



Independent Audit of the FirstEnergy 2014-2018 Energy Efficiency and Demand Reduction Programs

Submitted by Evergreen Economics to the
Public Utilities Commission of Ohio

FINAL Report

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MichaelsEnergy

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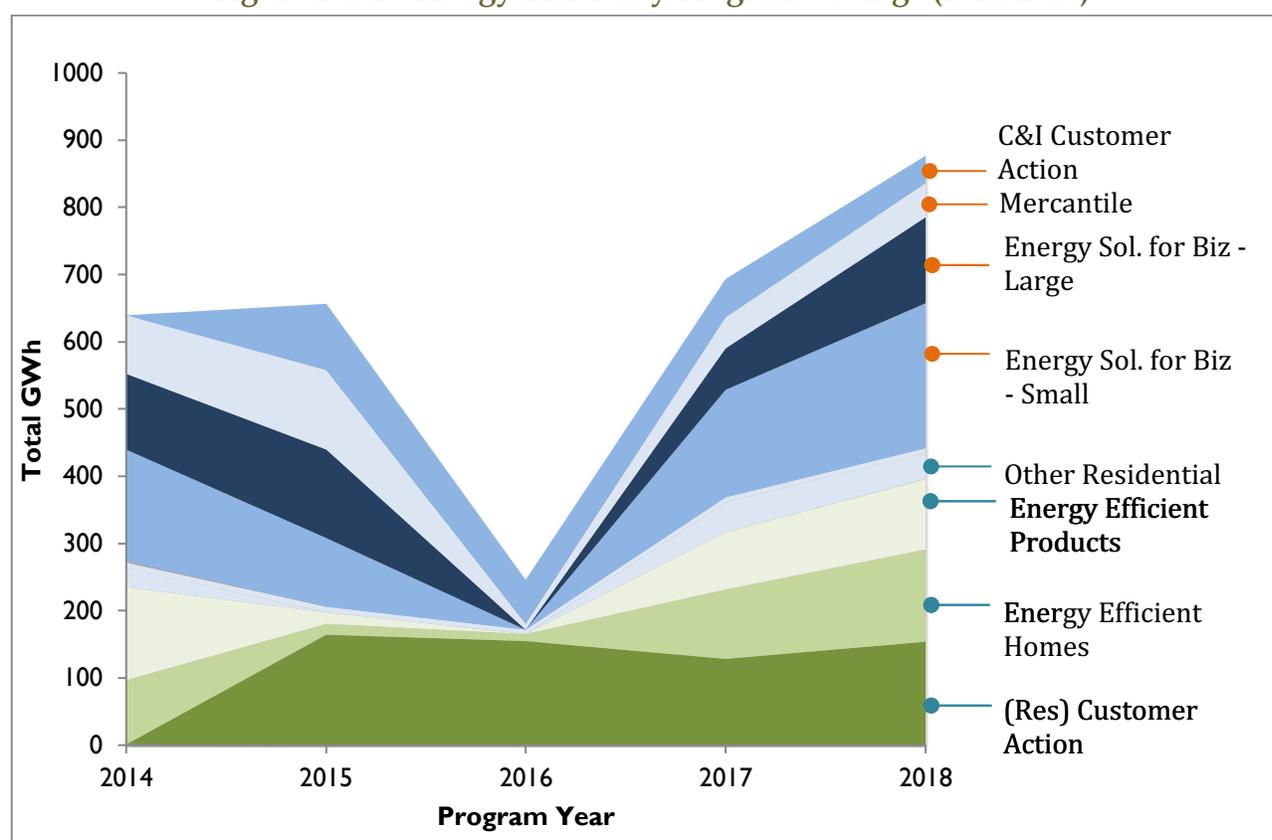
Executive Summary

In March 2019, the Public Utilities Commission of Ohio (PUCO) chose the Evergreen Economics team to conduct an independent audit of the Ohio electric utilities' energy efficiency and peak demand reduction programs. The audit team consists of staff from the following companies:

- Evergreen Economics
- Michaels Energy
- Dr. Philippus Willems / PWP

This report covers the audit review of all the energy efficiency and demand response programs for FirstEnergy's three Ohio Electricity Distribution Companies (Ohio Edison Company, The Cleveland Electric Illuminating Company, The Toledo Edison Company) over the 2014-2018 period. Figure 1 shows the annual energy savings claimed for each FirstEnergy program covered by this audit.

Figure 1: FirstEnergy Efficiency Program Savings (2014-2018)



The primary objectives for the audit established by the PUCO were as follows:

1. Review the annual energy and demand impacts reported by each utility and make recommended adjustments to the savings estimates as needed;
2. Review the various PUCO rulings that are relevant to these programs and confirm that the utilities have adhered to these directives;
3. Characterize the utility programs in terms of utilization of channel partners, independent evaluators, program costs, and opt out and mercantile customers; and
4. Update the Ohio Technical Reference Manual (TRM) to reflect current market conditions, technologies, and evaluation best practices.

As part of the background review of the FirstEnergy programs, we conducted the following activities.

- ***Review of annual portfolio status reports.*** Each of the annual reports was reviewed for the 2014-2018 period. These annual reports were the primary source of the claimed energy savings and program cost information whenever possible.
- ***Review of annual evaluation reports.*** The evaluation reports were included as appendices to the annual portfolio status reports; these were reviewed in detail for each year.
- ***Review of additional filings related to the FirstEnergy programs.*** Related utility filings such as the Green Rules, comments by intervenors on FirstEnergy filings, and FirstEnergy program plans were also reviewed as needed.
- ***Analysis of program-related data from FirstEnergy.*** Additional data supplied by FirstEnergy included information on channel partners and third party contractors that implemented and evaluated the programs, information on mercantile customers and opt out customers, and program cost details that were not included in the portfolio status reports.
- ***Interviews of FirstEnergy program managers.*** Interviews of the FirstEnergy program managers were conducted to collect additional information on the programs that were not captured in the related documents.

Most of the audit was spent reviewing the annual savings and program information for each of the FirstEnergy programs. All of the savings information from the evaluation reports was covered in an initial review, followed by a more in-depth review of selected programs and equipment types that accounted for the majority of program savings. The measures and programs selected for additional review were based on several criteria, including the amount of total savings provided, the uncertainty surrounding the savings estimates, and whether or not the savings calculation methods were in line with standard practice.

For the FirstEnergy programs, we focused our savings review on the Customer Action Programs (CAPs), both for residential and commercial/industrial customers. We chose the CAPs not only because they account for about one-third of claimed kWh savings across the 2014-2018 audit period, but also because the methods employed are completely different from those used for all other FirstEnergy programs.

For other programs, we reviewed the evaluations that were designed to determine the accuracy of each program's claimed savings; for CAP, the evaluations essentially are the claimed savings. As a result, the audit of the CAPs focused on the methods used to determine the number of customers installing energy efficient equipment, the specific measures they installed, the savings associated with those installations, and the extrapolation of results to the total population.

In addition to the CAPs, the other programs in the FirstEnergy portfolio with significant savings were also reviewed, including the Energy Efficient Homes and Energy Efficient Products residential programs and the Energy Solutions for Business program. Due to similarities of measures across programs, the review of these programs was completed by technology, with a focus on lighting and appliances.

Overall, we found that the annual program evaluations were generally consistent with best evaluation practices and conformed to the rules established in Ohio for estimating and reporting savings. In many cases, savings calculations relied on algorithms that are recommended in the Ohio TRM.

Based on the audit review, we have no recommendations for retroactive savings adjustments, but we did note several concerns that should be addressed in future years.

For the CAPs, we noted the following issues:

- While we could not quantify significant over- or under-estimation of program savings that would require a retrospective adjustment, we are concerned that savings for the C&I CAP in particular were sometimes based on a very limited number of observations that could not be proven to be representative of the C&I population.
- Moreover, the use of savings-based incentives in recruiting C&I customers for on-site verification of installed measures introduced a bias into the sample that was used to extrapolate results.
- In addition, a major hurdle in the savings review for both the residential and C&I CAP programs was the difficulty of verifying the baselines for individual projects and our inability to determine precisely what criteria were used to determine whether an equipment installation was qualified to count as savings, such as whether a residential unit was ENERGY STAR® qualified.

For other programs, we noted the following:

- For all lighting measures, the Evergreen team recommends that baseline wattages for all fixture types be updated to reflect current standards and market baselines.
- For appliances, the savings values calculated often do not reflect current standards, which can significantly affect savings. For example, the savings calculated using the current approach are approximately twice the expected savings calculated using ENERGY STAR criteria and current federal standards. We therefore also recommend that baseline wattages for appliances be updated to reflect current conditions.

For the future, our recommendation is that the Ohio Statutes be revised so that CAPs cannot be fielded as energy efficiency programs that generate claimed savings, unless there is an effort to attribute efficiency actions and claimed savings to the influence of current or past utility programs, other market interventions, or promotional activities.

In addition, for any approved energy efficiency programs going forward, we recommend that the following be adopted in order to apply standard practice to the development and application of evaluation results.

- As noted above with reference to lighting and appliances, market or standard practice baselines should be used for all equipment incented through the programs, except in cases of early replacements as specified in program requirements.
- *Ex ante* values should be updated based on the results of evaluations. If evaluations find credible, defensible savings values for specific measures that differ from those in the Ohio TRM, the actual results should become the basis for calculating *ex ante* savings going forward, superseding the information in the TRM until the TRM can be updated using the best data available from all the most recent Ohio evaluations.
- There should be acknowledgement that net program impacts are likely to be less than the gross savings claimed by the utilities, either through calculated net-to-gross values that can be applied going forward or through stipulated net-to-gross values agreed upon by the utilities, regulators, and stakeholders. The fact that FirstEnergy's evaluators were able to identify such a large volume of projects initiated by customers with no input at all from the utility is a clear indicator of significant free ridership, and future evaluations should strive to measure the extent of such free ridership.
- Moreover, some of the actions taken either outside available programs or when no programs were offered could in fact represent spillover from contemporaneous or previous energy efficiency initiatives, and an effort should be made to measure the extent to which program actions or previous participation led to the non-program efficiency actions.

I Introduction

In March 2019, the Public Utilities Commission of Ohio (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 and peak demand reduction programs.¹ The Independent Evaluator team consists of staff from the following companies:

- Evergreen Economics
- Michaels Energy
- Dr. Philippus Willems / PWP

The programs reviewed are for the 2014-2018 period and include those of the following Ohio utilities:

- American Electric Power Ohio (AEP Ohio)²
- The Dayton Power and Light Company (DP&L)
- Duke Energy Ohio (Duke Energy)
- FirstEnergy

As part of this process, the PUCO identified several primary objectives for the Independent Evaluator that can be summarized as follows:

1. Review the annual energy and demand impacts reported by each utility and make recommended adjustments to the savings estimates as needed;
2. Review the various PUCO rulings that are relevant to these programs and confirm that the utilities have adhered to these directives;
3. Characterize the utility programs in terms of utilization of channel partners, independent evaluators, program costs, and opt out and mercantile customers; and

¹ 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).

