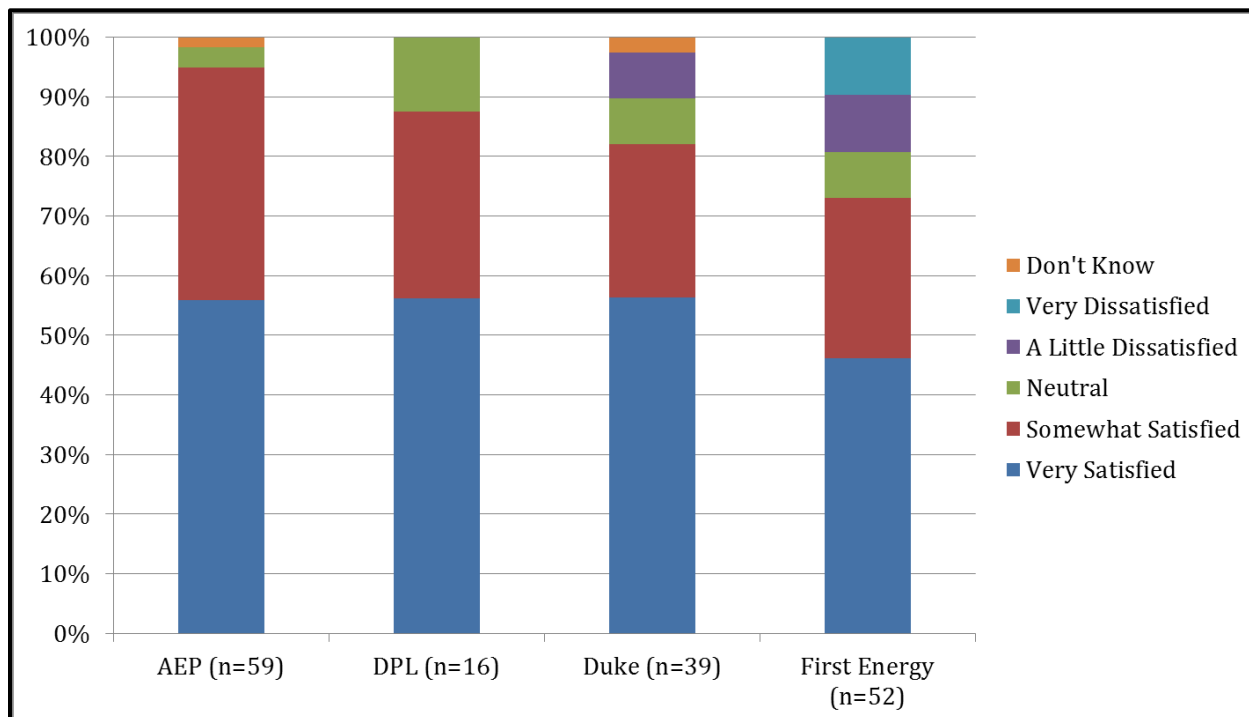


Table 27: Satisfaction with Length of Time to Receive Rebate *

Satisfaction with Time it Took to Receive Rebate	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Very Satisfied	56%	56%	56%	46%
Somewhat Satisfied	39%	31%	26%	27%
Neutral	3%	13%	8%	8%
A Little Dissatisfied	0%	0%	8%	10%
Very Dissatisfied	0%	0%	0%	10%
Don't Know	2%	0%	3%	0%
n	59	16	39	52

*Total percentages may not sum to 100% due to rounding.

Participants were also asked if they noticed any savings on their energy bill after installing new equipment, and, on average, 57 percent of the participants across programs stated that they did notice savings. This varied from a high of 78 percent of participants noticing savings in Duke Energy's SAW HVAC program to a low of 30 percent of the participants in AEP Ohio's Energy Efficient Products program seeing cost savings on their energy bills.

Of those participants who noticed monetary savings on their energy bills, the survey asked how satisfied they were with these savings. For all of the programs, virtually all participants reported being very or somewhat satisfied (see Table 28 and Figure 21 below). About 98 percent of participants across the programs were somewhat to very satisfied. Note that those respondents who did not notice any bill savings were not asked this question. Findings shown below should be viewed in this context.

Figure 21: Level of Satisfaction with Energy Bill Savings

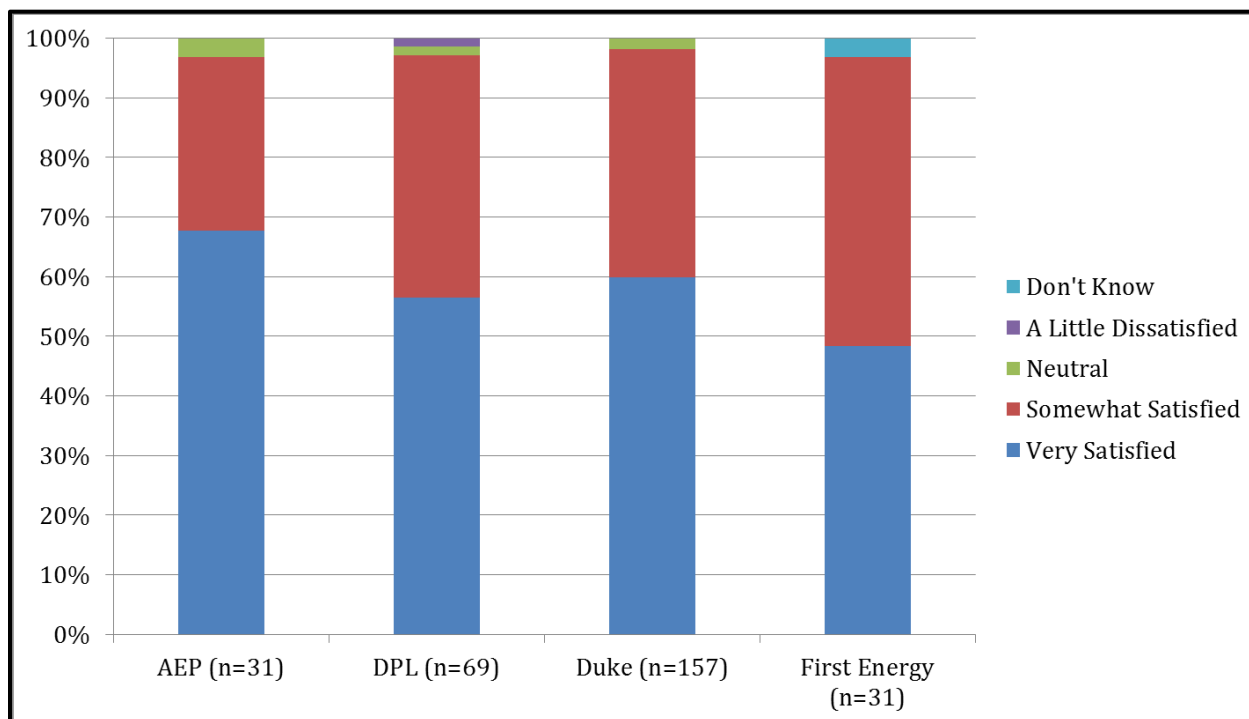


Table 28: Level of Satisfaction with Energy Bill Savings

Satisfaction with Energy Bill Savings	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Very Satisfied	68%	57%	60%	48%
Somewhat Satisfied	29%	41%	38%	48%
Neutral	3%	1%	2%	0%
A Little Dissatisfied	0%	1%	0%	0%
Don't Know	0%	0%	0%	3%
n	31	69	157	31

*Total percentages may not sum to 100% due to rounding.

When asked about overall satisfaction with the residential rebate programs, participants across the programs had similar responses. Figure 22 and Table 29 show that at least 60 percent of participants across all of the programs were very satisfied, and an average of 89 percent were very to somewhat satisfied. These results support the generally high satisfaction ratings participants gave to various program attributes as reported above.

Figure 22: Overall Level of Satisfaction with Residential Rebate Program

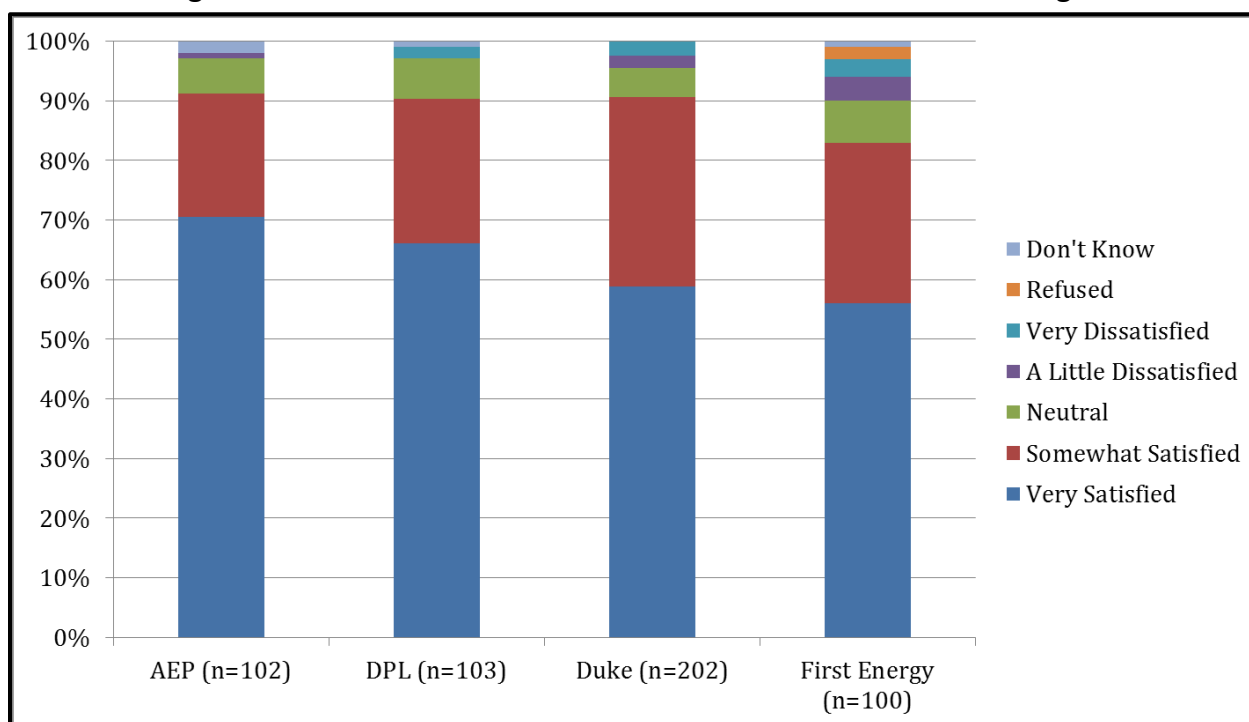


Table 29: Overall Level of Satisfaction with Residential Rebate Program

Overall Satisfaction with Rebate Program	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart \$aver Residential	FirstEnergy Energy Efficient Products
Very Satisfied	71%	66%	59%	56%
Somewhat Satisfied	21%	24%	32%	27%
Neutral	6%	7%	5%	7%
A Little Dissatisfied	1%	0%	2%	4%
Refused	0%	0%	0%	2%
Don't Know	2%	1%	0%	1%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Free Ridership

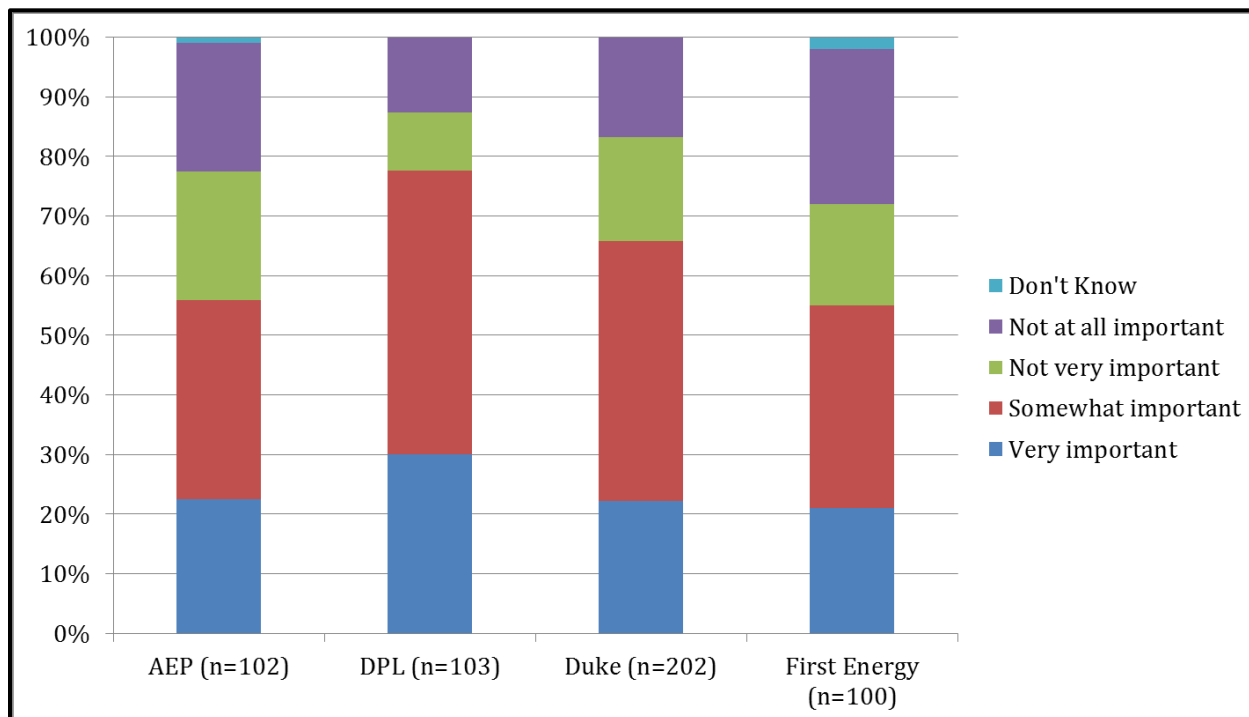
As discussed earlier in this report, one of the goals of the participant survey was to gauge the potential for free ridership among current program participants. All programs will likely have some level of free riders, or participants who would have purchased energy efficient equipment without program rebates. The purpose of asking several free ridership questions in this survey is to determine the significance of this issue in the energy efficiency programs offered by the Ohio utilities.

Measuring free ridership is a complex process that requires more than just reviewing responses to a few questions 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. However, even answers to 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 same equipment even if a rebate were not available.

The results of these questions do indicate that there is likely some level of free ridership with the programs examined. A more complete analysis of these survey questions using a scoring algorithm to calculate free ridership is presented in the final chapter of this report. With this context in mind, the responses to the individual questions relating to free ridership are presented below.

The first of the free ridership test questions asked program participants how important the rebate was to their decision to purchase energy efficient equipment. Based on the responses presented in Figure 23, participants in the programs had similar views about the importance of the rebate. Across the programs, between 55 and 78 percent of participants said the rebate was somewhat to very important in their decisions.

Figure 23: Importance of Rebate on Decision to Purchase EE Equipment



Participants were also asked when they learned about the rebate – before, during, or after making the decision to purchase the energy efficient equipment. Presumably if a customer learned about the rebate after deciding what equipment to buy, the rebate was not instrumental in the decision to purchase it and the participant would be considered a free rider. As shown in Table 30, 23 to 41 percent of the participants learned about the rebate after making a decision about the type of energy efficient equipment to purchase (23 percent for DP&L’s HVAC Rebates program to 41 percent for FirstEnergy’s Efficient Products program). This indicates some level of free-ridership in the programs included in the survey effort.

Table 30: When Participants Learned About Rebate

When participants learned about the rebate	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart Saver Residential	FirstEnergy Energy Efficient Products
Before deciding	33%	43%	38%	33%
After deciding	25%	23%	33%	41%
While researching/shopping	40%	31%	28%	21%
Don't Know	1%	3%	1%	5%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Participants were next asked about the type of equipment they would have purchased had the rebate not been available to them. Table 31 shows that about 80 percent of the respondents across the programs said they would buy the same equipment, which suggests a high level of free ridership. The answers presented in Table 31 seem to indicate levels of free ridership contradictory to the answers supplied by participants about the importance of the rebate as shown in Figure 23, however.