² AEP Ohio had two operating companies in 2011, 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. Update the Ohio Technical Reference Manual (TRM) to reflect current market conditions, technologies, and evaluation best practices.

This report presents our review of the FirstEnergy programs from 2014-2018. FirstEnergy offers these programs through its three utilities: Ohio Edison, Cleveland Electric, and Toledo Edison. Since the programs are implemented and evaluated the same for each utility, our discussion throughout this report refers to them collectively as FirstEnergy programs to mirror what is done in the evaluations. The annual program savings numbers are broken out by utility in *Appendix B* of this report.

1.1 Ohio Energy Efficiency Regulatory Background

On April 23, 2008, the Ohio legislature adopted Amended Substitute Senate Bill No. 221 (SB 221),³ which went into effect on July 31, 2008. Among the provisions of SB 221 was the requirement in Section 4928.66, Revised Code,⁴ 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.

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

Other important information is contained in the Green Rules promulgated by the PUCO in Chapter 4901:1-39, Ohio Administrative Code (O.A.C.).⁵ As stated in Sec. 4928.662 of SB 310,⁶ for the purpose of measuring and determining compliance with the energy efficiency and peak demand reduction requirements, the public utilities commission shall count and recognize compliance as follows:

³ Am. Sub. SB221 (Schuler, May 1, 2008). Amended Substitute Senate Bill Number 221. 127th General Assembly. 2007-2008.

⁴ Ohio 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>

⁵ Ohio General Assembly, Ohio Administrative Code. (Ohio, Effective Date December 10, 2009). Chapter 4901: 1-39. <http://codes.ohio.gov/oac/4901%3A1-39>.

⁶ SB 310 text taken from http://archives.legislature.state.oh.us/BillText130/130_SB_310_EN_N.pdf

(A) Energy efficiency savings and peak demand reduction achieved through actions taken by customers or through electric distribution utility programs that comply with federal standards for either or both energy efficiency and peak demand reduction requirements, including resources associated with such savings or reduction that are recognized as capacity resources by the regional transmission organization operating in Ohio in compliance with section 4928.12 of the Revised Code, shall count toward compliance with the energy efficiency and peak demand reduction requirements.

(B) Energy efficiency savings and peak demand reduction achieved on and after the effective date of SB 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method. For new construction, the energy efficiency savings and peak demand reduction shall be counted based on 2008 federal standards, provided that when new construction replaces an existing facility, the difference in energy consumed, energy intensity, and peak demand between the new and replaced facility shall be counted toward meeting the energy efficiency and peak demand reduction requirements.

(C) The commission shall count both the energy efficiency savings and peak demand reduction on an annualized basis.

(D) The commission shall count both the energy efficiency savings and peak demand reduction on a gross savings basis.

(E) The commission shall count energy efficiency savings and peak demand reductions associated with transmission and distribution infrastructure improvements that reduce line losses. No energy efficiency or peak demand reduction achieved under division (E) of this section shall qualify for shared savings.

(F) Energy efficiency savings and peak demand reduction amounts approved by the commission shall continue to be counted toward achieving the energy efficiency and peak demand reduction requirements as long as the requirements remain in effect.

(G) Any energy efficiency savings or peak demand reduction amount achieved in excess of the requirements may, at the discretion of the electric distribution utility, be banked and applied toward achieving the energy efficiency or peak demand reduction requirements in future years.

Finally, on July 23, 2019, the Ohio legislature passed House Bill 6 (HB 6) that gives the PUCO authority to end the requirement that utilities provide efficiency and demand response programs once the cumulative savings goal of 17.5 percent is achieved and no later than February 1, 2021. Despite this rule change, we have structured our report and



the Ohio TRM update to be prospective in nature and are assuming (for the purposes of this report) that the programs will continue indefinitely. As a result, we have presented our recommendations and the Ohio TRM update for use in future program years.

2 Audit Methods

The audit followed the same general process for each utility, beginning with a kickoff meeting held via webinar in April 2019. During this meeting, the Evergreen team discussed with FirstEnergy staff the specific tasks that would be completed as part of the audit review. Shortly after the kickoff meeting, a data request memo was sent to FirstEnergy that covered the program background information needed to complete the audit. Additional background material for each utility was also supplied by PUCO staff.

The various audit activities that followed the kickoff meeting are summarized below.

Program Characterization

Following the kickoff meeting, we reviewed as much background material as possible to familiarize ourselves with the FirstEnergy programs and to assess which programs and measure types should be subjected to a more thorough review of savings. As part of the background review, we conducted the following:

- ***Review of annual portfolio status reports.*** Each of the annual reports was reviewed for the 2014-2018 period. These annual reports were the primary source of the claimed energy savings and program cost information whenever possible.
- ***Review of annual evaluation reports.*** The evaluation reports were included as appendices to the annual portfolio status reports; these were reviewed in detail for each year.
- ***Review of additional filings related to the FirstEnergy programs.*** Related utility filings such as the Green Rules, comments by intervenors on FirstEnergy filings, and FirstEnergy program plans – both as filed initially and as modified – were also reviewed as needed.
- ***Analysis of program-related data from FirstEnergy.*** Additional data supplied by FirstEnergy included information on channel partners and 3rd party contractors that implemented and evaluated the programs, information on mercantile customers and opt out customers, and program cost details that were not included in the portfolio status reports.
- ***Interviews of FirstEnergy program managers.*** Interviews of the FirstEnergy program managers were conducted to collect additional information on the programs that were not captured in the related documents.

The conclusion of this background research culminated in a “Program Characterization” memo that summarized the annual program accomplishments and identified measures for additional in-depth review. Most of the memo results are provided in the following *Program Characterization* chapter of this report. *Appendix A* provides the annual savings and cost details for the FirstEnergy programs, and *Appendix B* shows the annual results by individual utility.

Savings Prioritization

The purpose of the program characterization was to review all the programs and measures over the 2014-2018 program years, and then identify those measures and/or programs that would benefit from a more in-depth review of the savings calculations. To identify which measures would receive a more in-depth review, several criteria were used to prioritize measures. Questions that were asked as part of this prioritization included:

- Which programs and measures are accounting for the largest share of savings?
- Which measures have the most uncertainty around their estimated savings?
- What are the relative costs associated with improving savings estimates? Are there secondary data sources that can easily be applied to measures in Ohio?
- How much evaluation work has been done for each specific program/measure and how much additional work is needed?
- Which programs have the highest realization rates relative to the original *ex ante* savings values? Which have the lowest? Have the realization rates changed over time?

One of the most significant developments for the FirstEnergy programs over the 2014-2018 period was the 2015 introduction of the Customer Action Programs (CAPs) for both residential and C&I customers. Citing Revised Code 4928.662, passed as part of SB 310 and approved by the PUCO, FirstEnergy claimed savings from qualifying customer installations of energy efficient equipment outside of utility-administered programs and did not attempt to show how those installations were influenced by any of those programs.

To estimate the savings resulting from customer actions taken in the relevant year, FirstEnergy's evaluation contractor ADM applied a series of market research methodologies. For residential customers, ADM utilized both a top-down market-data-based approach and a bottom-up survey-based approach where a large sample of customers were asked about their equipment replacement actions. For C&I customers, only the survey-based approach was used. In both cases, a sample of survey responses was verified by on-site visits.

In-depth Savings Review

As discussed in the next section, the FirstEnergy in-depth savings review focused primarily on the Customer Action Programs. In most cases, the in-depth savings review was conducted by engineers from Michaels Energy, with additional review on sampling and statistics conducted as needed by Evergreen and PWP staff.

There were several elements relating to the Ohio regulatory requirements that influenced the in-depth savings review and what recommendations were made.

1. ***The Ohio TRM.*** The Ohio TRM is considered a “safe harbor,” meaning that if this source is used for the deemed savings values, the audit team did not attempt to make changes to the savings numbers. The Ohio TRM is outdated, however, with the current version updated in September 2013. In our in-depth savings review, we note if the Ohio TRM is used and make recommendations as needed for future savings values if the Ohio TRM source is outdated.
2. ***SB 310 and Ex Ante Savings.*** Ohio SB 310 states that savings “shall be measured on the higher of an as found or deemed basis” (Section 4928.662(B), Revised Code), which effectively allows the utilities to use either the *ex ante* savings values or the current evaluation savings estimates – whichever is higher. This system provides a disincentive for utilities to adopt the evaluation results if they are lower than the existing *ex ante* values, and in general, the utilities did not appear to regularly update their *ex ante* savings values with the evaluation results from the prior year. This same section also states that “solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method.”
3. ***SB 310 and Non-program Savings.*** One part of SB 310 states that eligible energy efficiency savings and peak demand reductions can be claimed from “actions taken by customers or through electric distribution utility programs that comply with federal standards” (Section 4928.662(A), Revised Code). This has been interpreted as allowing the utility to claim savings for equipment upgrades made by their customers without having to show that these purchases were at all influenced by the utility.

With this regulatory context in mind, our in-depth savings review has resulted in two types of possible recommendations. The first is for *retroactive adjustments* to savings where we recommend that some or all of the savings be adjusted for the 2014-2018 programs. The retroactive adjustments are reserved for the most egregious calculations that clearly contain basic errors and/or are not adequately supported in the evaluation reports. The retroactive adjustments also take into account the considerable leeway that is provided by the three Ohio-specific issues described above.

The second type of adjustment is *prospective adjustments* that we are recommending for future program years. These are instances where the audit team has issues with how the savings are calculated, but the disagreement falls within the bounds of normal differences of interpretation that are commonly found between different evaluation teams. It also takes into account the information that was available to the evaluation team for each program year. In these cases, we recommend that savings values be modified for future program years. Where possible, our recommended savings values are also included in the update to the Ohio TRM that is being completed concurrently with these program reviews.

The results from each of these activities are presented in the following chapters.

3 Program Characterization

This chapter provides our characterization of the FirstEnergy energy efficiency and demand response programs in Ohio, including a succinct summary of the program achievements for this period and identification of specific energy efficient measures or programs that received a more in-depth review as part of this audit.

The programs are summarized by year (2014-2018), followed by additional contextual information that we obtained through our interviews with the utility program staff. Tables summarizing additional information on annual program budgets and impacts are provided at the end of the report. The materials used for this program characterization include the following:

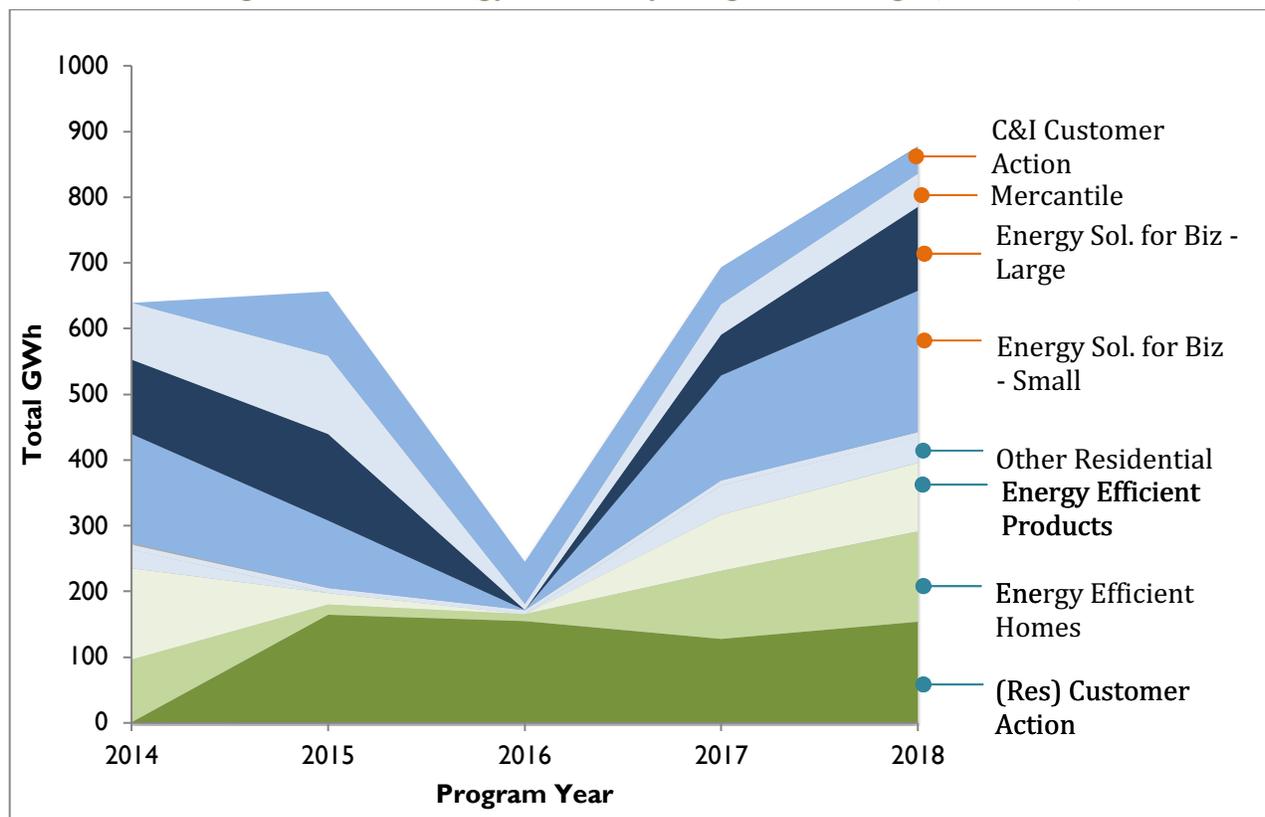
- FirstEnergy's Annual Reports
- FirstEnergy Evaluation Reports
- Additional filings and rulings available on the PUCO website
- Interviews with FirstEnergy staff involved with managing the programs
- FirstEnergy staff responses to a request for additional data

We interviewed five individuals with knowledge of all of the FirstEnergy programs, focusing on the evolution of the FirstEnergy portfolio, the sources of program savings estimates, and general portfolio and policy topics.

3.1 FirstEnergy Program Summary

More than the other Ohio utilities, FirstEnergy and its three electricity distribution utilities (EDUs) have had significant changes over the period covered by our audit, as shown in Figure 2. The first year of that period, 2014, saw continued implementation of FirstEnergy's second Energy Efficiency/Demand Response plan covering the 2013-2015 period, with the same program structure in place as the previous year. However, after the September 2014 passage of SB 310 froze the Ohio energy savings goals, FirstEnergy suspended most of its programs effective beginning in 2015, so that the results for 2015 primarily represent fulfillment of commitments made prior to the program suspension. The program suspension continued through 2016 until the energy savings goals were reinstated, and FirstEnergy launched a broader suite of programs in 2017, which were continued into and through 2018. Savings from these programs over the years are shown in Figure 2.

Figure 2: FirstEnergy Efficiency Program Savings (2014-2018)



In addition to the savings trends shown above, the number of mercantile projects for each year and the number of opt-out customers as of December 31, 2018 are summarized in Table 1, along with the program implementation and evaluation budgets from FirstEnergy’s Energy Efficiency and Peak Reduction Plans.

Table 1: FirstEnergy Mercantile Projects, Opt Outs and Budgets

Project Type	2014	2015	2016	2017	2018
Mercantile	315	41	31	123	66
Opt Out*	-	-	-	-	266
Program Budgets	\$90,627,509	\$85,875,701	N/A	\$89,163,719	\$88,118,973
Evaluation Budgets**	\$3,625,100	\$3,435,028	N/A	\$3,566,549	\$3,524,759

* Opt Outs only reported for 2018.

**Estimated at 4 percent of the program budget.

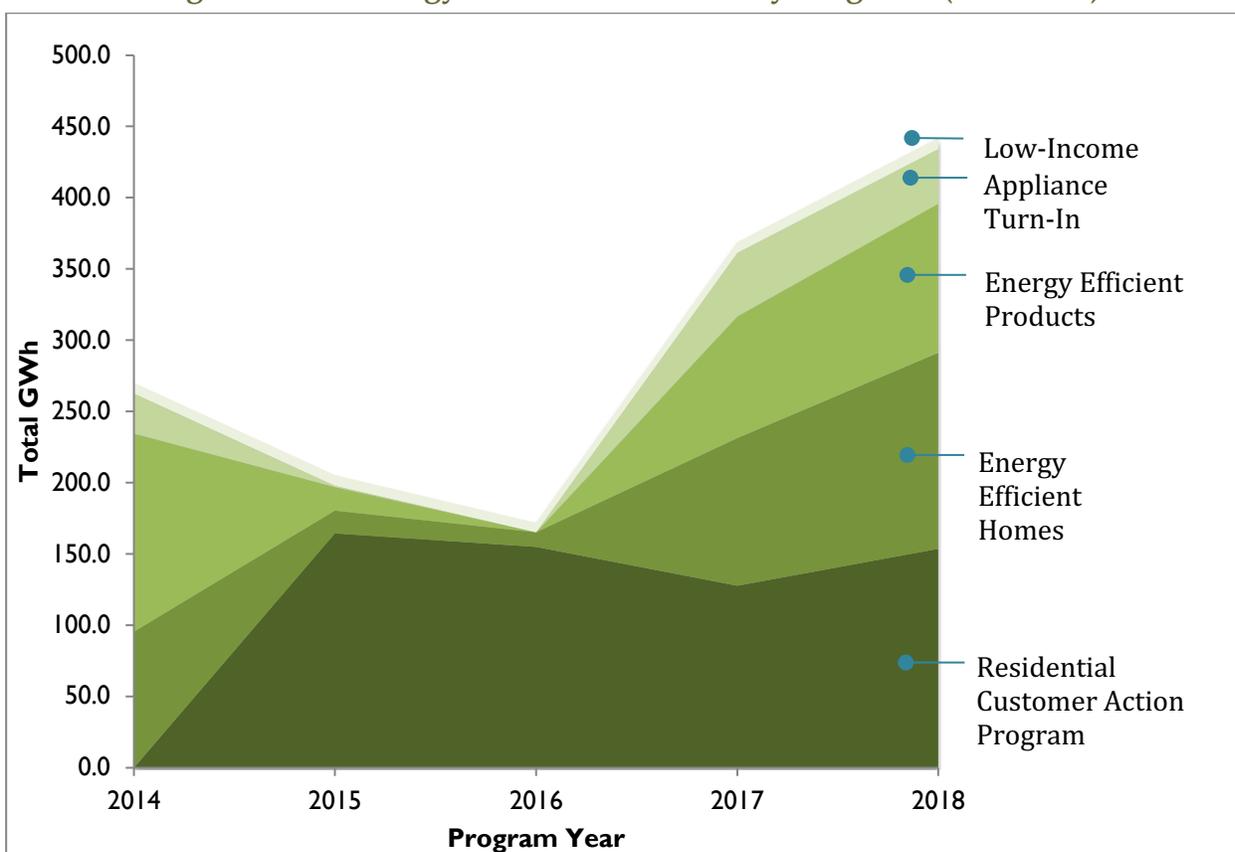
FirstEnergy’s programs are described below, along with any significant changes or issues that occurred over the analysis period.

For 2018, FirstEnergy offered a continuation of the programs that had been re-launched in 2017 after the program hiatus triggered by SB 310 in 2014. Each of FirstEnergy’s EDUs offered the following programs in 2018.

3.2 Residential Programs

The savings from FirstEnergy residential programs are summarized in Figure 3, and show changes in 2015, both from the decline in savings from existing programs and from the savings attributable to the Residential Customer Action Program.

Figure 3: FirstEnergy Residential Efficiency Programs (2014-2018)



The FirstEnergy residential programs during the period from 2014 to 2018 (in order of descending savings for the 2018 program year) are described below.

Customer Action. The residential Customer Action program in 2018 used a similar approach to previous years to capture energy savings and peak demand reductions

achieved through actions taken by customers in the current year outside of utility incentive programs. Estimated savings were based on surveys and other research conducted by the evaluation contractor, ADM, and covered HVAC, lighting, appliances, and consumer electronics purchased during the 2018 calendar year. Lighting and refrigerators/freezers accounted for 68 percent of the program's calculated savings, which represented more than a third of the residential total.

Energy Efficient Homes. This program comprises a suite of subprograms delivered by different implementation contractors and accounted for about 30 percent of residential program savings. The subprograms include:

- Administered by AM Conservation Group, the School Energy Efficiency subprogram provides an opportunity for parents or guardians of K-5 students to request an Energy Conservation Kit.
- The Energy Efficiency ("EE") Kits subprogram provides FirstEnergy customers with energy efficiency measures and educational materials to encourage residential energy usage reduction. This program was administered by Power Direct Energy.
- The audits and education subprogram itself comprises several individual offerings. The Comprehensive Home Audit portion of the subprogram was administered by Franklin Energy, while the Online Audit portion of the subprogram was administered by Aclara from January through March and Oracle from April through December of 2018.
- Oracle was also responsible for the Behavior Modification subprogram, which provides energy usage reports and specific information about each customer's energy usage as well as an analysis regarding their usage over time.