These responses illustrate the challenge of estimating free ridership from these types of questions, as answers are not always consistent across questions. This issue is addressed in more detail in the next chapter where the survey responses are scored to create a single free ridership estimate.

Table 31: Type of Equipment That Would Have Been Purchased Without Rebate

Type of Equipment Would have Purchased Without Rebate	AEP Ohio Efficient Products	DP&L HVAC Rebates	Duke Energy SAW Smart \$aver Residential	FirstEnergy Energy Efficient Products
Same equipment	80%	70%	82%	82%
Bought less expensive/less efficient equipment	17%	20%	15%	8%
Would not have bought anything	2%	4%	1%	6%
Don't Know	1%	6%	1%	4%
n	102	103	202	100

*Total percentages may not sum to 100% due to rounding.

Summary: Key Findings and Recommendations

Program Awareness

The utilities should continue to encourage contractors and equipment vendors to inform potential program participants of the available equipment rebates, particularly those contractors and installers of HVAC equipment. Generally speaking, contractors/installers are a key influence in driving program enrollment. Retailers also play a key role in informing customers about the rebate programs offered by the Ohio utilities, and as the sellers of rebated equipment, should also be encouraged to advertise the utilities programs in the future. By continuing to inform customers of incentives, the Ohio utilities will achieve additional energy savings from customers replacing or improving the operations of older, less efficient appliances, lighting, and HVAC equipment.

Barriers to Participation

The survey asked participants about potential barriers to participation. The only significant barrier to making investments in energy efficient equipment was found to be budget constraints, since energy efficient equipment oftentimes requires a larger upfront investment than standard equipment.

Understanding how to save energy in the home and customer interest in prioritizing energy efficiency when they make purchases of appliances, and heating and cooling equipment do not appear to be barriers to participation in the energy efficiency programs offered by Ohio utilities. Having an understanding of the availability of energy efficient equipment and gaining access to this equipment were not considered a barrier to participation either.

Program Satisfaction

Generally speaking, participants expressed satisfaction with the utility programs in which they participated. They noted their satisfaction with the application process, the size of the rebates received, and the length of time it took to receive their rebates.

Approximately 79 percent of the surveyed participants received their rebates within two months of submitting their applications. Based on customer feedback, this amount of time processing rebates appears satisfactory to most of the participants.

Participants were also asked if they noticed any savings on their energy bill after installing new equipment and on average, 57 percent of the participants across programs stated that they did notice savings. Those who did notice energy bill savings expressed high levels of satisfaction with the savings obtained. With increasingly better tools becoming available for energy management, it is possible that the percentage of participants who notice bill savings may increase in the future. If this is the case, it may lead to increased satisfaction with bill savings, and consequently program participation, as the programs operate in the future.

Appliance Recycling Participant Survey Results

The Evergreen team added a review this year of the Ohio IOU's residential appliance recycling program. Since this is the first time this program has been surveyed by the team, the results have been broken out separately.

The residential appliance recycling programs covered in the participant surveys are:

- AEP Ohio Residential Appliance Recycling Program,
- DP&L Residential Appliance Recycling Program, and
- FirstEnergy Appliance Turn-In Program.

These programs provide residential customers with an opportunity to recycle old refrigerators and freezers as long as they are in working condition. The AEP and DP&L programs allow customers to also recycle working room air conditioners if picked up at the same time as a refrigerator or freezer, although savings from room ACs were not included in the program metrics. In exchange, the programs offer rebates ranging from \$25 to \$50 (depending on the utility and the type of equipment recycled). Households are allowed to recycle more than one appliance or room AC at a time and are allowed to have equipment picked up multiple times from the same household.³⁶ These programs

³⁶ In FirstEnergy's Appliance Turn-In program description, there are limits on the number of units that can be recycled in a calendar year. An individual household is allowed to recycle up to two refrigerators or freezers and up to two room ACs that are picked up at the same time as a refrigerator/freezer. No quantity limits are

were designed to retire and recycle inefficient appliances and room ACs that are often kept in use as secondary or backup units.^{37 38 39}

A summary of the overall appliance recycling participant survey findings is presented below. Unless a particular program is identified, findings are discussed in general terms for all programs. Cases of significant differences across programs are noted in the discussion.⁴⁰ All program-specific findings for each survey question are included in an Appendix to this report. It should be noted that results presented for sub samples have not been tested for robustness and are included to show trends in customer awareness, participation, and satisfaction. They are not necessarily statistically reliable due to small sample sizes.

Confirmation of Program Incentive Receipt

The appliance recycling participant survey first asked respondents whether they recall receiving incentives through the Ohio utility programs in which they participated. The survey asked about incentives for up to two measure types recycled by a participant. Out of 306 surveyed participants who recycled at least one measure, 99 percent recalled receiving an incentive for recycling a refrigerator, freezer, or room air conditioner. Of the 306 surveyed participants, 34 of them recycled two different measure types (for example, a freezer and a refrigerator) according to the program tracking data provided by the Ohio utilities. All 34 of these participants confirmed the receipt of an incentive and recycled one unit of the second measure type. Table 32 summarizes the percentage of respondents who confirmed the receipt of an incentive for the recycling of program measures.

Table 32: Confirmation of Incentive Received from Appliance Recycling Program

	Recycled One Measure Type	Recycled Two Measure Types
Confirmed Participation	99%	100%
Did Not Confirm Participation	1%	0%
n	306	34

Table 33 displays the percentage of each measure type recycled for the two measure types that the survey addressed. Approximately 95 percent of all respondents recalled recycling refrigerators or freezers as their first measure recycled (76 percent refrigerators and 19 percent freezers). The remaining participants recycled room air conditioners as their first measure type. Of the 34

mentioned in DP&L and AEP Ohio's program descriptions and the tracking data show more than 4 different measure types picked up for some households.

³⁷ 2012 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs, Volume 1. Prepared by AEP Ohio. Submitted to Public Utilities Commission of Ohio. 15 May 2013.

³⁸ 2012 Energy Efficiency and Demand Reduction/Response Portfolio Status Report. Prepared by Dayton Power and Light. Submitted to Public Utilities Commission of Ohio. 15 May 2013.

³⁹ 2012 Appliance Turn-In Program Impact and Process Evaluation Report. Prepared by ADM Associates, Inc. Submitted to FirstEnergy Ohio Companies. 2013.

⁴⁰ Not necessarily statistically significant differences as these statistical tests have not been performed for this process evaluation.

respondents who recycled a second measure type, close to two-thirds recycled refrigerators and just over one-third recycled freezers.

Table 33: Measure Types Recycled through Appliance Recycling Program*

Measure Type Recycled	First Measure Type	Second Measure Type
Refrigerator	76%	62%
Freezer	19%	38%
Room air conditioners	4%	0%
n	306	34

*Total percentages may not sum to 100% due to rounding.

Participants of the appliance recycling programs in Ohio are allowed to have more than one unit picked up at a time for recycling. The appliance recycling programs offered by DP&L and AEP Ohio programs do not limit the number of units that can be recycled. However based on the tracking data, it appears that most participants had only one unit picked up for recycling. Table 34 shows that of the 292 participants who recycled refrigerators or freezers as their first measure type, 97% recycled one unit.

Table 34: Refrigerator/Freezer Units Recycled (First Measure) through Appliance Recycling Program

	Respondents	Percent of Total
Recycled 1 Unit	283	97%
Recycled 2 Units	9	3%
Total	292	100%

Of the subset of participants who recycled a single refrigerator or freezer, close to 60 percent said the unit was still in use when it was picked up for recycling (see Table 35). Approximately 34 percent indicated that the units were not in use but still in working condition. A small fraction of participants stated that the unit they recycled was broken. These units should not have been picked up for recycling, as appliances are only eligible for pickup, per the program guidelines, if they were in working condition.

Table 35: Condition of Refrigerator/Freezer (First Measure) when Recycled through Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
In Use	60%	58%	57%	65%
Not in Use but in Good Operating Condition	34%	35%	34%	32%
Broken	5%	6%	6%	3%
Don't Know	1%	1%	3%	0%
n	283	95	95	93

*Total percentages may not sum to 100% due to rounding.

The subset of participants with a refrigerator or freezer still in use at the time it was picked up for recycling was then asked if they were using it as a main unit or as a secondary/spare unit. The survey results presented in Table 36 show that 47 percent of the 175 in-use units were being used as main units, while 49 percent were being used as spares.

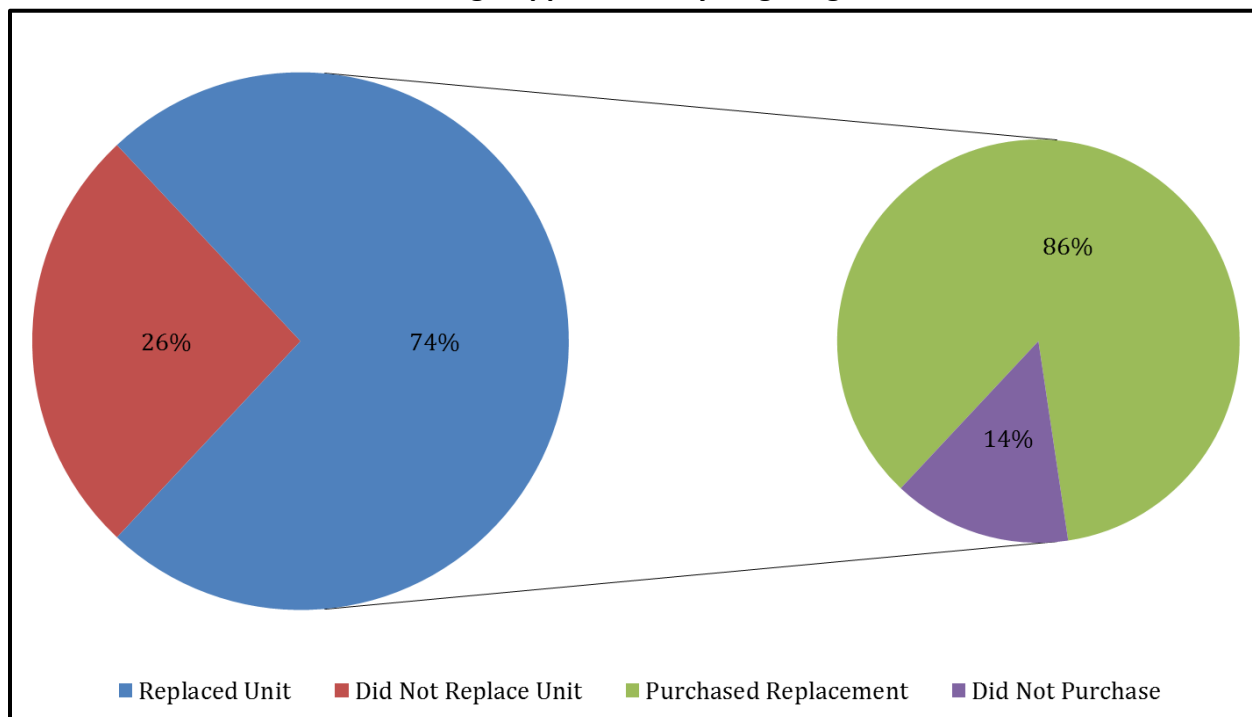
Table 36: In-Use Refrigerators/Freezers Recycled through Appliance Recycling Program that Served as Main versus Secondary Units*

	All Programs	AEP	DPL	First Energy
Main	47%	43%	42%	57%
Secondary/Spare	49%	53%	53%	42%
Neither	3%	3%	5%	2%
n	175	58	57	60

*Total percentages may not sum to 100% due to rounding.

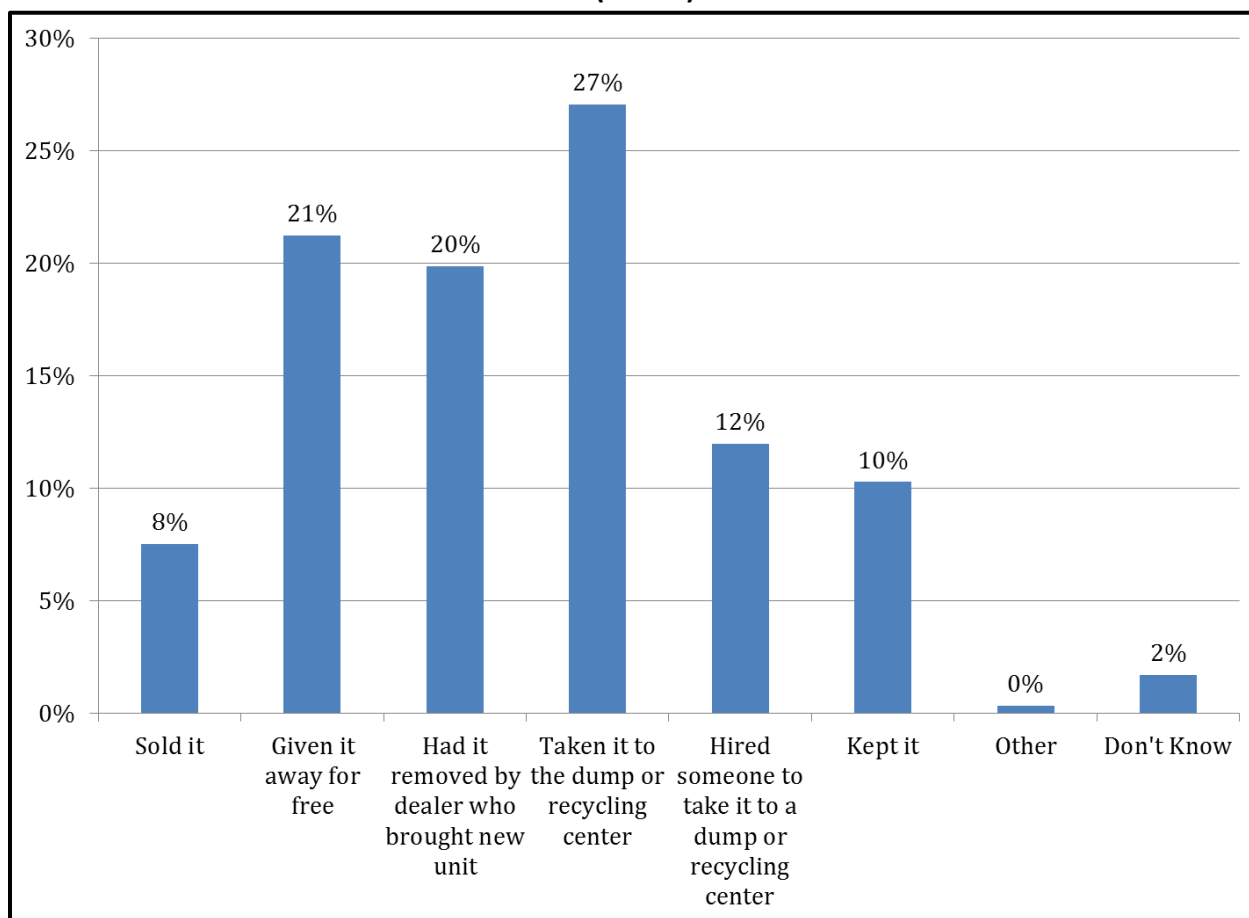
All 292 respondents who recycled refrigerators or freezers as their first measure were asked if they replaced the units that were picked up. Of the 216 who affirmed that they replaced their recycled refrigerator or freezer, about 86 percent stated that they purchased their replacement. These results are depicted in Figure 24. Most of those who purchased a replacement did so before the old unit was picked up.