Prior to 2017, this same basic set of program elements was known as the Home Performance Program and accounted for about 30 percent of residential savings in 2014.

Energy Efficient Products. This program provides rebates and incentives to retailers and distributors that sell and residential customers who purchase and install ENERGY STAR[®] qualified appliances, efficient lighting, and consumer electronics. The Consumer Electronics, Lighting and HVAC subprograms are all implemented by Honeywell Smart Energy. Savings amounted to about one quarter of the residential total.

Appliance Turn-In. Managed by implementation contractor Recleim, LLC, this program is designed to help customers reduce their energy consumption by removing old, working refrigerators, freezers, room air conditioners, and dehumidifiers from their homes for recycling.

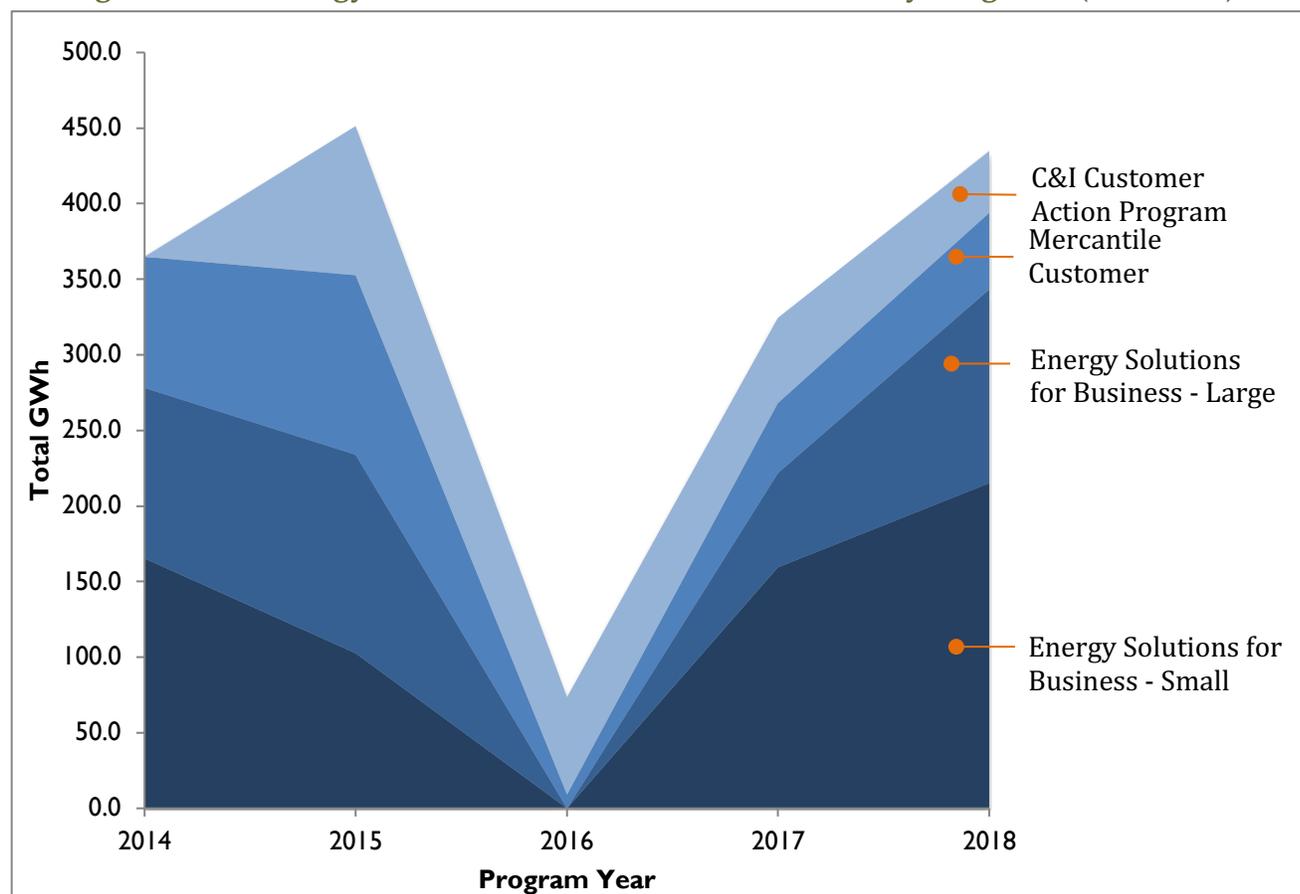
Low Income. The Low-Income program provides weatherization measures, energy efficiency solutions, and client education to low-income customers. It includes the

Community Connections subprogram, which has been operating since 2003 as a collaborative effort to leverage federal, state, utility, and other funding sources to provide weatherization and energy saving products and services to low-income customers. The program generally has a cost-effectiveness ratio of less than 1.0.

3.3 Commercial and Industrial Programs

Programs oriented to small businesses have generally accounted for the largest share of Commercial and Industrial savings, as shown in Figure 4.

Figure 4: FirstEnergy Commercial and Industrial Efficiency Programs (2014-2018)



Individual Commercial and Industrial programs are described below.

Energy Solutions for Business - Small. This program offering was created in 2017 by the combination of the Energy Efficient Equipment – Small and Energy Efficient Buildings – Small programs that had been part of FirstEnergy’s portfolio in 2013-2015. The Energy Solutions program offers rebates for multiple technologies applicable to business and other non-residential facilities defined as “small” by their rate schedule. Subprograms

include HVAC, Lighting, Food Service, Appliance Turn In, Appliances, Consumer Electronics, Agricultural, Data Centers, Custom, Retro-Commissioning, and Custom Buildings. Sodexo, Inc. is the primary implementation contractor. The program accounted for 24 percent of total Energy Efficiency Program savings in 2018, or almost half of the savings from all C&I programs.

Energy Solutions for Business - Large. Also administered by Sodexo, this program's primary objective is to increase the energy efficiency of existing buildings used by commercial, industrial, and municipal customers. Subprograms implemented as part of the C/I Energy Solutions for Business Program - Large are HVAC, Lighting, Data Centers, Custom, Retro-Commissioning, and Custom Buildings. This program, too, was the result of combining the previous Energy Efficient Equipment and Energy Efficient Buildings offerings.

Mercantile Customer. This program continues to provide large customers that meet the regulatory definition of "mercantile" and that achieve energy efficiency and peak demand reduction savings independent of other direct utility programs or incentives the opportunity to file joint applications with the utility to the Commission in exchange for a cash incentive or exemption from the efficiency rider. Customers are eligible to apply with energy saving projects completed anytime within the past three years. Savings attributed to the Mercantile Customer program were larger in 2014 and 2015 than in more recent years.

Customer Action - Small and Large C&I. Like its residential counterpart, this program consists of identifying and estimating the savings achieved by commercial and industrial customers that installed energy efficient equipment outside any other FirstEnergy program. The Customer Action Program accounted for most of C&I savings in 2016, but its share has declined in subsequent years.

The remaining Government Tariff Lighting, T&D Improvements, and Smart Grid Modernization Initiative programs all achieved only very modest savings in 2018.

1) Cost per kWh

To gauge the relative cost-effectiveness of the various FirstEnergy programs, we calculated the cost per kWh by program, for each year and over the entire 2014-2018 audit period (Table 2). Note that the Customer Action Programs had by far the lowest costs, while the Low Income residential program, which is not subject to the same cost-effectiveness criteria as the other programs, had the highest.

Table 2: FirstEnergy Expenditure per kWh of Annual Savings

Program Name	2014	2015	2016	2017	2018	2014-2018
Appliance Turn-In	0.120	0.961		0.131	0.124	0.131
Energy Efficient Products	0.049	0.077		0.059	0.076	0.061
Energy Efficient Homes	0.108	0.074		0.130	0.093	0.104
Low-Income	0.690	0.762	0.851	0.841	0.812	0.790
Customer Action Residential		0.002	0.004	0.002	0.002	0.003
Energy Solutions for Business – Small (Eqpt + bldgs pre-16)	0.070	0.080		0.107	0.087	0.087
Energy Solutions for Business – Large (Eqpt + bldgs pre-16)	0.095	0.086		0.136	0.092	0.102
Mercantile Customer	0.073	0.003	0.074	0.059	0.061	0.043
Customer Action – All CI		0.007	0.017	0.005	0.007	0.009
Government Tariff Lighting	0.284			0.454	0.106	0.198
Total	0.087	0.045	0.033	0.086	0.073	0.069

3.4 Audit Portfolio Assessment

The first year of the 2014-2018 period covered by our audit reflected FirstEnergy’s second Energy Efficiency/Peak Demand Reduction (EE/PDR) Plan, filed on July 31, 2012 and approved on March 23, 2013, which included most of the components of the previous plan, with only minor modifications.

However, the FirstEnergy programs changed dramatically after the passage of Senate Bill 310 on September 12, 2014. Within 10 days, FirstEnergy requested approval to amend its existing EE/PDR plan, effective January 1, 2015 and running through December 31, 2016. The Commission approved the amended EE/PDR Plans on November 20, 2014.

At that point, as program managers noted during interviews, FirstEnergy began to wind down its programs in an orderly fashion, and suspended applications to most of its programs at the end of the year, meaning that 2015 totals represent fulfillment of commitments made prior to the program suspension. For example, the Residential Energy

Efficient Products program still reported incremental savings of 16.6 GWh in 2015, down from 138.9 GWh in 2014.

Programs still active in 2015 included the Residential Direct Load Control, Residential Low Income, and Mercantile programs. A significant change in 2015 was the introduction of the Customer Action Programs for both residential and C&I customers. Citing Revised Code 4928.662, passed as part of SB 310 and approved by the PUCO, FirstEnergy claimed savings from qualifying customer installations of energy efficient equipment that were outside of utility-administered programs, with no indication of any program or utility influence.⁷

To estimate the savings resulting from customer actions taken in the relevant year, FirstEnergy's evaluation contractor ADM applied a series of market research methodologies. For residential customers, ADM utilized both a top-down market-data-based approach and a bottom-up survey-based approach where a large sample of customers were asked about their equipment replacement actions. For C&I customers, only the survey-based approach was used. In both cases a sample of survey responses was verified by on-site visits.