Figure 24: Proportion of Refrigerators/Freezers that were Replaced (n=292) after Recycled through Appliance Recycling Program



About three-fourths of the participants claimed that they would have gotten rid of their refrigerator or freezer even if the program did not exist. Had the program not been in existence, participants reported being most likely to have either taken their old unit to a dump or recycling center on their own (27 percent), given it away for free (21 percent), or have it removed by the dealer who brought the new unit (20 percent). Figure 25 displays the proportion of participants who would have selected these alternative approaches to disposing of their appliances had the program not been available.

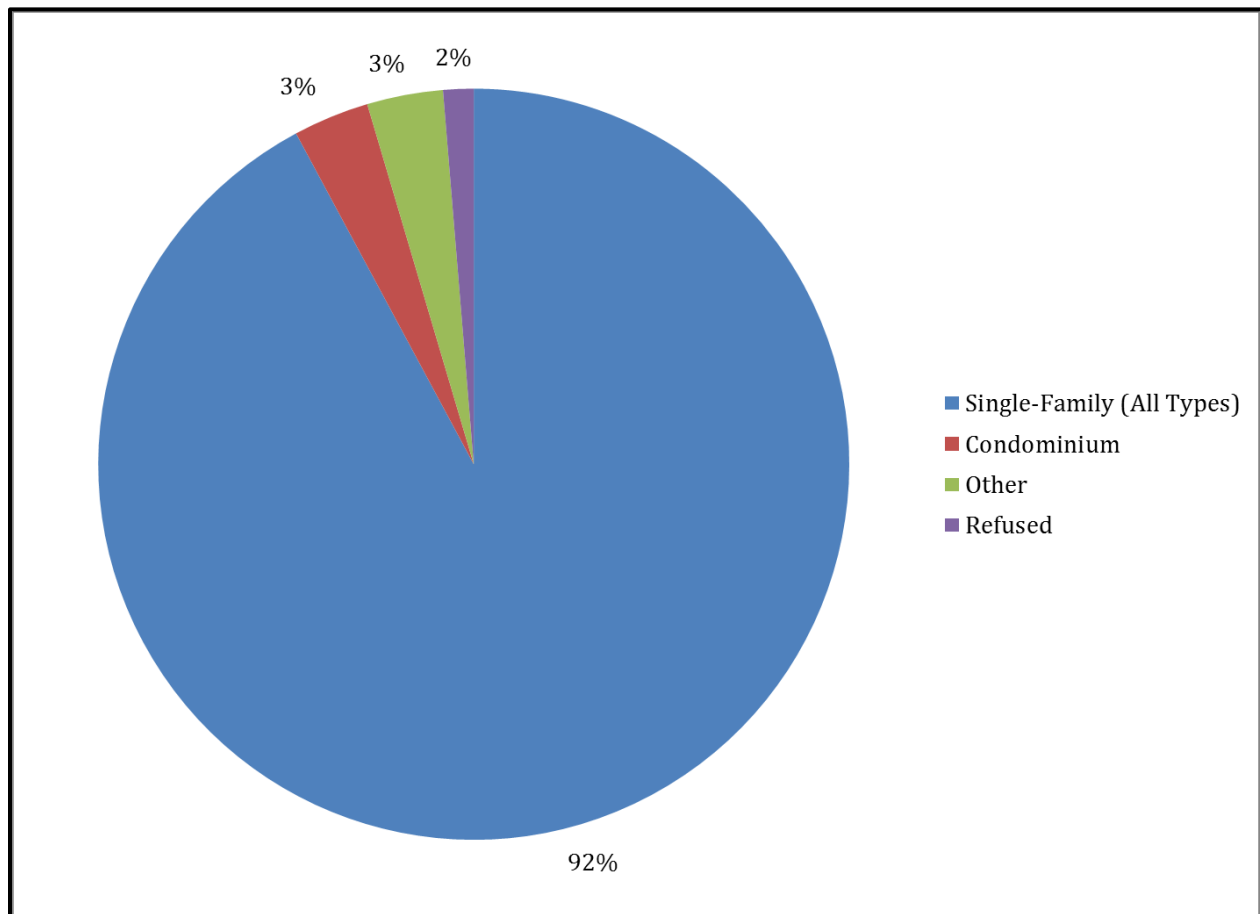
Figure 25: Alternative Strategies if Appliance Recycling Program Had Not Been Available (n=292)



Home Characteristics

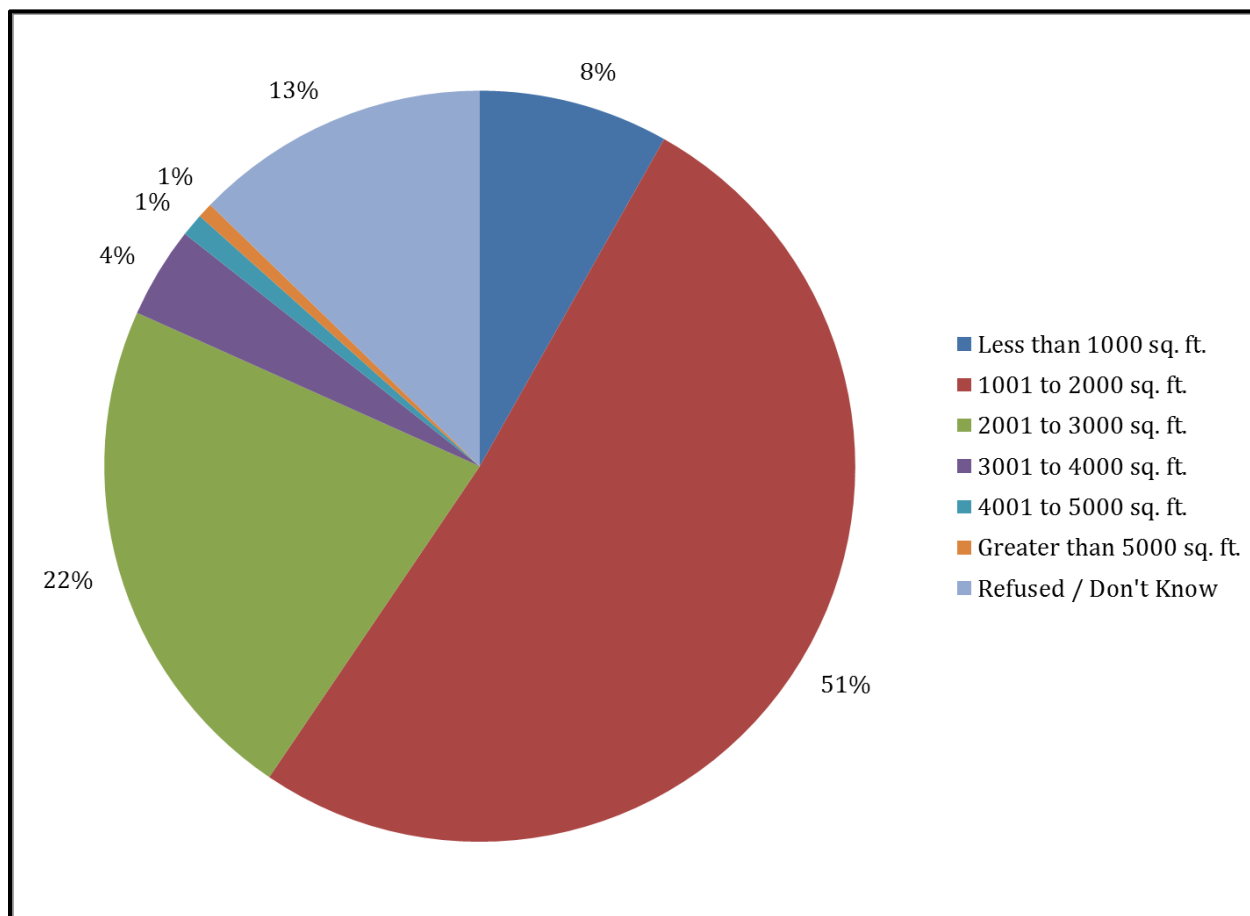
All survey respondents were asked about their home type in order to determine the residential structures of those who are participating in the appliance recycling programs. Approximately 92 percent of respondents across the three programs reported living in single-family homes, as illustrated in Figure 26. The majority of these are detached single-family homes, as opposed to factory-manufactured or mobile homes. Just 3 percent of respondents live in condominiums. Unsurprisingly, 93 percent of respondents stated that they own their home, with less than 6 percent saying that they rent. This is consistent with the fact that residents who rent often do not own the appliances in their homes.

Figure 26: Home Types Represented by Appliance Recycling Program Surveyed Participants (n=306)



Over 50 percent of respondents indicated that their home is between 1,001 and 2,000 square feet of above-ground living space, with 22 percent living in homes between 2,001 and 3,000 square feet. Figure 27 provides a graphical representation of the appliance recycling program participants by home size. Almost half of respondents indicated that their home has no conditioned below-ground living space and another 22 percent stated that their conditioned below-ground living space is less than 1,000 square feet.

Figure 27: Home Sizes Represented by Appliance Recycling Program Surveyed Participants (n=306)



Program Awareness

The survey asked participants when they first heard of the programs in which they participated. As shown in Table 37, approximately 57 percent of respondents reported first learning of the program in 2012, followed by just 14 percent in 2011 and declining for the years prior. Interestingly, the data in Table 37 show that a small percentage of participants indicated knowing about the program several years before their existence. AEP Ohio⁴¹ and DP&L's⁴² Residential Appliance Recycling Programs began in 2009 and FirstEnergy's Appliance Turn-In Program⁴³ began in 2011.

⁴¹ 2012 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs, Volume 1. Prepared by AEP Ohio. Submitted to Public Utilities Commission of Ohio. 15 May 2013.

⁴² 2012 Energy Efficiency and Demand Reduction/Response Portfolio Status Report. Prepared by Dayton Power and Light. Submitted to Public Utilities Commission of Ohio. 15 May 2013.

⁴³ 2012 Appliance Turn-In Program Impact and Process Evaluation Report. Prepared by ADM Associates, Inc. Submitted to FirstEnergy Ohio Companies. 2013.

Table 37: Year in which Participants First Learned about the Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
2006	0%	0%	1%	0%
2007	1%	2%	1%	0%
2008	2%	4%	3%	0%
2009	2%	5%	1%	1%
2010	8%	6%	10%	8%
2011	14%	14%	14%	15%
2012	57%	54%	53%	64%
2013	1%	2%	0%	0%
Don't Know	14%	14%	17%	13%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

When asked where they first learned about the appliance recycling program, 37 percent of survey respondents mentioned a utility bill insert as their first source of information. Another 15 percent of respondents heard about the program by word of mouth from family, friends, or coworkers. Two other sources cited by participants were newspaper advertisements and television/radio advertisements. As shown in Table 38, utility bill inserts were the primary source of information for all three programs.

Table 38: First Source of Information about Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
Utility Bill Insert	37%	26%	48%	37%
Word of Mouth	15%	14%	18%	15%
Newspaper Ad	10%	10%	9%	11%
Television/Radio Ad	10%	18%	1%	13%
Retail Store	7%	9%	3%	10%
Website/Online	5%	5%	8%	3%
Salesperson	4%	6%	2%	4%
TV/Newspaper Story/Article	5%	5%	6%	5%
Participated or Received Rebate Before	0%	1%	0%	0%
Utility Call Center or Utility/Program Staff	0%	0%	1%	0%
Other	1%	3%	0%	0%
Don't Know	4%	4%	5%	4%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

The 293 respondents who were able to recall their first source of information were then asked about other sources they used to gather information about the program. Fifty-four percent indicated that they used no other sources of information. About 20 percent of respondents reported that they used a website or online source in conjunction with their first source.

Respondents who listed more than one source of information were asked which one they found to be most useful in helping them decide to participate in the program. Interestingly, although more respondents indicated that they first heard about the program through a utility bill insert, AEP Ohio's participants listed online sources of information as the most useful source more often than they listed the bill insert. An equal percentage of DP&L's participants listed online sources and utility bill inserts. These results are summarized in Table 39.

Table 39: Most Useful Sources of Information about Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
Website/Online	24%	26%	26%	19%
Utility Bill Insert	22%	12%	26%	31%
Word of Mouth	10%	14%	8%	8%
Television/Radio Ad	8%	11%	3%	10%
Retail Store	7%	9%	3%	8%
Utility Call Center or Utility/Program Staff	7%	7%	10%	4%
Newspaper Ad	6%	5%	5%	8%
TV/Newspaper Story/Article	2%	0%	3%	4%
Salesperson	3%	5%	3%	2%
Other	2%	4%	3%	0%
Don't Know	9%	7%	13%	8%
n	148	57	39	52

*Total percentages may not sum to 100% due to rounding.

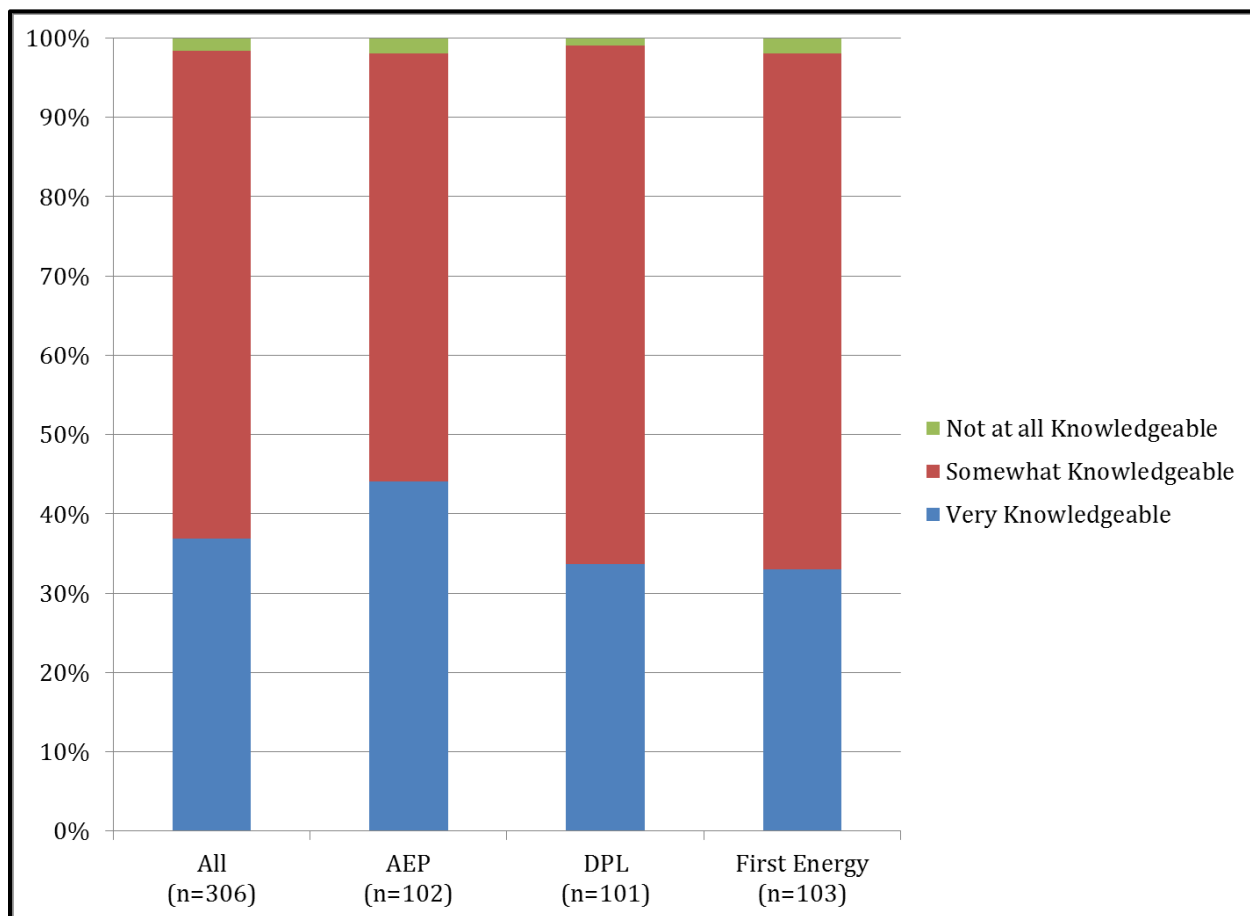
Barriers to Participation

A variety of barriers are encountered by customers who purchase energy efficient equipment or undertake other energy efficiency actions. This section presents participants' assessments of the magnitude of certain barriers, including their knowledge about ways they can save energy in their homes, the effect of budget constraints on their purchasing decisions, the difficulty of gaining expertise about energy efficient measures, and the importance of saving energy.