- Because the market research conducted by ADM provided the sole basis for the significant savings claimed for the Customer Action programs in 2015 and beyond, we conducted in-depth savings reviews of the relevant evaluation reports.
- For most of the programs operated by FirstEnergy, ADM's evaluations have consistently found realization rates that are within 10 percent of 1.0, and these evaluations generally follow standard practice for the industry and are well documented. One exception to industry best practice appears to be due to the Ohio R.C. §4928.662 provisions that mandate that savings shall be measured on the higher of the two between an "as found" or deemed basis, regardless of the age of the existing equipment. As noted in the 2018 Evaluation of the 2018 Energy Efficient Products Program (p. 1-3), "ADM calculated gross savings for measures in the program with "as found" baseline conditions, hours of use, and installation rates. As specified in Ohio R.C. §4928.662, the values reported for energy savings (kWh) and peak demand reduction (kW) represent the higher calculated value obtained from both methodologies, for both ex-ante and ex-post energy savings."

⁷ From the Ohio Revised Code: Energy efficiency savings and peak demand reduction achieved through actions taken by customers or through electric distribution utility programs that comply with federal standards for either or both energy efficiency and peak demand reduction requirements, including resources associated with such savings or reduction that are recognized as capacity resources by the regional transmission organization operating in Ohio in compliance with section 4928.12 of the Revised Code, shall count toward compliance with the energy efficiency and peak demand reduction requirements.

- While there are discussions among evaluators regarding what actions qualify as early replacement, it is generally agreed-upon evaluation practice to require a market or standard practice baseline when equipment is replaced at or near the end of its life, which could significantly reduce savings from many of these programs. Again, however, this practice is consistent with the Ohio Revised Code, and the evaluations were conducted accordingly, so we did not recalculate those results.
- As with the other Ohio utilities, FirstEnergy programs have relied heavily on lighting, which accounted for over 70 percent of savings for the Large and Small C&I programs and over 90 percent of C&I CAP savings in 2018. The evaluation realization rates for lighting measures are generally high, but we conducted an in-depth review of selected measures to confirm that claimed savings values remain valid.

4 Savings Review

The savings review is intended to verify that the evaluations and claimed program savings are consistent with industry standards and are compliant with the Ohio energy efficiency program rules. Because the market research conducted by ADM provided the sole basis for the significant savings claimed for the Customer Action Programs in 2015 and beyond, we believe its approach warrants an in-depth savings review.

4.1 Customer Action Program (CAP)

For all the FirstEnergy electric distribution utilities, we focused our savings review on the Customer Action Programs (CAPs), both for residential and commercial/industrial customers. As noted previously, we chose the CAPs not only because they account for a significant share of claimed savings (33 percent of kWh savings across the 2014-2018 audit period), but also because the methods employed are completely different from those used for all other FirstEnergy programs.

For other programs, the audit team reviewed the evaluations that were designed to determine the accuracy of each program's claimed savings; for CAPs, the evaluations essentially are the claimed savings. The CAPs are not utility incentivized programs at all, but an effort to estimate and claim energy savings from actions taken by utility customers completely on their own. As a result, the audit of the CAPs focuses on the methods used to determine the number of customers installing energy efficient equipment, the specific measures they installed, the savings associated with those installations, and the extrapolation of results to the total population.

4.1.1 Overall Approach

We discuss the overall approach to the CAP evaluation in some detail below, precisely because it is so different from standard evaluation reports, where *ex post* savings are calculated and compared to the *ex ante* savings claimed by the program. The approach was developed and first applied to claim savings for actions taken in 2015. It was essentially unchanged for 2016, 2017, and 2018, although the specific discussion below applies to the 2015 analysis.

4.1.2 Analytical Approach – Residential

For residential customers, ADM estimated savings through two alternative approaches:

1. A bottoms-up approach that relied on a household survey of customers in FirstEnergy service territories to estimate the number of residential customers that

installed lighting or purchased a new refrigerator in 2015 or intended to purchase lighting or a refrigerator in 2016.⁸

2. A top-down approach that utilized data from the Energy Information Administration (EIA); the Association of Home Appliance Manufacturers; the Air-Conditioning, Heating, and Refrigeration Institute (AHRI); and ENERGY STAR.

For the bottom-up analysis, ADM purchased a database of telephone numbers for the zip codes within the FirstEnergy (Ohio) service territories. ADM then contracted with a third-party survey implementer to randomly contact a sample of customers. Prior to completing a survey, customers were screened to ensure that they were a customer of one of FirstEnergy's service territories. Customers who agreed to participate in the survey were compensated with a \$5 Target gift card. While the ADM report does not state how many residential customers the ADM team attempted to contact, for the bottom-up household survey, it does state that they obtained information from 1,800 customers of one of the three FirstEnergy service companies.

ADM compared the age of home⁹ and household income (both of which were asked in the phone survey) to U.S. Census data from the American Community Survey (ACS) to ensure that the sample of households approximately matched the actual distribution of customers on these two characteristics, which ADM reasonably hypothesized influence the purchase of energy efficiency measures. ADM found no statistically significant difference in household income between survey respondents and the ACS data, but did find that the age of the home is statistically significantly different, but ADM (seemingly) concluded that the difference was not of practical significance and so did not factor age-of-home into their analytical weighting scheme.

Lighting

ADM's survey instrument included questions to establish the familiarity of residential customers with LED and CFL bulbs, as well as with increased efficiency incandescent and halogen bulbs. The survey then asked about LED, CFL, and increased efficiency incandescent and halogen bulb purchases in 2015, if and when the bulbs were installed and in what location within the home, and what type of bulb the new (higher efficiency) bulb replaced. The survey instrument did not include questions related to rebates or incentives received from a FirstEnergy service company or from any other organization, although customers who had participated in programs were removed from the sample.

⁸ ADM also asked about installation of new HVAC systems, but due to the low incidence of surveyed customers that installed a new HVAC, ADM relied on the top-down approach to estimate savings from the installation of HVAC systems.

⁹ ADM actually used the term "age of the household," which typically implies the age of the head-of-household; however, in Table 4-1 it is clear that ADM actually refers to the age of the home.

With the information gathered through the survey and equations contained in the Ohio TRM, ADM estimated energy savings and demand reduction for 2015 for each lighting measure (LED, CFL, halogens).¹⁰

Refrigerator

ADM's survey asked residential customers if they purchased a refrigerator in 2015 and, if so, whether the refrigerator was ENERGY STAR qualified. Customers who responded that they had purchased a refrigerator were then asked if the refrigerator was purchased as a replacement for an existing broken or functional refrigerator and, if so, what did they do with the old unit. This question is important because the deemed savings associated with a new higher efficiency refrigerator is only realized when the old unit it replaces is no longer in service (i.e., is recycled or otherwise disposed of).

ADM used the information gathered through the household survey to corroborate estimated energy savings from higher efficiency replacement refrigerators developed using a top-down approach. ADM's top-down approach utilized data from FirstEnergy, the U.S. Census Bureau, EIA, and the Air-Conditioning, Heating and Refrigeration Institute (AHRI).¹¹

ADM followed a top-down analytical approach and relied on the same data sources to estimate energy savings from refrigerator replacements that is similar to the approach it used for HVAC replacement.

HVAC

ADM's survey instrument included a question asking respondents if they installed any of the following HVAC equipment in 2015: Room Air Conditioner, High-Efficiency Central Air Conditioner, Air-to-Air Heat Pump, or Mini-Split Heat Pump. Similar to the battery of questions associated with refrigerators, for those residential customers who indicated they purchased any of these types of HVAC units, the ADM team asked follow-up questions regarding the efficiency rating of the new equipment and whether the new equipment replaced an existing unit.

It is not clear in ADM's description of their analytical approach how the information gathered through the household survey of residential customers factored into ADM's calculation of estimated energy savings and demand reduction for 2015 for customers that purchased energy efficient HVAC equipment – which included room air conditioners,

¹⁰ Formulas used by ADM are shown on pages 4-5 – 4-7 of the ADM evaluation report of the Customer Action Program.

¹¹ Formulas and factors used by ADM are show on pages 4-10 – 4-15 of the ADM evaluation report of the Customer Action Program.

central air conditioners (CACs), and heat pumps.¹² Instead, it appears that ADM’s approach relied entirely on aggregate data obtained from FirstEnergy’s service companies, the U.S. Census Bureau, EIA, and AHRI. This should not be considered a criticism of ADM’s approach, but rather an observation.

ADM’s analytical approach seems reasonable and takes into account key factors affecting a homeowner’s decision to purchase energy efficient HVAC equipment such as income, climate zone, and the EUL of existing equipment, which is represented in ADM’s approach through residential HVAC purchase data for the EIA region that includes northern Ohio.

4.1.3 Savings Analysis – Residential

According to the 2018 Customer Action Program Measurement and Verification Report, the evaluation contractor investigated installations of and savings from four residential measure categories: lighting, appliances, HVAC, and consumer electronics. Claimed annual kWh savings from these categories are shown below in Table 3.

Table 3: Residential Savings Estimation Approaches

	2018 Annual GWh Savings	Primary Approach	Secondary Approach
HVAC*	23,869.6	Top-down	Bottom-up
Refrigeration	35,194.6	Bottom-up	Top-down
Lighting	45,835.8	Bottom-up	Top-down
Consumer Electronics	35,494.8	Bottom-up	Top-down
Total Residential	140,394.8	Bottom-up	Top-down

* Dehumidifiers used bottom-up primary, top-down secondary.

Our approach to the analysis of residential savings is to examine each group of measures separately. For 2015 through 2017, this included HVAC, lighting, and appliances. Consumer electronics were added in 2018. For each of those categories, we will analyze:

- The calculation and reasonableness of the percentage of customers installing each type of equipment;
- What specific customer-installed measures were included in the analysis and how those were determined;

¹² Formulas and factors used by ADM are show on pages 4-16 – 4-19 of the ADM evaluation report of the residential Customer Action Program.

- The per site savings from those installed measures and whether they are reasonable compared to TRM values and claimed savings from the same or similar measures when covered by a program; and
- How the savings from the customers in the study were extrapolated to the total population and whether those extrapolations are reasonable.

4.1.4 Number of Installations

HVAC

For central air conditioners, heat pumps, and room air conditioners, ADM in 2015 used a top-down approach that appears to have relied heavily on EIA data from the 2009 Residential Energy Consumption Survey (RECS), including the saturation of HVAC equipment, the number of CAC, heat pump, and room AC units that were less than 2 years old, and the distribution of HVAC saturation (including equipment age) by income category – which appears to have been available at a national level only.

The result of ADM's analysis for 2015 was that an estimated 2.1 percent of FirstEnergy's 1.8 million residential customers generated savings by installing a CAC and another .15 percent bought heat pumps. While the 2009 EIA data do show that 4.3 percent of homes in Ohio and Indiana (separate data by state were not available) had CAC units, including heat pumps, that were less than two years old (indicating that half that many presumably would have been replaced in a single year), it seems unlikely that every one of those installations would have generated significant energy savings. Moreover, the estimate of the number of units less than two years old has a relative standard error of 20, which makes it a questionable basis for generating an estimate of savings down to the single digit kWh for FirstEnergy overall, let alone the individual EDUs.

For room ACs, the percentage of units less than two years old for all five East North Central states was 2.8 percent, with a relative standard error of 20.7, again limiting the reliability of any estimates only for FirstEnergy customers in Ohio.

Lighting

For lighting, ADM's 2015 analysis used a bottom-up approach and found that 70 percent of the 1,800 survey respondents reported installing lighting, with 93 percent of bulbs reported by those respondents confirmed as being installed. Ultimately, ADM found that on average, each FirstEnergy residential customer had installed 1 CFL and 1 LED, but only 1 in 14 had installed a halogen bulb. This resulted in a total of 131,137 halogen lamps, 1,716,792 CFLs, and 1,956,397 LEDs. In contrast, in 2018, a similar number of halogens were installed (129,487 lamps), but significantly more LEDs were installed than CFLs, at 1,202,646 LEDs compared to 316,016 CFLs. The installation rate had also dropped to 76 percent bulbs reported as purchased.

Appliances

For refrigerators, ADM concluded that 6.4 percent of FirstEnergy residential customers purchased a refrigerator in 2015, and calculated savings on a quantity of 126,142 refrigerators. However, applying 6.4 percent to the 2015 residential population of 1.8 million yields a total of 118,600 refrigerators, a difference that is not addressed in the evaluation report. Moreover, the number of ENERGY STAR rated refrigerators would be expected to be only about half that total, based on the 2017 ENERGY STAR® Unit Shipment and Market Penetration Report, which estimates ENERGY STAR market penetration for refrigerators at 46 percent. As a result, the number of refrigerators used in the savings calculations presented on page 5-3 of the evaluation report is not supported. In addition, the discussion does not make clear whether all refrigerators or only ENERGY STAR refrigerators were used in the calculation.

4.1.5 Savings Per Installed Unit

HVAC

Savings per unit for CAC, heat pump, and Room AC measures calculated from the number of units and savings reported in the evaluations are summarized below Table 4.

Table 4: Residential HVAC Savings Values

HVAC Measure	Per Unit Annual kWh Savings			
	2015	2016	2017	2018
CAC	347.3	346.7	436.6	529.3
Heat Pump	575.1	574.2	571.7	580.5
Room AC	9.4	9.4	9.3	9.4

By way of comparison, the 2018 Energy Efficient Products evaluation reports the following number of units installed and overall savings (shown in Table 5), which we used to calculate kWh savings per unit. Note that the per unit CAC savings are much lower, while the heat pump and room AC savings per unit are roughly twice as much as those calculated for CAP installations for all four years.

Table 5: Energy Efficient Products Evaluation HVAC Savings Summary (2018)

HVAC Measure	No. Of Units	kWh	kWh/Unit
CAC	529	76,128	143.9
Heat Pump	153	183,263	1,197.8
Room AC	4,861	94,755	19.5

The primary differences in the savings estimates for the CAC measure are due to differences in the assumed baseline CAC unit efficiencies. Specifically, the Energy Efficient Products program is based on the installation of efficient equipment relative to a new, code-compliant unit with an efficiency of 13 SEER. The CAP program is based on the installation of a new unit relative to an existing, low-efficiency unit with an efficiency of 10 SEER. This difference results in approximately three to five times the savings level (depending on the installed unit efficiency) for the CAP program compared to the Efficient Products program for the same installed unit.

Under SB 310, savings are allowed to be claimed compared to existing unit efficiency. However, it is not clear how the SEER 10 baseline unit efficiency was determined. The SEER 10 baseline unit reflects an expected efficiency for an aged unit in poor operating condition. This would not be appropriate for new construction, new installations, or units replacing non-functional units. The Evergreen team recommends that this efficiency level be investigated to ensure consistency with the actual weighted average existing unit efficiency, or the deemed approach from the TRM should be used.

Conversely, the savings claimed for heat pumps and room AC savings are less in the CAP than in the Efficient Products program. Based on the 2018 evaluation report, the room AC unit savings for the CAP program appears to be artificially suppressed due to the savings being based on typical efficiency levels for CAC units rather than for room AC units. The efficiency levels appear to be calculated correctly for the Efficient Products program.

The savings for heat pump systems are significantly lower in the CAP program for heat pumps than the savings for heat pumps in the Efficient Products program. However, it is important to note that the savings presented are based on the *evaluated* savings for the Efficient Products program. In 2018, the evaluated savings were found to be 74 percent greater than the *ex ante* savings estimates based on actual installed units' efficiencies, locations, and baseline system types. The top-down approach utilized by the CAP program is not able to fully utilize this information; therefore, it was not adjusted similarly and is much closer to the originally claimed savings values.

Lighting

Savings per unit for halogen, CFL, and LED installations calculated from the number of units and savings reported in the CAP evaluations are shown below in Table 6.

Table 6: CAP Lighting Savings

Lamp type	Per Unit Annual kWh Savings			
	2015	2016	2017	2018
Halogen	3.0	3.9	1.3	4.5
CFL	36.8	36.2	28.3	21.0
LED	68.7	35.5	29.1	32.1

The savings in the table above are based on the survey data to determine the type of lamp replaced with the installation of the efficient halogen, CFL, or LED lamp as well as the expected lamp hours of operation based on the installed location. The variation by year is a reflection of changes to these variables. The breakdown of removed bulb type by installed bulb from 2018 is shown in Table 7.

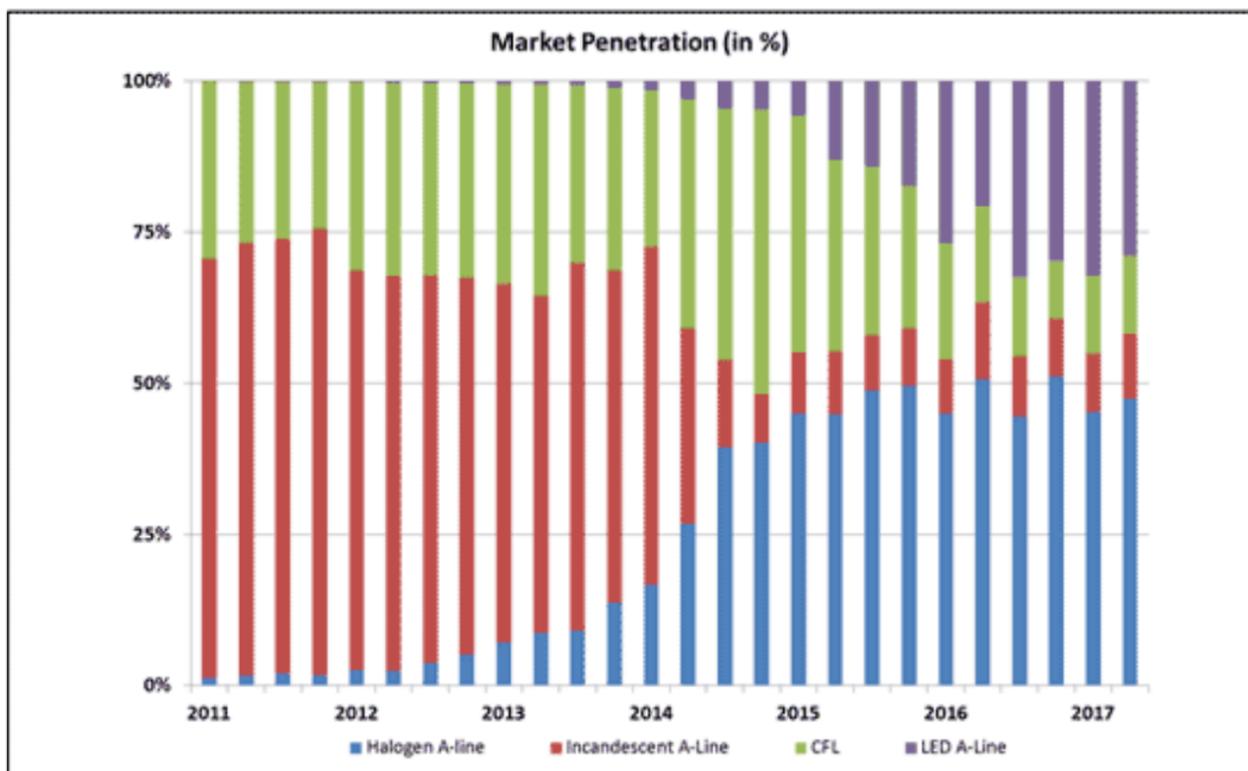
Table 7: Comparison of Installed and Removed Bulb Types (2018)

Pre-existing Bulb	Installed Bulb Type		
	CFL	LED	Halogen
Incandescent	56.34%	63.44%	51.24%
Halogen	5.03%	5.67%	36.94%
CFL	32.93%	22.72%	8.13%
LED	5.70%	8.18%	3.69%

Approximately 60 percent of the installed bulbs are described as replacing incandescent bulbs, based on the customer survey responses. It should be noted that this finding is inconsistent with data from the National Electric Manufacturers Association (NEMA) on the market penetration rate of incandescent A-type bulbs. As shown in Figure 5, the NEMA lamp data¹³ indicate that incandescent lamps have accounted for less than approximately 10 percent of the consumer lamp market since mid-2014. Moreover, incandescent lamps have a much shorter expected life than CFLs and LEDs, so their reduced market penetration would be expected to translate to fewer installed incandescent lamps relatively quickly, particularly in fixtures with longer hours of operation.

¹³ Second Quarter 2017 Year-Over-Year LED A-Line Lamp Indices (<https://www.nema.org/Intelligence/Indices/Pages/Second-Quarter-2017-Year-Over-Year-LED-A-Line-Lamp-Shipment-Up.aspx>). Accessed September 11, 2019.

Figure 5: NEMA Lightbulb Market Penetration Rates (2011-2017)



While these data do not directly compare to the removed lamp data used to develop the savings, the low level of sales for the previous five years suggests that the incandescent lamp removal rate may be overestimated. It is possible that customers are not able to accurately differentiate between incandescent and halogen bulbs. This issue should be addressed in future evaluations, and the assumed wattages for replaced lamps need to be updated to reflect current market conditions.