To get a sense of how familiar utility customers are about ways they can save energy in their homes, appliance recycling program participants were asked to rate their level of knowledge regarding this issue. As Figure 28 shows, almost all surveyed participants feel they are somewhat to very knowledgeable about ways they can save energy in their homes. Between 53 to 65 percent of participants across the programs (61 percent overall) stated that they are somewhat knowledgeable, with an additional 33 to 44 percent (37 percent overall) stating that they are very knowledgeable.

In comparison, 59 percent of Ohio residential program participants surveyed for other programs reported being somewhat knowledgeable and 39 percent of residential program respondents reported being very knowledgeable. In both the appliance recycling and other residential programs, over 98 percent of respondents reported being knowledgeable about ways they can save energy in their homes.

Figure 28: Appliance Recycling Program Participant Level of Knowledge about Saving Energy in the Home



Respondents were also asked how much of an obstacle budget constraints are to making investments in energy efficient equipment. Table 40 shows that between 24 and 29 percent of participants across the programs (26 percent overall) claim budget constraints are a large obstacle. A slightly larger fraction of participants consider this a medium-sized obstacle, ranging from 33 to 42 percent across the three programs (39 percent overall). In comparison, across the other residential programs surveyed, 23 percent of participants designated budget constraints a large obstacle and 46 percent a medium-sized obstacle in program participation.

Table 40: Budget Constraint as an Obstacle to Making Investments in Residential EE Equipment for Appliance Recycling Program Participants*

	All Programs	AEP	DPL	First Energy
Large Obstacle	26%	26%	29%	24%
Medium-Sized Obstacle	39%	41%	33%	42%
Small Obstacle	11%	7%	16%	11%
Not an Obstacle	21%	24%	21%	17%
Refused	1%	1%	1%	0%
Don't Know	3%	1%	1%	6%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

Participants were also asked if they considered gaining the expertise needed to buy energy efficient appliances or heating and cooling equipment an obstacle to making the purchase of this type of equipment. Across utilities, 35 to 44 percent of participants reported that gaining expertise is not an obstacle to taking energy-saving actions, amounting to 38 percent overall, as shown in Table 41. Only 12 percent of survey respondents in all three programs reported this as a large obstacle, while 27 percent considered it a medium-sized obstacle, and 18 percent a small obstacle. Compared to the responses given by participants about budget constraints, gaining expertise is viewed as less of an obstacle to the purchase of energy efficient equipment.

Table 41: Gaining Expertise as an Obstacle to Making Investments in Residential EE Equipment for Appliance Recycling Program Participants*

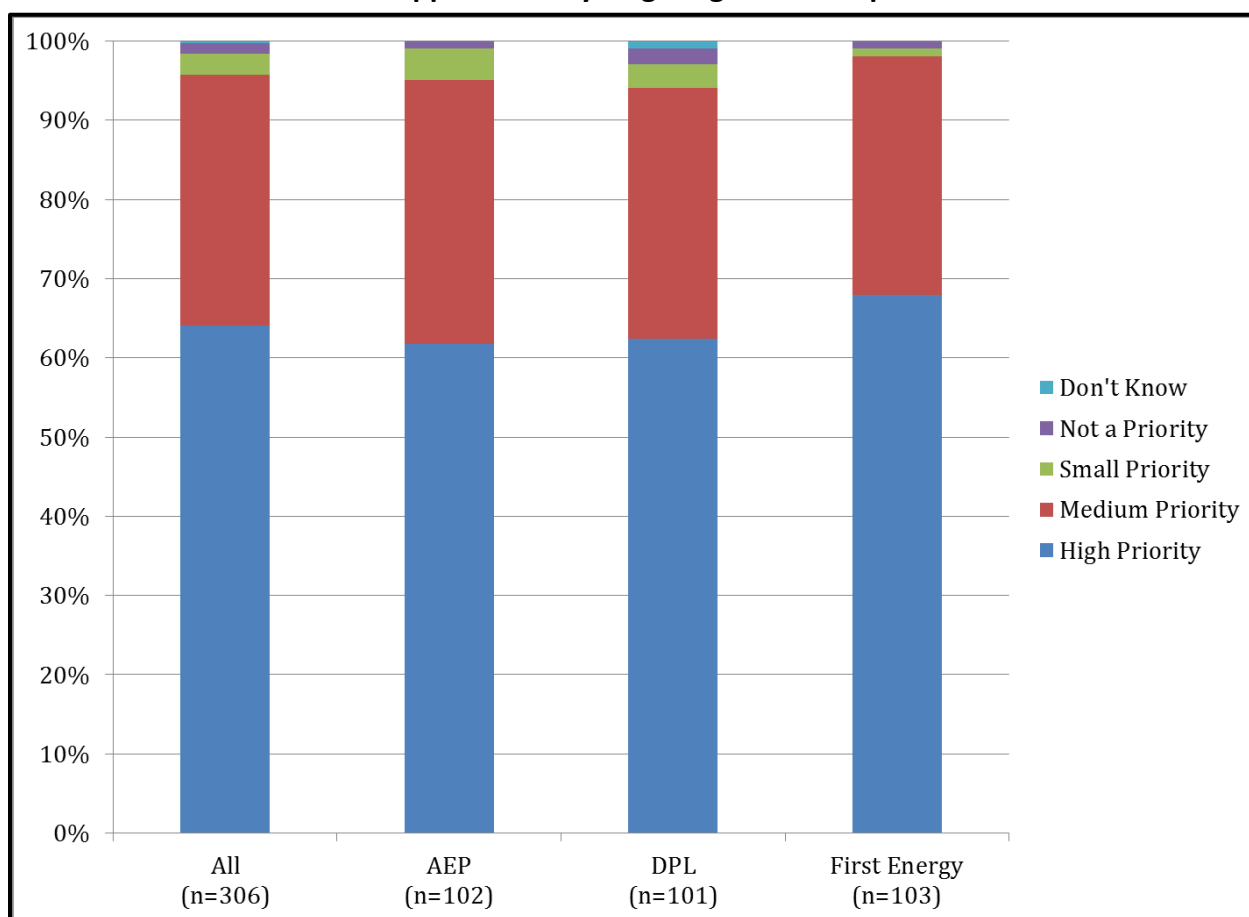
	All Programs	AEP	DPL	First Energy
Large Obstacle	12%	12%	11%	13%
Medium-Sized Obstacle	27%	25%	29%	29%
Small Obstacle	18%	18%	21%	16%
Not an Obstacle	38%	44%	36%	35%
Refused	0%	1%	0%	0%
Don't Know	4%	1%	4%	8%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

Finally, customers were asked how high a priority they consider energy efficiency when deciding on appliances, heating and cooling equipment, and other purchases like lighting and electronics. Most participants rated energy efficiency as a high priority: 64 percent overall, as depicted in Figure 29. Less than 4 percent of the total respondents indicated that energy efficiency was either a small priority or not a priority at all. These results could imply that appliance purchasers who place a high priority on energy efficiency are more likely to participate in the appliance recycling program than

those who consider energy efficiency a lower priority. However, it is also possible that survey respondents may have overstated their consideration of energy efficiency so as not to be cast in a negative light, a phenomenon known as response bias. It is unclear which of these two scenarios caused these results. However, it may be concluded from customer responses to these questions that their understanding of energy efficiency and their commitment (or lack thereof) does not appear to be barriers to program participation.

Figure 29: Priority of Energy Efficiency When Purchasing Appliances, HVAC, and Other Measures for Appliance Recycling Program Participants



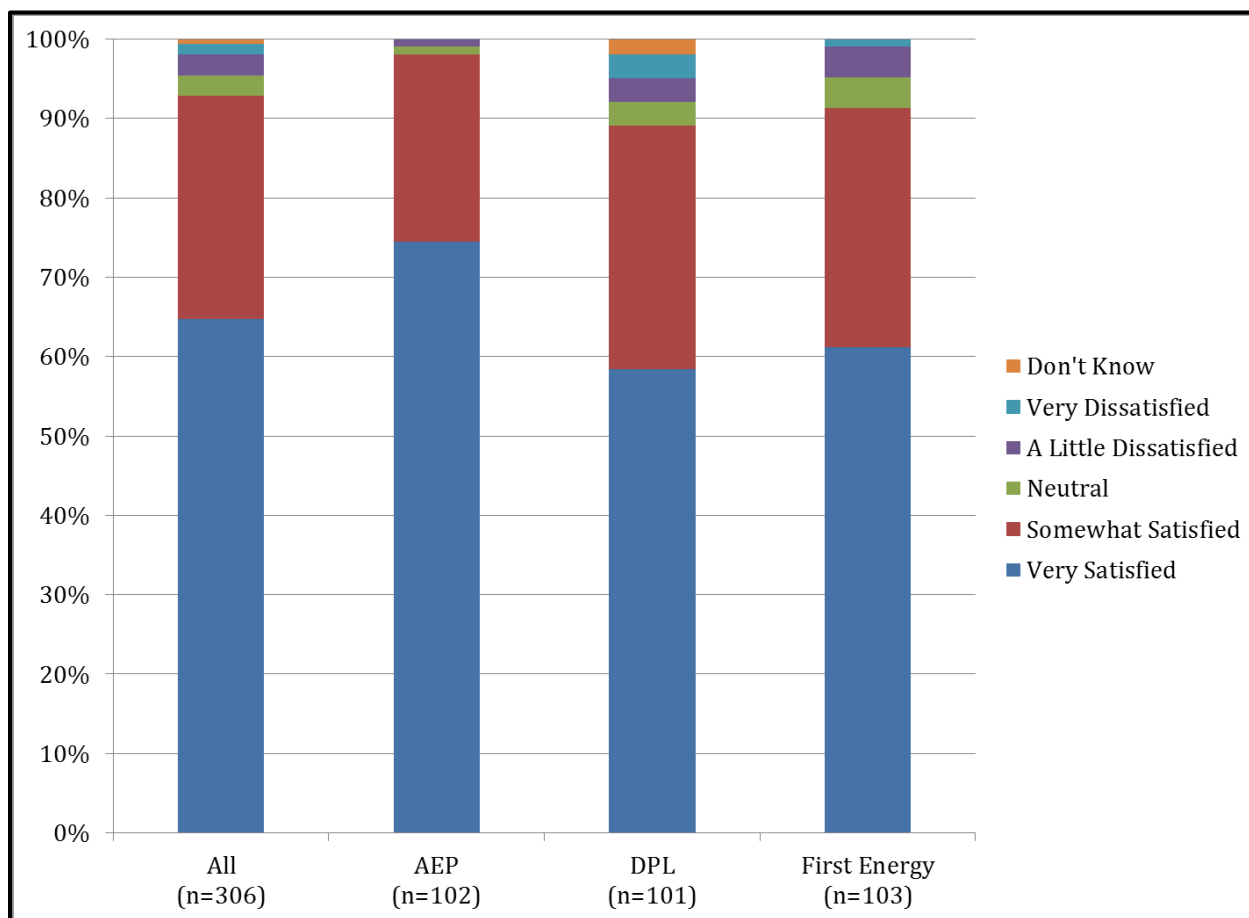
Program Satisfaction

Various aspects of the program were discussed with participants to determine their satisfaction with participation, including incentive amount, contractor experience, energy savings from participation, and overall program satisfaction.

First, respondents were asked about their level of satisfaction with the amount of the incentive they received. These results are illustrated in Figure 30. A total of 93 percent of overall participants indicated that they are somewhat satisfied or very satisfied with this program attribute, with over 60 percent stating that they are very satisfied. Less than 6 percent of participants in any one program indicated any dissatisfaction with the incentive amount. Of the participants from AEP Ohio's

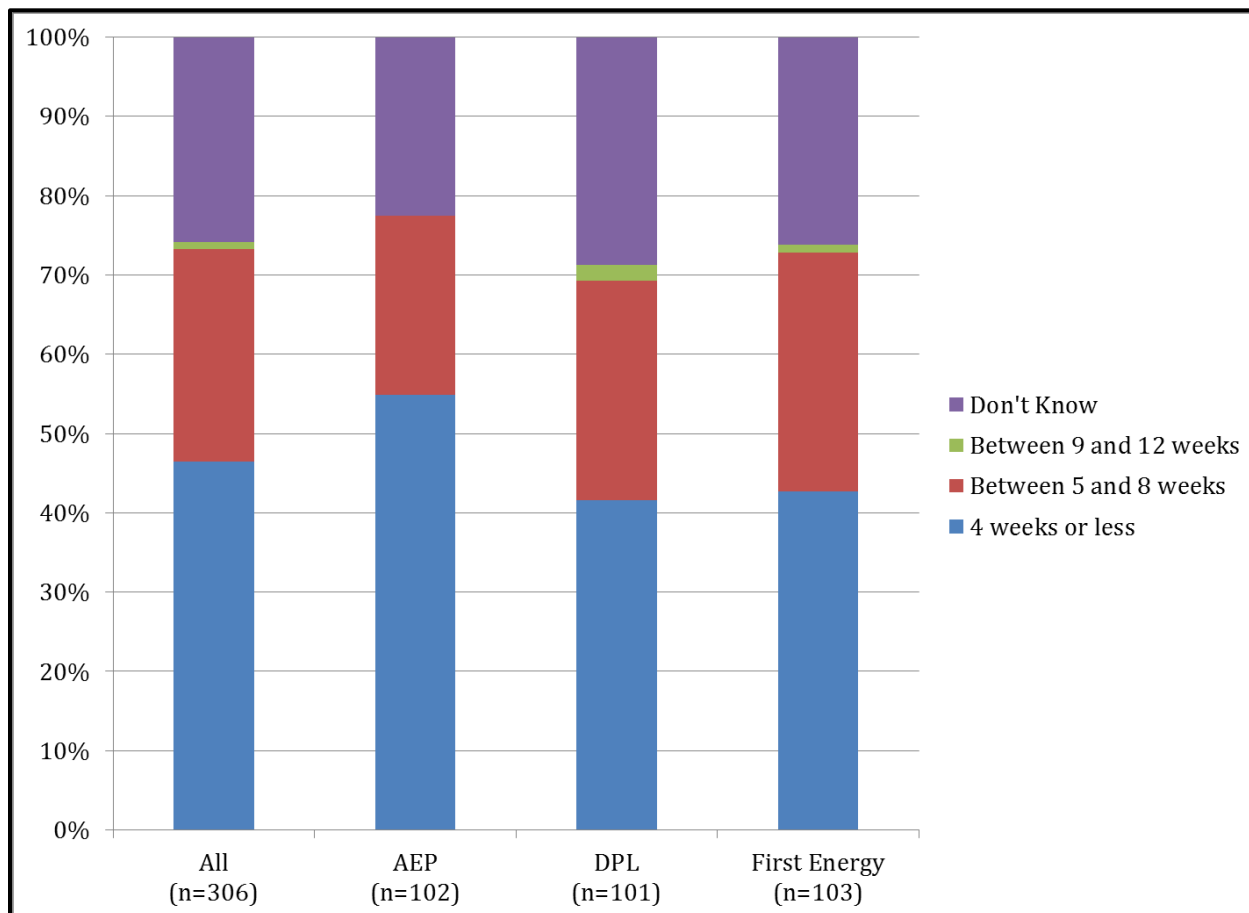
program, just one survey respondent reported slight dissatisfaction, and none indicated that they were very dissatisfied. In contrast, 85 percent of survey respondents who participated in other residential programs reported being somewhat or very satisfied with the rebate amount.

Figure 30: Satisfaction with Rebate Amount Received through Appliance Recycling Program



Survey respondents were next asked how long it took to receive their incentive checks from the time the recycled equipment was picked up. As shown in Figure 31, one-fourth of respondents did not know how long it took them to receive their rebate. Of those who could recall, the vast majority received their incentive checks within eight weeks of the date of equipment pick-up. A mere 1 percent of respondents indicated that it took nine weeks or more.