It is important to note, however, that the resulting savings for the installation of the CFL and LED bulbs are reasonable when compared to the claimed savings for similar lamps in other programs. Specifically, the LED savings are similar to the claimed savings for a 9W LED lamp claimed for the audit track in the Energy Efficient Homes program. Since the use of either an existing case baseline or a “new construction” halogen baseline is acceptable and the overall change to the program savings would be small, no retroactive changes are recommended. However, care should be taken in future years to both identify burned out bulbs as well as differentiate between halogen and incandescent bulbs.

Appliances (Refrigerators)

Savings per unit for refrigerators and freezers are based only on the number of units installed, with the per unit savings taken from the 2010 Ohio TRM. The per-unit savings reported in the 2018 CAP evaluation are shown in Table 8.

Table 8: Refrigeration Savings Values (2018)

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

While the use of the 2010 TRM values is acceptable under the guidelines of SB 310, the 2010 TRM values are outdated and do not accurately represent the savings for current refrigerator installations. Specifically, the 2010 TRM does not reflect current federal standards nor current ENERGY STAR criteria. Updating to current standards would reduce the savings for these installations by approximately half, depending on the types of refrigerators and freezers installed as well as their sizes.

4.1.6 Analytical Approach – Commercial & Industrial

To develop estimates of energy savings for C&I, ADM grouped C&I customers by operating company into six strata based on average annual energy use (18 strata in total) and randomly selected a sample of customers from each stratum for the telephone survey.

For each sampled firm willing to provide responses to the telephone survey, a representative of the ADM team asked if the C&I customer had installed or planned to install any of the following equipment in 2015: lighting, refrigeration unit (including ice makers and freezers), HVAC systems or components, boilers, hot water heaters, electric motors, or clothes washers. C&I customers that did install new equipment and were willing to respond to the survey were compensated \$50.

For C&I customers who were willing to participate in on-site evaluation, ADM requested documentation on the installed measure and an on-site evaluation was scheduled. These customers were compensated up to a maximum of \$1,000 based on the verified kWh savings associated with the installation of any of the equipment types listed above. On-site visits included verification that all measures were installed and collection of data to develop estimates of energy savings, and customers were interviewed to obtain additional information on the installed measure(s).

We would note here that we believe the structure of the incentive offered by ADM (as a representative of FirstEnergy) may have led to an unintended bias in responses by C&I

customers due to the payment being based on the amount of verified electricity savings. It is reasonable to assume that customers with larger projects – and therefore greater energy savings – were more likely to agree to an onsite verification. Under this scenario, verified electricity savings would be upward biased.

Commercial customers were asked the following questions regarding the characteristics of their buildings in order to develop estimates of energy savings: size of building(s), normal operating days and hours, holiday and other business closures, and facility type (e.g. health care, warehouse, industrial, school).

Customers that installed lighting were asked a battery of questions to document the type of lighting (e.g. LED, linear florescent), how many bulbs they installed, if they replaced existing lighting and what type of lighting they replaced, and the number and/or size of the units installed (e.g. number of LED bulbs). This battery of questions was repeated for each type of installed lighting.

The ADM team then asked about the installation of the other energy efficient equipment listed above, the efficiency rating (e.g. SEER/EER) and/or size of the installed equipment (e.g., square feet of conditioned space, tons or Btu/hour capacity), if the new equipment replaced existing equipment, and the type and age of the old equipment. Customers were also asked their primary fuel for heating and their standard temperature set points used for HVAC equipment.

For water heating equipment, customers were asked about the number, capacity, thermal capacity, and, for electric storage, if the new equipment is GAMA/AHRI certified. Customers were then asked if the new equipment replaced existing water storage equipment and, if so, the characteristics of that equipment. The ADM survey also covered tankless water heating equipment and hot water boilers. Where applicable, customers were asked about installation of low-flow faucet aerators, spray valves, low-flow shower heads, and clothes washers.

Finally, for customers that installed new motors, the ADM survey instrument included a battery of questions about the new and existing equipment.

4.1.7 Review of Savings Calculations – Commercial & Industrial 2015

For 2015,¹⁴ ADM reported that 159 C&I customers provided all of the required documentation necessary to verify installation of the respective energy efficient equipment. Given that ADM stratified the universe of 189,631 C&I businesses into 18

¹⁴ The audit team reviewed the 2015, 2016, 2017, and 2018 CAP evaluation reports. The evaluation protocols followed by ADM were similar each year; therefore, while our comments focus specifically on 2015, they hold for the other years as well.

strata (six strata for each of the three operating companies), this means that on average, each stratum was composed of about nine customers. ADM then reported that their verification achieved a level confidence of 95 percent with a precision of 5.63 percent – but ADM based this on a sample size of 2,684 sites, which is meaningless because it does not factor in the 5.9 percent response rate ($159/2,684 \approx 5.9\%$) achieved in their outreach. In fact, given that ADM stated that C&I customers provided all of the documentation necessary to verify savings for only 159 sites (page 5-4), the level of precision of their efforts would likely be not better than ± 12.5 percent.

ADM then reported that there were only 124 sites with calculated energy savings (see page 5-7), suggesting that the actual sample of C&I customers was even smaller than earlier stated, with a resulting higher relative precision. For the sample of 124 sites, the distribution of installed measures is as follows:

- 108 sites included lighting measures
- 25 included HVAC measures
- 16 included refrigeration measures
- 10 included electric water heating measures
- 5 included high efficiency motor measures
- 7 included industrial process improvements or other custom energy efficiency equipment

Extrapolation of results to the full C&I population appears to have been done at the stratum level for 17 strata across the three FirstEnergy utilities, which would be valid in theory, but severely restricts the number of points per stratum contributing to the extrapolation. While ADM appears to have excluded some outlier businesses from the population (e.g., opt-out customers, premises with less than 2,000 kWh of annual consumption, premises with one or more months of missing consumption data over a two-year period, and premises with average annual energy usage over a certain value), the ADM report did not provide sufficient detail for us to judge the reasonableness of their savings estimates. However, it is concerning that their samples were so small for all of the measures except lighting. ADM calculated an overall level of savings from the sampled projects of 0.23 percent, but ADM did not state how the savings proportion was calculated. Nor did ADM state how those 35 sites ($159 - 124 = 35$ sites) for which ADM did not calculate energy savings factored into their analysis.

As demonstrated above, the statistical precision for their overall savings estimate is likely ± 14 percent or greater – which suggests that their analysis does not provide statistically significant evidence of electricity savings for C&I customers. Far more important, however, is that based on the limited information provided by ADM, it appears that ADM simply calculated energy savings from the very small and biased sample of sites that

provided documentation and access for on-site verification. ADM then simply extrapolated those results to the universe of C&I sites without consideration for the likelihood that a site actually installed any energy efficiency measures at all. Again, given the limited documentation within the report, it is difficult to fully ascertain ADM's analysis or the reasonableness of their overall estimate. Nevertheless, it is clear that given the very small sample, the statistical precision is not sufficient to conclude an accurate level of energy savings with any degree of statistical certainty, particularly in light of the inherent sample bias introduced by the offer of an incentive based on energy savings.

4.2 Other Programs

In addition to the Customer Action Programs, the other programs in the FirstEnergy portfolio with significant savings levels were also reviewed. This included the Energy Efficient Homes program, the Energy Efficient Products program, and the Energy Solutions for Business program. Due to similarities of measures across programs, the review of these programs is completed by technology.

4.2.1 Lighting

The vast majority of savings for the Energy Efficient Homes program, Energy Efficient Products program, and the Energy Solutions for Business program are attributable to lighting projects, the majority of which (especially in the later years) were for the installation of LED lighting. LED lighting was not included in the 2010 Ohio TRM. Therefore, the savings for these measures were instead calculated using the algorithms from the Pennsylvania TRM using the hours of operation from the Ohio TRM, which is a reasonable approach. It is important to note that the Pennsylvania TRM uses baseline wattages consistent with EISA standards. However, for the limited number of lamps (e.g., 3-ways and CFLs) that were included in the 2010 Ohio TRM, the deemed baseline wattages were not updated to reflect EISA standards.

The evaluation of this measure focused on verifying the installation rate for the lamps as well as updating the hours of operation. For these measures, both the original savings estimates and the evaluation approaches were reasonable and consistent with Ohio SB 310 requirements. Therefore, no changes are recommended. For future evaluations, we recommend that the deemed baseline wattages for all fixture types be updated to reflect current standards. These updated baselines (and the LED measure) are included in the current update to the Ohio TRM that is being completed as part of this audit.

4.2.2 Appliances

The Energy Efficient Products program included savings for the installation of high efficiency appliances, including refrigerators, room air conditioners, and dehumidifiers. The savings for these measures were calculated using the algorithms or deemed savings values from the 2010 Ohio TRM.

The evaluation of this measure focused on verifying the installation and rate for the lamps as well as updating the hours of operation. For these measures, both the original and the evaluation approaches were reasonable and consistent with Ohio SB 310 requirements. Therefore, no changes are recommended. It is important to note, however, that the savings values calculated do not reflect current appliance standards, and this difference can be significant. For example, the savings calculated using the current approach are approximately twice the expected savings calculated using current ENERGY STAR criteria and current federal standards.

5 Conclusions and Recommendations

For this audit, Evergreen Economics, PWP, and Michaels Energy reviewed FirstEnergy's efficiency and demand response programs covering the 2014-2018 period. The audit process involved a thorough review of the annual reports and associated program evaluations that FirstEnergy filed each year. FirstEnergy provided additional program cost information as part of a data request made by the audit team. The audit team also interviewed members of FirstEnergy staff to obtain additional contextual details about these programs.

We draw the following conclusions from our review of the FirstEnergy program savings claims and evaluation reports.

- The *ex ante* savings estimates used when developing long range plans were generally drawn either from the Ohio TRM, from TRMs for adjoining states when values were not available in the Ohio TRM, and from engineering estimates that follow standard practice.
- For most of the evaluations of FirstEnergy programs we reviewed, the evaluation contractor ADM used accepted evaluation practices and the rules set forth in Ohio SB 310 and found realization rates that were generally within 10-15 percent of 1.0.

Retroactive Savings Adjustments

None.

Prospective Savings Adjustments

While we did not find any basis for retroactive revision of savings values, our review of the savings for non-Customer Action Programs (CAPs) identified the following issues that should be addressed going forward:

- For lighting measures, the Evergreen team recommends that the deemed baseline wattage for all fixture types be updated to reflect current standards.
- Similarly, deemed baseline values for appliances used in the future should reflect current ENERGY STAR criteria and current federal standards.

For the CAPs, which were the focus of most of our savings review, the evaluation researchers were faced with the daunting task of estimating savings from customer-initiated actions in a very tight timeframe. The approaches they used were creative and attempted to combine top-down and bottom-up analysis to calculate and verify savings.