Figure 31: Length of Time to Receive Rebate from Appliance Recycling Program



Those who were able to recall the length of time it took to receive their incentives were then asked if they were satisfied with this timeframe. As Table 42 shows, between 88 and 95 percent of these respondents across the three programs (91 percent overall) stated that they were somewhat or very satisfied. DP&L program participants expressed a slightly higher rate of dissatisfaction, with close to 10 percent of respondents indicating some level of dissatisfaction with how long it took to receive their rebates.

In comparison, 84 percent of participants in other residential programs reported being somewhat or very satisfied with the amount of time it took to receive the rebate, with most respondents again reporting less than nine weeks between equipment installation and receipt of the rebate.

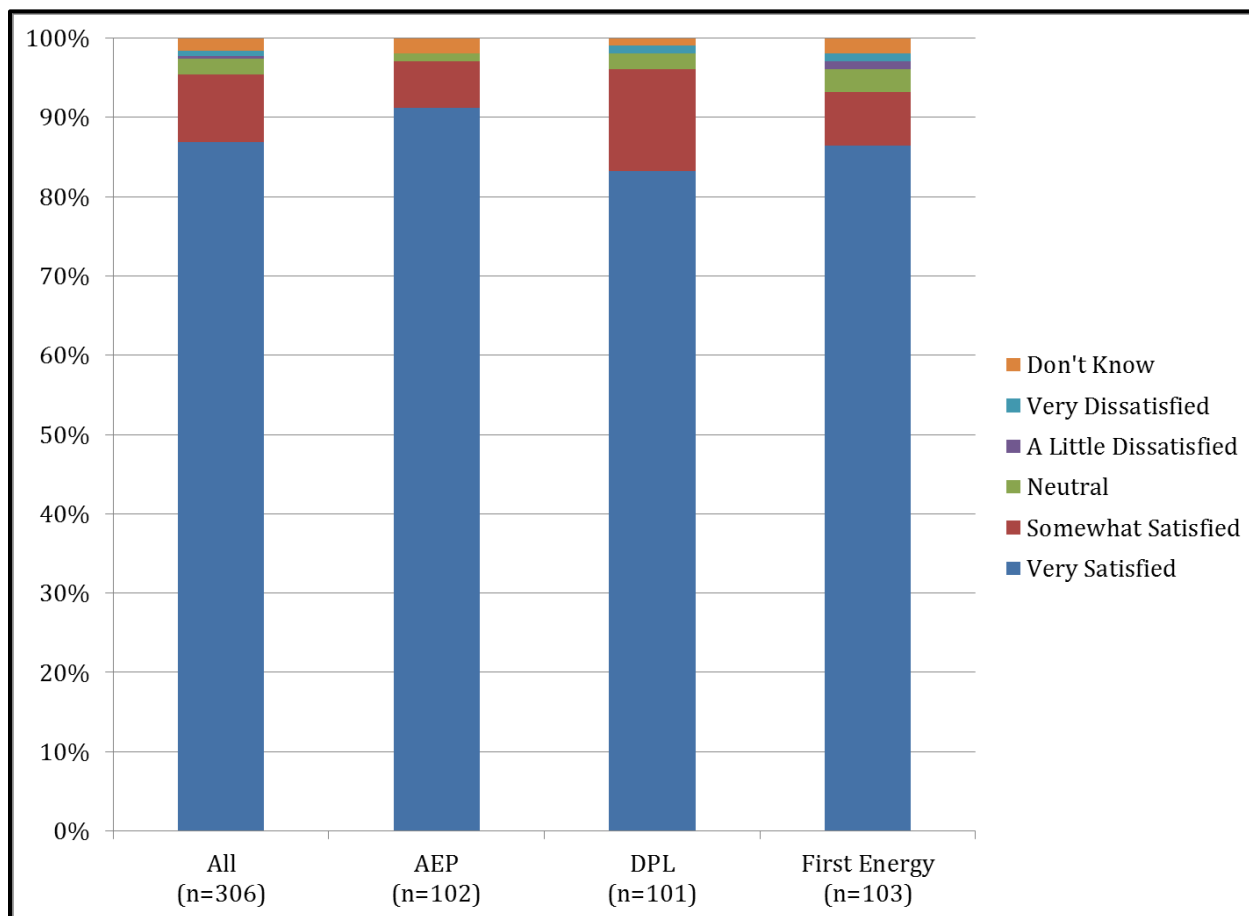
Table 42: Satisfaction with Length of Time to Receive Rebate from Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
Very Satisfied	69%	80%	57%	70%
Somewhat Satisfied	22%	15%	31%	21%
Neutral	4%	5%	3%	4%
A Little Dissatisfied	4%	0%	8%	3%
Very Dissatisfied	1%	0%	1%	1%
Don't Know	0%	0%	0%	1%
n	227	79	72	76

*Total percentages may not sum to 100% due to rounding.

Next, respondents were asked about their level of satisfaction with the contractor who picked up their appliance. As Figure 32 illustrates, the vast majority of surveyed participants expressed satisfaction with their contractor experience, with 95 percent across all programs indicating that they were somewhat to very satisfied. Only three total respondents, representing 1 percent of those surveyed, indicated some level of dissatisfaction with the contractor. Similarly, 95 percent of respondents who participated in other residential program respondents reported being somewhat or very satisfied with the contractor who installed their equipment.

Figure 32: Satisfaction with Contractor Who Picked up Equipment for Appliance Recycling Program



Participants were also asked if they noticed any savings on their energy bill after installing new equipment and, on average, 41 percent of all participants stated that they did notice savings, compared to 38 percent who did not. As Table 43 demonstrates, these findings were generally consistent across the three programs, although for DP&L's program a slightly smaller proportion of participants noticed savings than did not (38 and 45 percent, respectively). A sizeable proportion of respondents were unable to provide feedback on energy savings for various reasons, most notably because at the time the survey was conducted it was too soon to tell.

Table 43: Energy Savings Noticed Since Installing Energy Efficient Equipment following Appliance Recycling Program Participation*

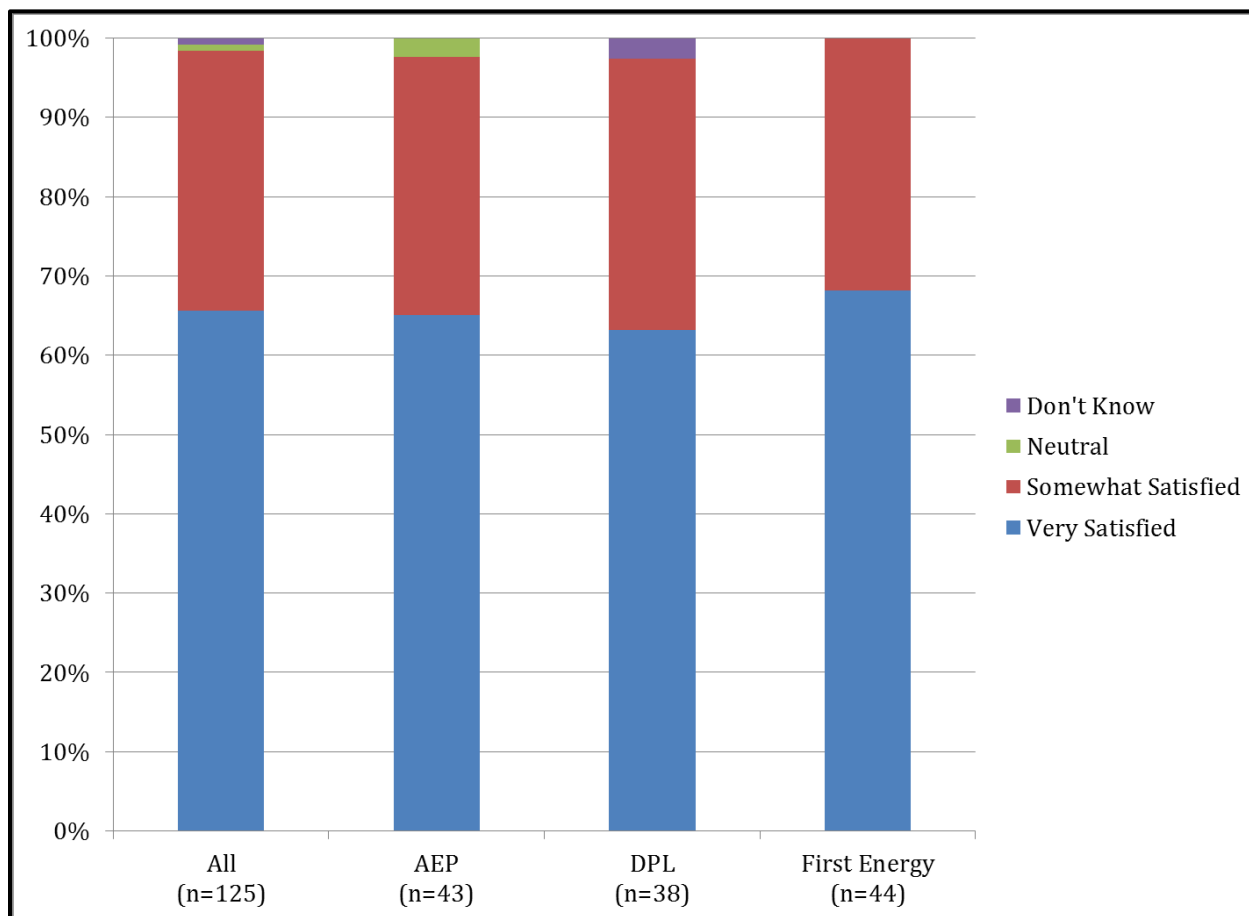
	All Programs	AEP	DPL	First Energy
Yes	41%	42%	38%	43%
No	38%	36%	45%	32%
Too Soon To Tell	14%	14%	10%	17%
Refused	0%	0%	1%	0%
Don't Know	8%	8%	7%	8%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

Participants who noticed monetary savings on their energy bills were then asked how satisfied they were with these savings. For all three programs, virtually all participants reported some level of satisfaction, illustrated in Figure 33. Over 98 percent of participants across the programs were somewhat or very satisfied with the energy savings they observed. None of the survey respondents who saw savings on their electric bills after installing new energy efficient equipment reported dissatisfaction with these savings.

About 57 percent of survey respondents who participated in other residential programs noticed electric savings after participating in the programs, and 98 percent of these participants reported being somewhat or very satisfied with the savings they noticed.

Figure 33: Satisfaction with Energy Bill Savings following Appliance Recycling Program Participation



When asked to rate their overall satisfaction with the appliance recycling program, the vast majority of participants in each program reported general satisfaction. Table 44 shows that approximately 78 to 88 percent of respondents in a given program were very satisfied with the program in which they participated (82 percent overall), with an average of 98 percent of all respondents reporting some degree of satisfaction. These results are consistent with the generally high satisfaction ratings participants gave to the various program attributes reported above.

In comparison, 89 percent of survey respondents who participated in other residential programs reported being somewhat or very satisfied. Appliance recycling program participants appear to have higher rates of satisfaction overall and with individual program elements than other residential program participants.

Table 44: Overall Satisfaction with Appliance Recycling Program*

	All Programs	AEP	DPL	First Energy
Very Satisfied	82%	88%	79%	78%
Somewhat Satisfied	16%	12%	16%	20%
Neutral	1%	0%	4%	0%
Somewhat dissatisfied	1%	0%	1%	2%
n	306	102	101	103

*Total percentages may not sum to 100% due to rounding.

Summary: Key Findings and Recommendations

The residential appliance recycling programs were designed to incentivize residential customers into getting rid of their old, inefficient appliances by providing a rebate for recycling them. About three-fourths of the participants claimed that they would have gotten rid of their refrigerator or freezer even if the program did not exist. Since no free ridership questions were asked as part of the appliance recycling program participant survey, it is not clear whether the existence of the rebate was an incentive for customer participation in this program, although several survey findings hint that the rebate sweetened an already attractive program design. Anecdotally, when asked to describe their overall satisfaction rating, a large proportion of respondents mentioned that the program helped them dispose of an unwanted appliance and that the incentive was a nice addition. Only 2 percent of respondents reasoned that the program incentivized or expedited the replacement of their old unit. Additionally, when asked if they have any suggestions for improvement, only 5 percent of respondents suggested an increase in the incentive amount.

It seems that one of the programs' goals of recycling and disposing of inefficient equipment in an environmentally responsible manner was successful, in that participants who would have gotten rid of their old appliance in the absence of the program would have likely done so by either taking it to the dump, giving it away for free, or having it removed by the dealer who brought their new unit. These alternative methods do not guarantee that the inefficient units are excluded from the used appliance market or that they are disposed of responsibly. In this manner, the programs appear to meet their objective.

Program Awareness

The utilities should continue to promote program awareness among residential customers. Particularly, it seems that residents of multi-family homes are underserved, as approximately 92 percent of respondents across the three programs reported living in single-family homes. One explanation of this may be that homeowners are more likely to participate in the programs than landlords of rented spaces. In this case, it may be beneficial to expand marketing to the owners of multi-family residences, which could benefit just as much from reductions in energy consumption and proper appliance disposal as single-family homes.

When asked if they have any suggestions for program improvement, about 10 percent of survey respondents suggested that advertising be increased to promote greater awareness. Based on survey

findings, utility bill inserts are an effective method of promoting the programs, with 37 percent of respondents mentioning this as their first source of information about the program.

Barriers to Participation

Of the participation barriers addressed in this survey, budget constraint appears to be the only constraint mentioned as significant. Approximately 26 percent of all respondents named budget constraints as a large obstacle, and 39 percent stated it was a medium-sized obstacle. Knowledge about ways to save energy in the home, the difficulty of gaining expertise about energy efficient measures, and customer interest in prioritizing energy efficiency when making purchases of appliances do not appear to be barriers to participation in the residential appliance recycling programs.

Program Satisfaction

Appliance recycling program survey respondents generally expressed a high level of satisfaction with the various programmatic elements addressed and with the program as a whole. The majority of respondents reported that they were somewhat to very satisfied with the incentive amount, the length of time it took to receive the incentive check, their contractor experience, and the energy savings they noticed from participation.

Over 73 percent of the surveyed participants received their incentive checks within eight weeks of when their equipment was picked up, with the remaining participants largely being unable to recall how long it took. Based on customer feedback, this was a satisfactory timeframe.

The vast majority of surveyed participants expressed satisfaction with the contractor who picked up their equipment; 95 percent indicated that they were somewhat satisfied or very satisfied.

About 41 percent of participants stated that they noticed savings on their electric bills after installing new equipment, compared to 38 percent who did not. Virtually all of the participants who noticed energy savings (over 98 percent) reported satisfaction with the savings they observed. None of the survey respondents who saw savings on their electric bills reported dissatisfaction.

The appliance recycling programs overall achieved high levels of satisfaction among surveyed participants. An average of 98 percent of all respondents reported being somewhat to very satisfied.

Non-Residential Participant Surveys

A summary of the salient non-residential participant survey findings is presented below. Results are displayed for each of the programs in the tables and figures, but the discussion focuses on general trends observed in the findings. If instances of significant differences are seen across programs, they are noted in the discussion. All program-specific findings for each survey question are included in an appendix to this report. It should be noted that results presented for sub samples have not been tested for robustness and are included to show trends in customer awareness, participation and satisfaction. They are not necessarily statistically reliable due to small sample sizes.

A total of 450 participants were surveyed across the four utility programs. These programs represent a variety of business types including: education, health care, restaurants, hospitality, warehouses, industrial electronics and machinery manufacturing, community and religious assembly, municipalities, agricultural and personal service. Predominate in the sample of completes were warehouses, industrial electronics and machinery manufacturing, and assembly.

Confirmation of Participation

The non-residential participant survey first asked respondents whether they recall the installation of measures for which they received rebates through the Ohio utility programs. Approximately 95 percent of respondents confirmed that measures for which they received rebates were installed (see Table 45). Respondents were also asked if the equipment for which they received rebates was still installed and virtually all participants indicated that their energy efficient measures were (over 99 percent across the four programs).

Table 45: Verification of Participation in Non-Residential Rebate Programs

Verification of Participation	All	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Yes	94%	95%	84%	97%	98%
No	6%	5%	16%	3%	2%
n	450	200	75	75	100

Program Awareness

When non-residential participants were asked how they first learned about the energy efficiency programs in which they participated, a large proportion (between 34 and 56 percent across the programs) indicated that contractors served as their first source of information (see Table 53 and Table 46). Word of mouth and other utility sources (brochures, website, etc.) followed as primary program information sources. Less relevant sources of information included utility representatives, events such as conferences and workshops, and other miscellaneous sources.

Figure 34: First Source of Information about Non-residential Prescriptive Programs

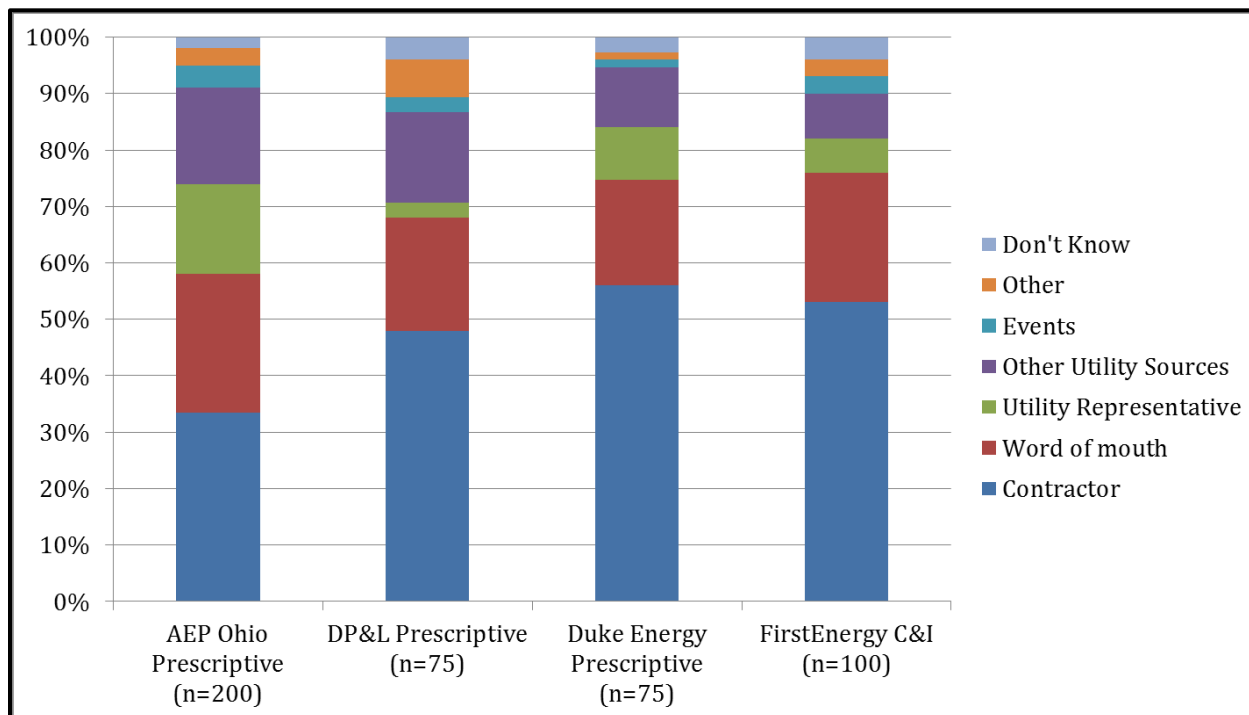


Table 46: First Source of Information about Non-Residential Programs *

First Source of Program Awareness	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Contractor	34%	48%	56%	53%
Word of mouth	25%	20%	19%	23%
Other Utility Sources (incl. brochures & website)	17%	16%	11%	8%
Utility Representative	16%	3%	9%	6%
Events	4%	3%	1%	3%
Other	3%	7%	1%	3%
Don't Know	2%	4%	3%	4%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

Beyond their primary source of information, participants were asked about other sources of information from which they learned about the programs. On average across the programs, approximately 42 percent stated that they encountered no additional information sources. An average of 25 percent of participants found information on their respective utility websites. Overall, the most frequently cited source of information was contractors followed by word of mouth.

Participants were also asked which source of information was “*most useful*” to them in making the decision to participate in a program. Approximately 38 percent of participants across the programs noted that contractors played a major role in their decision to participate. This was followed by other utility sources such as their websites, which were mentioned by about 19 percent of participants as the most useful source of information in their participation decision.

Barriers to Participation

A variety of barriers are encountered by non-residential customers who purchase energy efficient equipment. This section presents the non-residential participant assessments of a variety of barriers that may prevent customers from participating in available programs. Some of the participation barriers examined include energy efficiency knowledge, the higher upfront cost of EE equipment, concerns about EE equipment performance, and access to financing for energy efficient investments.

The survey asked how knowledgeable participants are about ways to save energy at their places of business to assess whether they might consider this a barrier to program participation. Figure 35 and Table 47 both show that over 20 percent of participants across the programs say they are very knowledgeable with another 46 to 56 percent stating that they are somewhat knowledgeable about how to save energy in their places of business. There is still room for education, as over a quarter of participants indicate that they are only a little knowledgeable or not at all knowledgeable about ways to save energy at their place of business. Overall, however, participants feel they are knowledgeable enough about ways to save energy in their places of business.

Figure 35: Knowledge about Ways to Save Energy in Places of Business

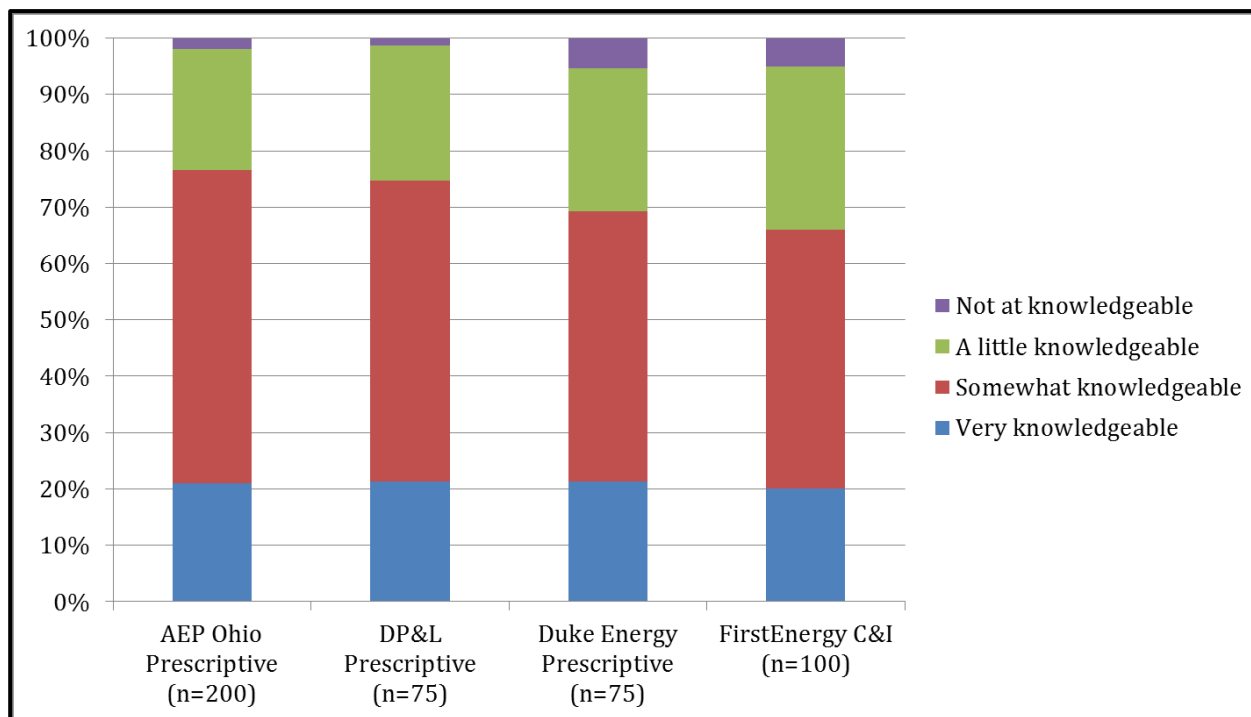


Table 47: Knowledge About Ways to Save Energy in Places of Business

Knowledge of Energy Saving in Places of Business	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very knowledgeable	21%	21%	21%	20%
Somewhat knowledgeable	56%	53%	48%	46%
A little knowledgeable	22%	24%	25%	29%
Not at knowledgeable	2%	1%	5%	5%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

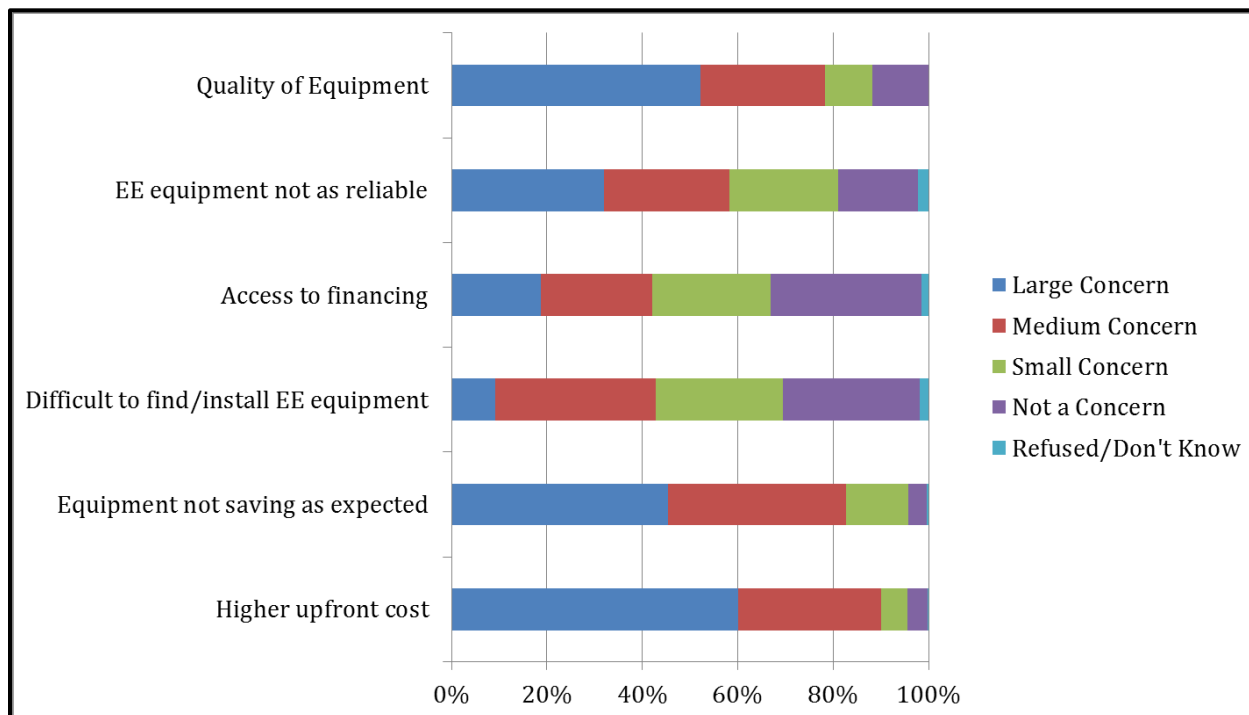
The survey presented a list of possible concerns that non-residential participants may have had when considering investments in energy efficient equipment. Participants were asked to state whether each of these concerns was of large, medium, small, or no concern. Responses to these questions are shown in aggregate across all respondents in Figure 36 below.

The concerns that were most in the minds of the participants were:

- the higher upfront cost of energy efficient equipment,
- the quality of equipment,
- the equipment not saving as much as promised, and
- performance issues (i.e., not as reliable as comparable less efficient equipment).

A majority of participants stated that each of these were large- or medium-level concerns. In fact, 60 percent of participants mentioned that the higher upfront cost of energy efficient equipment is a large concern to them. Far lesser concerns included access to financing and the difficulty of locating and installing energy efficient equipment.

Figure 36: Concern Level Regarding Energy Efficient Equipment



Participation Process and Program Satisfaction

In order to participate in the non-residential programs, eligible customers are required to fill out a program application. Participants were asked where they received their applications, and based on survey responses presented in Figure 37 and Table 48; more than 50 percent of participants in three of the four programs (AEP Ohio Prescriptive, Duke Energy Prescriptive, and FirstEnergy C&I) received applications from contractors or equipment vendors. Over 45 percent of participants in the other program (DP&L Prescriptive) also stated that contractors and equipment vendors provided them with program applications. Overall, 55 percent of participants across all programs received their applications through contractors or equipment vendors. Aside from contractors and vendors, a sizable proportion (over 25 percent) of participants across the programs accessed their applications online.

Figure 37: Source of Rebate Application

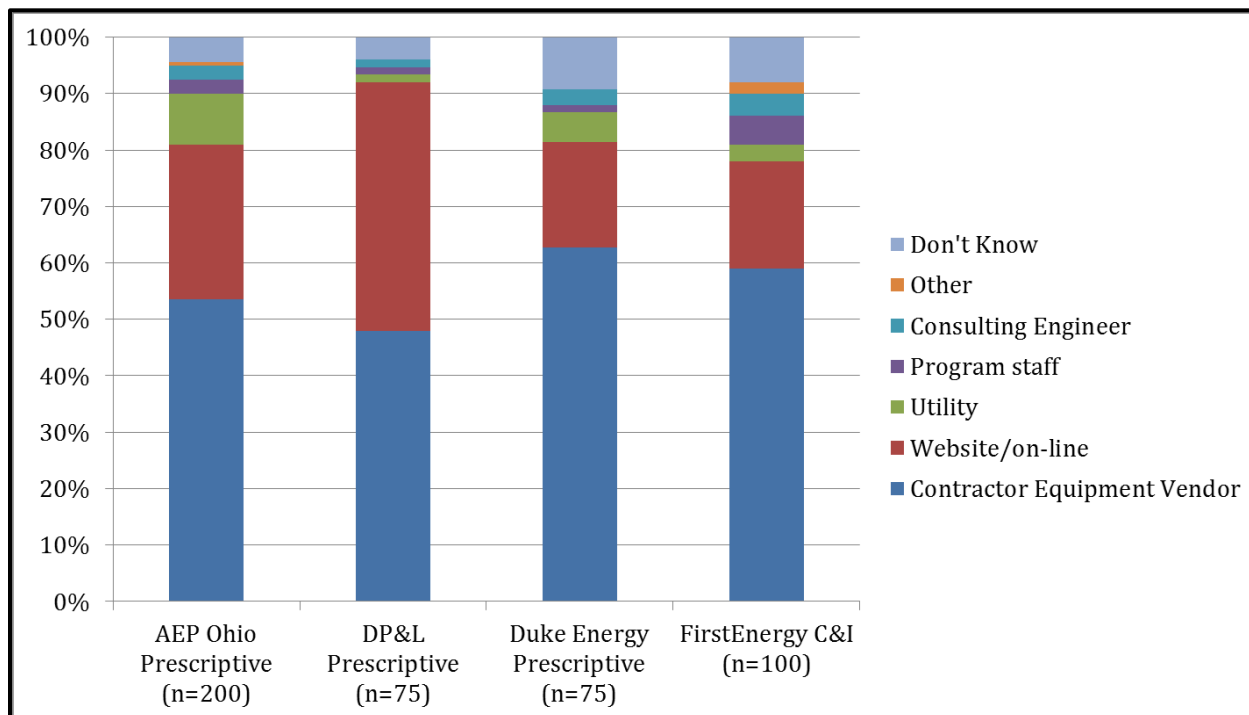


Table 48: Source of Rebate Application *

Source of Rebate Application	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Contractor/ Equipment Vendor	54%	48%	63%	59%
Website/on-line	28%	44%	19%	19%
Utility	9%	1%	5%	3%
Program staff	3%	1%	1%	5%
Consulting Engineer/Architect	3%	1%	3%	4%
Other	1%	0%	0%	2%
Don't Know	5%	4%	9%	8%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

Participants were next asked who completed their program applications. Based on responses received, approximately 40 percent completed their own applications. The subset of participants who filled out their own forms were then asked how satisfied they were with the ease of completion (n=175). As Figure 38 and Table 49 show, 71 to 85 percent were somewhat to very satisfied with the ease of filling out the program applications. In fact, for the DP&L and Duke Energy Prescriptive programs, 50 percent or more of the participants stated that they were very satisfied with the

simplicity of the application process. The research team asked an open-ended question of those participants who were somewhat or very dissatisfied about ways they would have been more satisfied with the application process. Very few responses were provided, but of those responding, the main comment received was that the application could have been shorter or less complex.

Figure 38: Satisfaction Level with Ease of Completing Rebate Applications

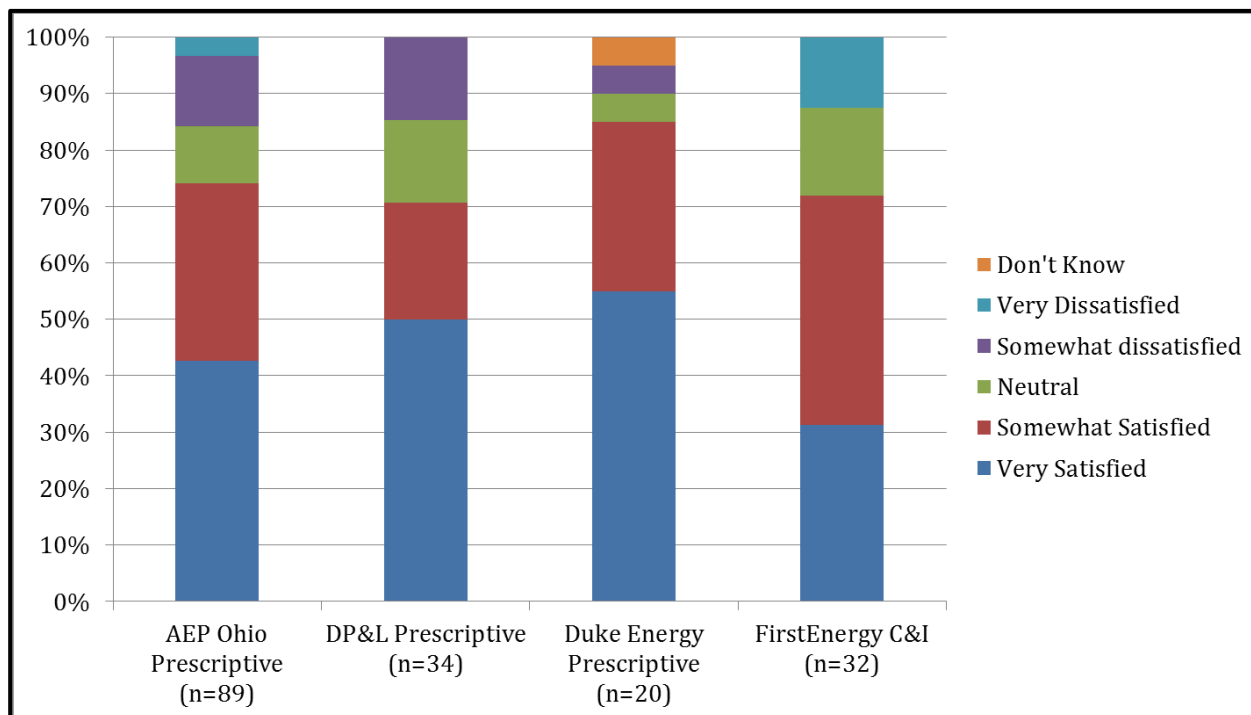


Table 49: Satisfaction Level with Ease of Completing Rebate Applications *

Ease of Completing Rebate Application	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very Satisfied	43%	50%	55%	31%
Somewhat Satisfied	31%	21%	30%	41%
Neutral	10%	15%	5%	16%
Somewhat Dissatisfied	12%	15%	5%	0%
Very Dissatisfied	3%	0%	0%	13%
Don't Know	0%	0%	5%	0%
n	89	34	20	32

*Total percentages may not sum to 100% due to rounding.

Participants were also asked how satisfied they were with the amount of the rebate received for the energy efficient equipment purchased through the program. Across all of the programs, at least 85

percent of program participants are somewhat to very satisfied with their rebate amounts. The proportion of participants who stated that they were very satisfied ranges from a low of 33 percent from FirstEnergy's program to a high of 57 percent from AEP Ohio's Express program (see Figure 39 and Table 50).

Figure 39: Level of Satisfaction with Rebate Amount

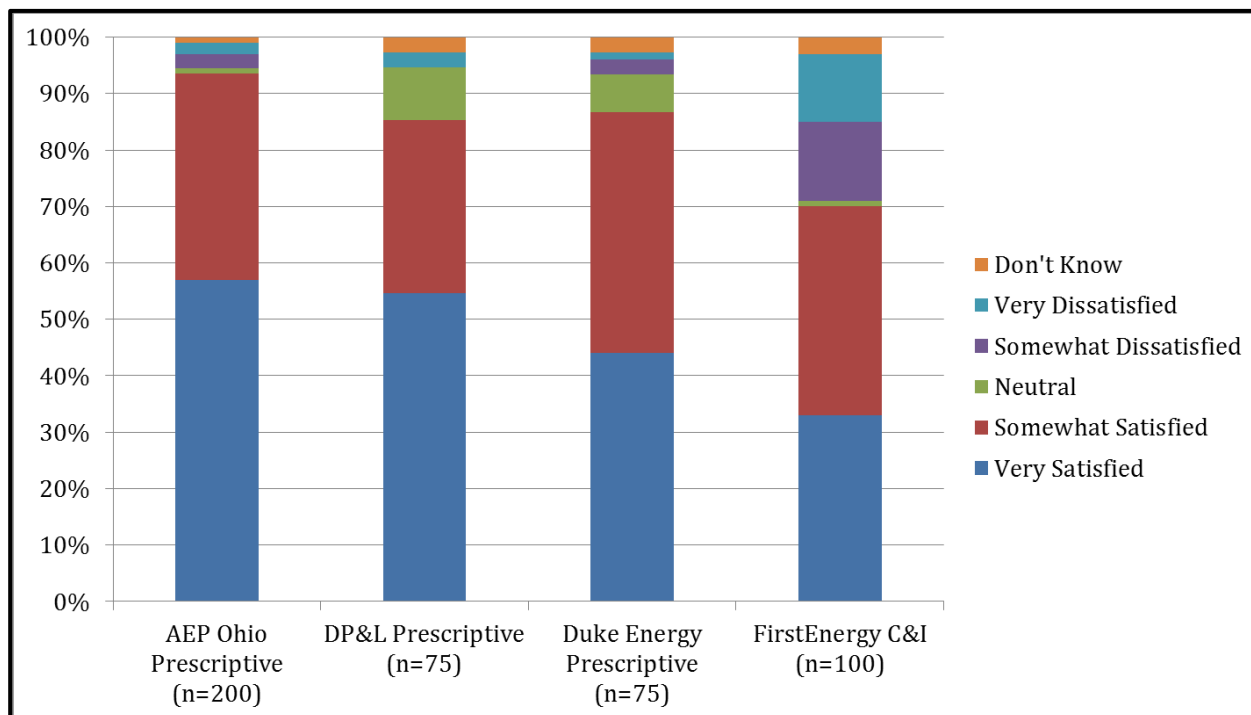


Table 50: Level of Satisfaction with Rebate Amount *

Satisfaction with Rebate Amount	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very Satisfied	57%	55%	44%	33%
Somewhat Satisfied	37%	31%	43%	37%
Neither Satisfied nor Dissatisfied	1%	9%	7%	1%
Somewhat Dissatisfied	3%	0%	3%	14%
Very Dissatisfied	2%	3%	1%	12%
Don't Know	1%	3%	3%	3%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

All participants were asked how long it took for them to receive their rebate from the time they submitted their program application. Table 51 below shows that it took approximately four weeks or less for roughly a quarter of the participants to receive rebates, and about 67 percent of all

participants received them within 12 weeks. A closer examination of this table shows that, on average, the participants of the FirstEnergy C&I program received their rebates later than the participants of the other programs. In fact, less than 10 percent of FirstEnergy C&I program participants received their rebates within one month. DP&L program participants seemed to get their rebates the fastest, with 44 percent receiving theirs within 4 weeks, and 72 percent within 8 weeks.

Table 51: Length of Time to Receive Rebate*

Length of Time to Receive Rebate	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
4 weeks or less	28%	44%	25%	9%
Between 5 and 8 weeks	38%	28%	29%	28%
Between 9 and 12 weeks	8%	4%	3%	18%
Between 13 and 16 weeks	1%	0%	0%	6%
More than 16 weeks	2%	0%	0%	14%
Did not receive a rebate	0%	1%	7%	2%
Don't Know	25%	23%	36%	23%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

All participants were then asked to rate their satisfaction with the length of time it took to receive their rebate. Given the participant responses seen in Table 51, the answers presented in Figure 40 and Table 52 are not surprising. There is a strong correlation between the reported length of time to receive the rebate and the resulting satisfaction. The participants of the FirstEnergy C&I program were far less satisfied than the participants of the other programs. Thirteen percent of these FirstEnergy participants stated they were very dissatisfied and an additional 10 percent were somewhat dissatisfied with the length of time that passed between their application submission and the receipt of their rebate check. Satisfaction levels were higher for the AEP Ohio, DP&L, and Duke Energy Prescriptive programs. The proportions of participants who were somewhat to very satisfied with the length of time it took to receive their rebates for these three programs were 80, 81, and 66 percent, respectively. All three of these programs have dissatisfaction rates of less than five percent.

Figure 40: Satisfaction with Length of Time to Receive Rebate

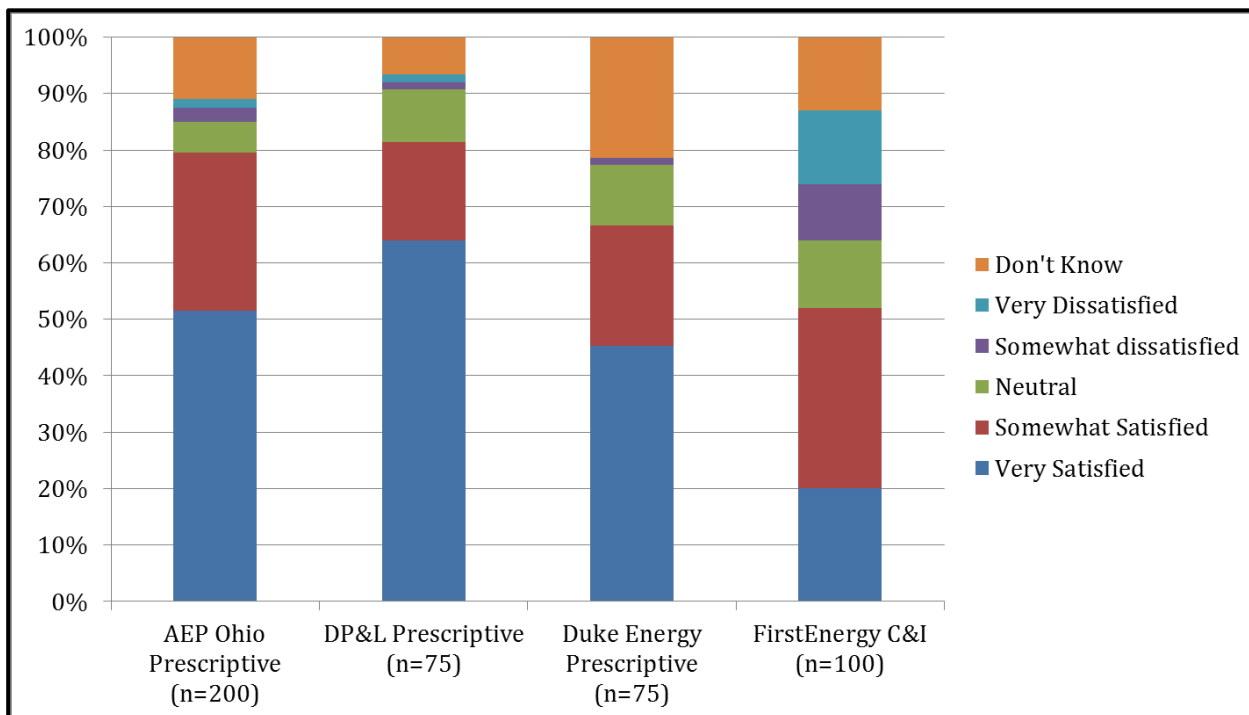


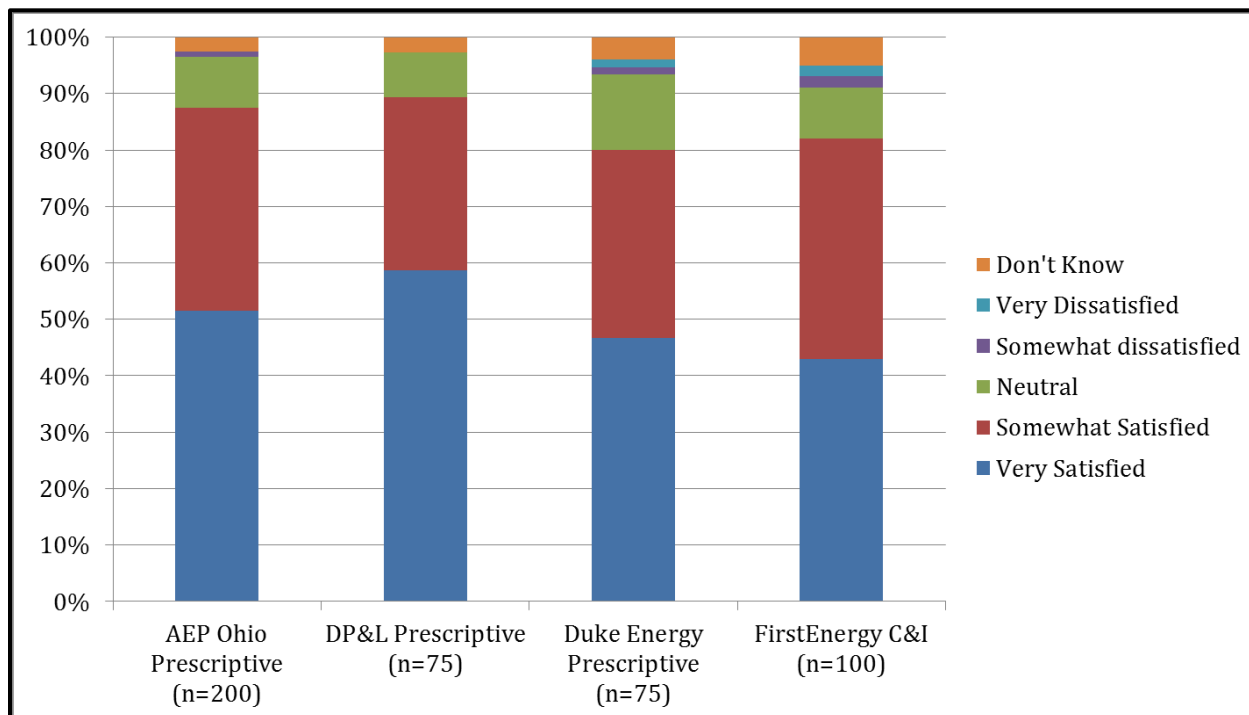
Table 52: Satisfaction with Length of Time to Receive Rebate*

Satisfaction with Time to Receive Rebate	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very Satisfied	52%	64%	45%	20%
Somewhat Satisfied	28%	17%	21%	32%
Neutral	6%	9%	11%	12%
Somewhat Dissatisfied	3%	1%	1%	10%
Very Dissatisfied	2%	1%	0%	13%
Don't Know	11%	7%	21%	13%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

In addition to inquiring about participant satisfaction with the rebate application, rebate amount, and length of time it took to receive the rebate, the participant survey asked customers how satisfied they were with the level of energy efficiency they were required to meet with the equipment purchased in order to qualify for the rebate. Responses to this question, as shown in Figure 41, indicate that participants were overwhelmingly satisfied with the minimum requirement. Across all of the programs, at least 80 percent of participants noted that they were somewhat to very satisfied.

Figure 41: Satisfaction with Level of Efficiency Required to Receive Rebate



The survey next inquired about how satisfied the non-residential participants were with the equipment they purchased through the program. Participants reported remarkably high levels of satisfaction across all of the programs. Between 95 and 99 percent of participants across the non-residential energy efficiency programs stated that they were somewhat to very satisfied with their energy-efficient measure (see Figure 42 and Table 53). In fact, over 80 percent across all of the programs stated that they were very satisfied with their equipment.

Figure 42: Satisfaction with Energy Efficient Measure Installed

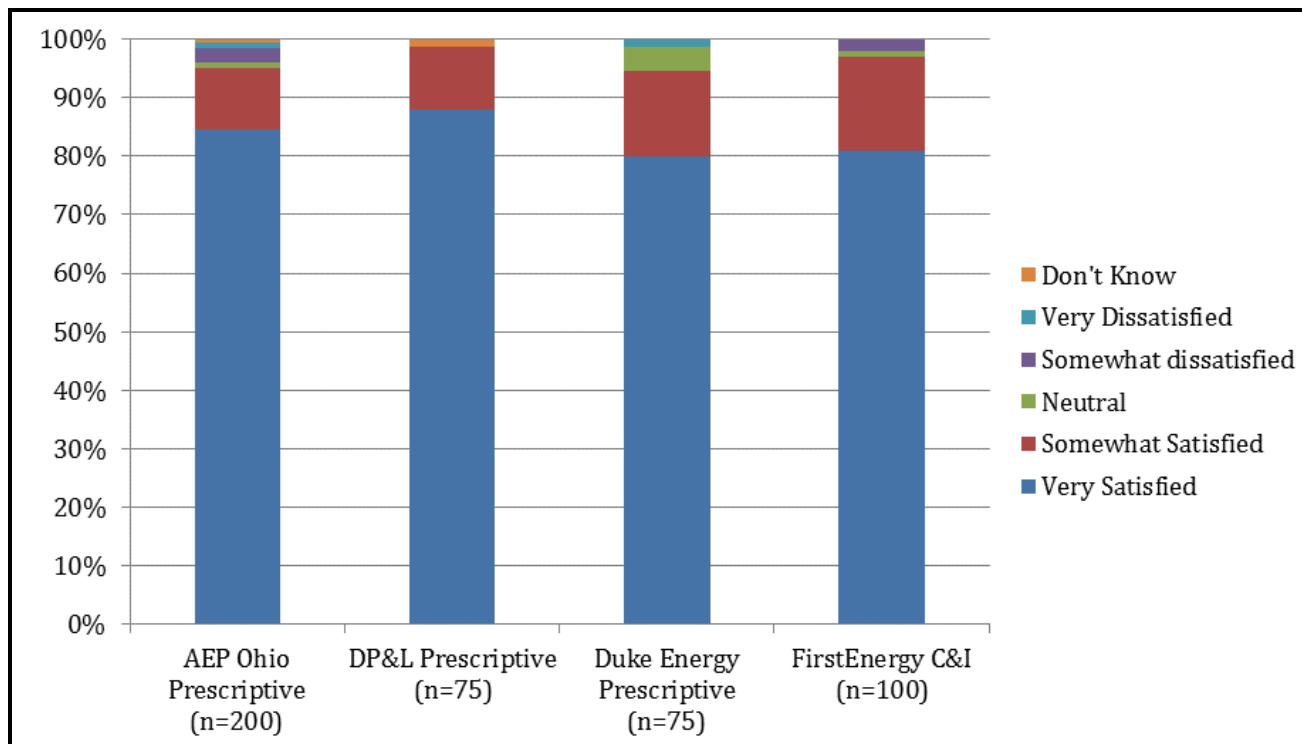


Table 53: Satisfaction with Energy Efficient Measure Installed

Satisfaction with EE Measure Installed	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very Satisfied	85%	88%	80%	81%
Somewhat Satisfied	11%	11%	15%	16%
Neutral	1%	0%	4%	1%
Somewhat Dissatisfied	3%	0%	0%	2%
Very Dissatisfied	1%	0%	1%	0%
Don't Know	1%	1%	0%	0%
n	200	75	75	100

Participants were also asked to provide an overall satisfaction rating for the program in which they participated. An overwhelming majority of participants noted that they were somewhat to very satisfied (Figure 43 and Table 54). Those participants who said they were somewhat to very satisfied varied from a low of 85 percent in the FirstEnergy C&I program to a high of 96 percent in DP&L's Prescriptive program. Participants in First Energy's program appeared to be the most dissatisfied, with 12% reporting that they were somewhat or very dissatisfied overall. In fact, these participants tended to report lower satisfaction levels than the others in several categories. A total of 13 percent of FirstEnergy's participants were very dissatisfied with the ease of completing the rebate application,

compared to the next highest rate of 3 percent for AEP Ohio. Similarly, 26 percent were at least somewhat dissatisfied with the rebate amount, compared to the next highest of 5 percent for AEP Ohio. This trend continues, with 23 percent at least somewhat dissatisfied with the length of time to receive the rebate compared to AEP Ohio's 5 percent.

However, participants of FirstEnergy's program indicated similar satisfaction levels with the installed measures. This suggests that the FirstEnergy program participants' frustrations lie with application and rebate process rather than the equipment itself. Comparing Figure 42 with Figure 43 shows that participants tended to give higher satisfaction ratings to the energy efficient equipment purchased than to the programs overall.

Figure 43: Overall Satisfaction with Non-Residential Energy Efficiency Program

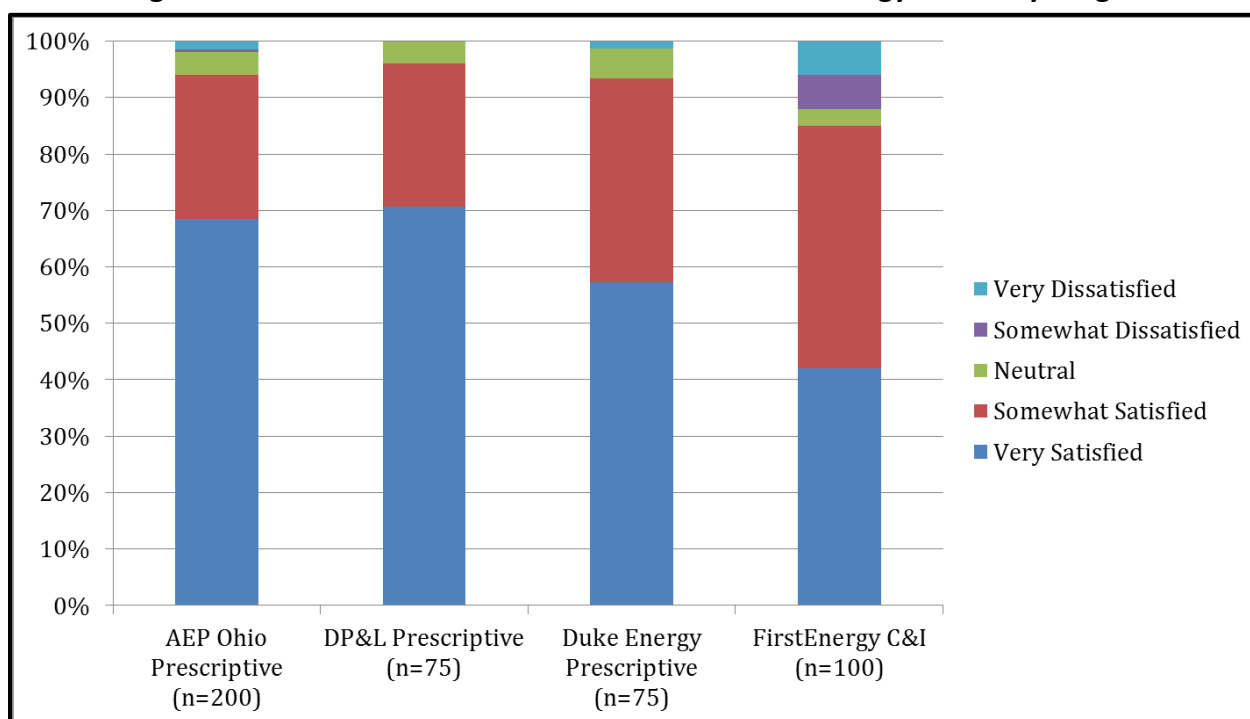


Table 54: Overall Satisfaction with Non-residential Energy Efficiency Program*

Satisfaction with Program	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Very Satisfied	69%	71%	57%	42%
Somewhat Satisfied	26%	25%	36%	43%
Neutral	4%	4%	5%	3%
Somewhat Dissatisfied	1%	0%	0%	6%
Very Dissatisfied	2%	0%	1%	6%
n	200	75	75	100

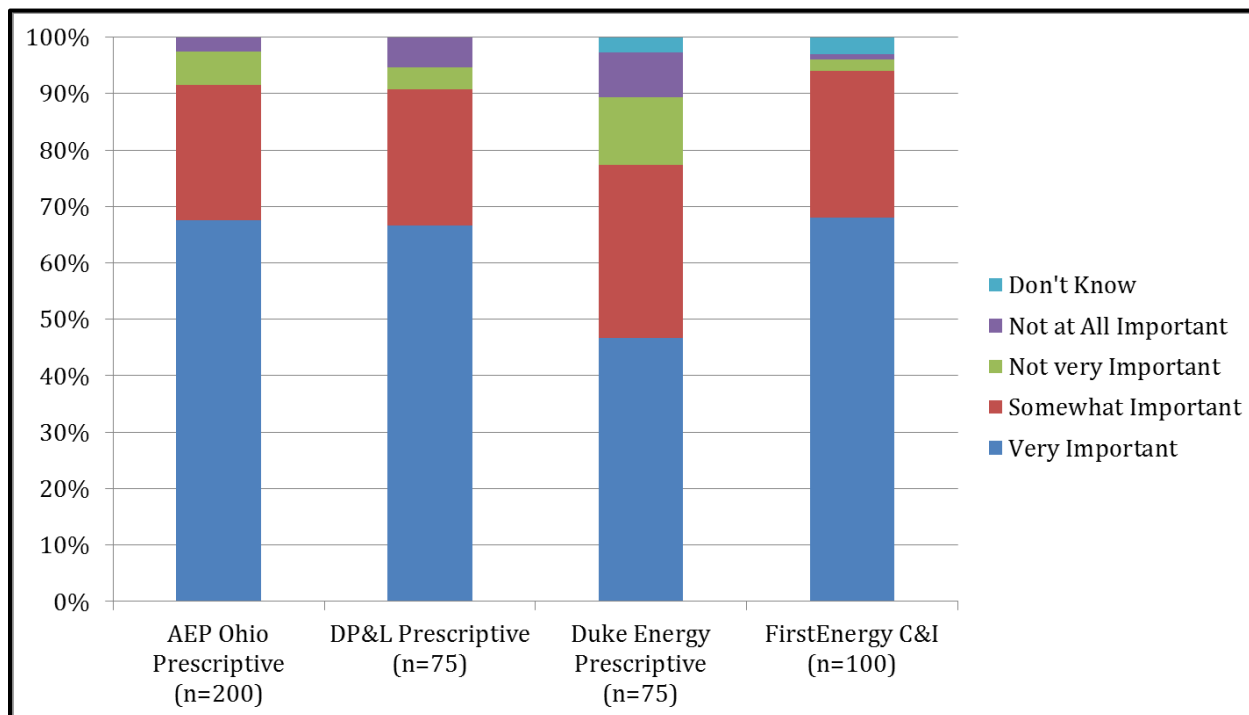
*Total percentages may not sum to 100% due to rounding.

Free Ridership

A free ridership battery of questions was asked of non-residential program participants in order to estimate the degree of free ridership in these programs. As discussed previously, 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, a sizable fraction of participants claim that the rebate was important to their decision to purchase energy efficient equipment. On the other hand, there are also a significant proportion of customers who say that they would have purchased the same equipment even without a rebate during the same budget cycle.

Participants were asked how important various attributes were to their decision to purchase energy efficient equipment. When they were asked about how much the rebate affected their decision, over 90 percent across three of the four programs stated that it was somewhat to very important (see Figure 44). For the same three programs (i.e., AEP Ohio, DP&L, and FirstEnergy), at least 66 percent noted that the rebate was very important. These findings seem to indicate that the rebate was instrumental to some degree in these customers' decisions to participate in the program.

Figure 44: Importance of Rebate on Decision to Purchase EE Equipment



Another question (used as a consistency check) asked participants to choose between different options that describe what they would have done if the rebate were not available to them. Responses to this question are shown in Table 55. For some participants, the importance of the rebate is confirmed. Between 43 to 66 percent would not have undertaken the project during the current budget cycle and/or would have cancelled or postponed some or all of it.

The responses in Table 55 do indicate some free ridership by the proportion of participants who stated that they would have done the project at the same time with the same equipment even if no rebate was available to them. The percentage of participants who said they'd have completed the project as planned without the rebate ranges from a low of 24 percent for FirstEnergy C&I participants to a high of 44 percent for the participants of Duke Energy's Prescriptive program.

Table 55: How Project Might Have Changed If Rebates Were Not Available*

Project Status in Absence of Rebate	AEP Ohio Prescriptive	DP&L Prescriptive	Duke Energy Prescriptive	FirstEnergy C&I
Would not have done project during this budget cycle	61%	60%	43%	66%
Would have done project with different equipment	7%	4%	11%	10%
Would have done project with same equipment at same time	31%	31%	44%	24%
Don't Know	2%	5%	3%	0%
n	200	75	75	100

*Total percentages may not sum to 100% due to rounding.

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. Word of mouth has also shown to be effective in the promotion of non-residential rebate programs in Ohio. This shows that perhaps because the programs have been in existence for a few years, the positive experiences from participation are being relayed between non-residential customers.

Barriers to Participation

Based on survey responses, non-residential participants are concerned about the upfront cost of energy efficient equipment, the quality of the equipment, and the possibility that the energy savings from this equipment will not be as large as they anticipate. The Ohio utilities can help increase customer knowledge and overcome these barriers to participation by providing them with specific energy savings information for energy efficiency measures they may be interested in. A marketing piece presenting the net financial benefits, perhaps using historical data, of these investments would likely prove useful in overcoming the barrier to participation related to the higher upfront costs of measures. The marketing campaign could also provide information on energy efficient equipment reliability and performance as comparable or better to less efficient equipment.

Participation Process and Program Satisfaction

Contractors are the main source of recruitment of non-residential participants to the energy efficiency programs offered by the Ohio utilities. They not only inform their customers about the programs but are oftentimes the ones who fill out program applications (or at the very least provide the applications to their non-residential customers). Their large role in recruiting customers should be encouraged, as mentioned earlier.

Satisfaction with the energy efficient equipment and the programs overall was very high across the programs. Participants also indicated their general satisfaction with the rebate amounts received, as well as with the length of time it took to process rebates. To keep satisfaction with this program high, utilities should continue to process rebates quickly.

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in

Case No(s). 14-0569-EL-UNC

Summary: Report of the Ohio Independent Evaluator, 2012 Ohio Efficiency Programs,
Volume I: Main Report, electronically filed by Raymond W. Strom on behalf of PUCO Staff