As detailed in the savings review, we noted some issues with the savings calculations and with the extrapolation of sample results to the overall population. While we could not

quantify significant over- or under-estimation of program savings that would require a retrospective adjustment, we are concerned that savings for the C&I CAP in particular were sometimes based on a very limited number of observations that could not be proven to be representative of the C&I population. Moreover, the use of savings-based incentive payments in recruiting C&I customers for on-site verification of installed measures introduced a bias into the sample that was used to extrapolate results.

A major hurdle in the savings review was the difficulty of verifying the baselines for individual projects and our inability to determine precisely what criteria were used to determine whether an equipment installation was qualified to count as savings, such as whether a unit was ENERGY STAR qualified.

For the future, our recommendation is that the Customer Action Programs should not be fielded as energy efficiency programs that generate claimed savings, unless there is an effort to attribute efficiency actions to the influence of current or past utility programs, other market interventions, or promotional activities. Techniques for documenting attribution are described in the evaluation literature, and those techniques could be applied to such an effort.

In addition, for any approved energy efficiency programs going forward, we recommend that the following be adopted in order to apply standard practice to the development and application of evaluation results.

- As noted above with reference to lighting and appliances, market or standard practice baselines should be used for all equipment incented through the programs, except in cases of early replacements as specified in program requirements.
- *Ex ante* values should be updated based on the results of evaluations. If evaluations find credible, defensible savings values for specific measures that differ from those in the Ohio TRM, the actual results should become the basis for calculating *ex ante* savings going forward, superseding the information in the TRM until the TRM can be updated using the best data available from all the most recent Ohio evaluations.
- There should be acknowledgement that net program impacts are likely to be less than the gross savings claimed by the utilities, either through calculated net-to-gross values that can be applied going forward or through stipulated net-to-gross values agreed upon by the utilities, regulators, and stakeholders. The fact that FirstEnergy's evaluators were able to identify such a large volume of projects initiated by customers with no input at all from the utility is a clear indicator of significant free ridership, and future evaluations should strive to measure the extent of such free ridership.
- Moreover, some of the actions taken either outside available programs or when no programs were offered could in fact represent spillover from contemporaneous or previous energy efficiency initiatives, and an effort should be made to measure the

extent to which program actions or previous participation led to the non-program efficiency actions.

Appendix A: Total FirstEnergy Energy Savings and Costs

The following tables show the program costs and claimed savings by year, first for all of FirstEnergy, and then for each Electric Distribution Utility individually in a separate set of tables. Information for these tables was taken directly from the FirstEnergy Portfolio Status Reports or supplied by FirstEnergy in response to a data request made as part of this audit. Cost figures do not include PJM revenue. Note that the information from the 2014-2016 Portfolio Status reports was presented as cumulative totals. To obtain the totals for the individual years, the audit team subtracted the cumulative totals each year using 2013 as the starting point. The 2017 and 2018 Portfolio Status Reports provided information separately for these years.

Program Year 2018

Table 9: FirstEnergy Energy Efficiency Programs – Energy Impacts (2018)

Program Name	Budget	MWh Savings	Share of Total Savings
Appliance Turn-In	\$4,792,725	38,512	4%
Energy Efficient Products	\$7,973,310	104,607	12%
Energy Efficient Homes	\$12,826,027	137,524	15%
Low-Income	\$6,392,165	7,873	1%
Customer Action - Residential	\$235,481	153,713	17%
Energy Solutions for Business – Small	\$18,815,679	215,126	24%
Energy Solutions for Business – Large	\$11,749,491	128,215	14%
Mercantile Customer	\$3,111,181	50,658	6%
Customer Action – Small	\$308,500	46,618	5%
Customer Action – Large	\$0	-	0%
Government Tariff Lighting	\$30,707	290	0%
T&D Improvements	\$0	19,864	2%
Smart Grid Modernization Initiative	\$0	0	0%
Total	\$66,235,266	903,000	100%

Table 10: FirstEnergy Energy Efficiency Programs MW Impacts (2018)

Program Name	MW Savings	Share of Total Savings
Appliance Turn-In	7.44	5%
Energy Efficient Products	13.71	9%
Energy Efficient Homes	16.99	11%
Low-Income	1.10	1%
Customer Action- Residential	34.42	23%
Energy Solutions for Business – Small	34.90	24%
Energy Solutions for Business – Large	18.17	12%
Mercantile Customer	6.12	4%
Customer Action – Small	9.53	6%
Customer Action – Large	-	
Government Tariff Lighting	.04	0%
T&D Improvements	5.82	4%
Smart Grid Modernization Initiative	0	0%
Total	148.25	100%

Table 11: FirstEnergy Demand Response Programs (2018)

Program Name	Costs	MW Savings	Share of Total Savings
Direct Load Control	\$45,541	0	0%
C&I Demand Response	\$0	802.32	100%
Total	\$45,541	802.32	100%

Program Year 2017

Table 12: FirstEnergy Energy Efficiency Programs – Energy Impacts (2017)

Program Name	Costs	MWh Savings	Share of Total Savings
Appliance Turn-In	\$5,867,652	44,633	6%
Energy Efficient Products	\$5,023,500	84,985	12%
Energy Efficient Homes	\$13,408,388	103,521	15%
Low-Income	\$6,693,023	7,958	1%
Customer Action - Residential	\$317,125	127,976	18%
Energy Solutions for Business – Small	\$17,137,202	159,421	23%
Energy Solutions for Business – Large	\$8,453,207	62,094	9%
Mercantile Customer	\$2,762,952	46,530	7%
Customer Action – Small	\$241,577	47,730	7%
Customer Action – Large	\$24,168	8,710	1%
Government Tariff Lighting	\$15,886	35	0%
T&D Improvements	\$0	3,626	1%
Smart Grid Modernization Initiative	\$0	-	0%
Total	\$59,944,680	697,219	100%

Table 13: FirstEnergy Energy Efficiency Programs MW Impacts (2017)

Program Name	MW Savings	Share of Total Savings
Appliance Turn-In	8.67	7%
Energy Efficient Products	10.50	9%
Energy Efficient Homes	12.47	10%
Low-Income	1.13	1%
Customer Action - Residential	33.64	28%
Energy Solutions for Business – Small	26.38	22%
Energy Solutions for Business – Large	9.92	8%
Mercantile Customer	4.67	4%
Customer Action – Small	10.70	9%
Customer Action – Large	1.41	1%
Government Tariff Lighting	.01	0%
T&D Improvements	1.25	1%
Smart Grid Modernization Initiative	.01	0%
Total	120.77	100%

Table 14: FirstEnergy Demand Response Programs (2017)

Program Name	Costs	MW Savings	Share of Total Savings
Direct Load Control	\$270,960	-	0%
C&I Demand Response		812.34	100%
Total	\$270,960	812.34	100%

Program Year 2016

Table 15: FirstEnergy Energy Efficiency Programs – Energy Impacts (2016)

Program Name	Costs	MWh Savings	Share of Total Savings
Appliance Turn-In	\$0	-	0%
Energy Efficient Products	\$0	-	0%
Home Performance	\$0	10,337	4%
Low-Income	\$5,566,878	6,545	3%
Customer Action – Residential	\$653,624	154,886	58%
Energy Efficient Equipment - Small	\$0	-	0%
Energy Efficient Buildings - Small	\$188,229	-	0%
Mercantile Customer	\$664,198	8,967	4%
Energy Efficient Equipment – Large	\$0	16	0%
Energy Efficient Buildings – Large	\$36,272	-	0%
Government Tariff Lighting	\$0	52	0%
Customer Action – C&I (large plus small)	\$1,072,757	64,466	32%
Total	\$8,181,958	245,269	100%

Table 16: FirstEnergy Energy Efficiency Programs MW Impacts (2016)

Program Name	MW Savings	Share of Total Savings
Appliance Turn-In	0	0%
Energy Efficient Products	0	0%
Home Performance	10.39	14%
Low-Income	0.93	1%
Customer Action – Residential	42.59	57%
Energy Efficient Equipment - Small	0	0%
Energy Efficient Buildings - Small	0	0%
Mercantile Customer	8.97	12%
Energy Efficient Equipment – Large	0.02	0%
Energy Efficient Buildings – Large	0	0%
Government Tariff Lighting	0.05	0%
Customer Action – C&I (large plus small)	11.79	16%
Total	74.74	100%

Table 17: FirstEnergy Demand Response Programs (2016)

Program Name	Costs	MW Savings	Share of Total Savings
Direct Load Control	\$1,797,733	14.43	2%
Demand Reduction	\$0	841.91	98%
Total	\$1,797,733	856.34	100%

Program Year 2015

Table 18: FirstEnergy Energy Efficiency Programs – Energy Impacts (2015)

Program Name	Costs	MWh Savings	Share of Total Savings
Appliance Turn-In	\$563,939	587	0%
Energy Efficient Products	\$1,271,736	16,581	2%
Home Performance	\$1,178,206	15,904	2%
Low-Income	\$6,092,855	7,993	1%
Customer Action – Residential	\$318,554	164,644	25%
Energy Efficient Equipment – Small	\$7,666,696	98,432	15%
Energy Efficient Buildings – Small	\$500,365	4,140	1%
Mercantile Customer	\$410,907	118,995	18%
Energy Efficient Equipment – Large	\$9,990,618	114,357	17%
Energy Efficient Buildings – Large	\$1,261,049	16,853	3%
Government Tariff Lighting	\$5,050	-	0%
Customer Action – C&I – large and small	\$776,593	113,273	17%
Total	\$30,036,568	671,760	100%

Table 19: FirstEnergy Energy Efficiency Programs MW Impacts (2015)

Program Name	MW Savings	Share of Total Savings
Appliance Turn-In	.11	0%
Energy Efficient Products	2.29	2%
Home Performance	3.51	2%
Low-Income	1.14	1%
Customer Action – Residential	40.6	25%
Energy Efficient Equipment – Small	13.82	15%
Energy Efficient Buildings – Small	.01	1%
Mercantile Customer	10.87	18%
Energy Efficient Equipment – Large	14.87	17%
Energy Efficient Buildings – Large	2.17	3%
Government Tariff Lighting	-	
Customer Action – C&I – large and small	22.5	17%
Total	111.89	100%

Table 20: FirstEnergy Demand Response Programs (2015)

Program Name	Costs	MW Savings	Share of Total Savings
Direct Load Control	\$1,196,142	11.56	1%
Demand Reduction	0	908.27	99%
Total	\$1,196,142	919.83	100%

Program Year 2014

Table 21: FirstEnergy Energy Efficiency Programs – Energy Impacts (2014)

Program Name	Costs	MWh Savings	Share of Total Savings
Appliance Turn-In	\$3,410,622	28,334	4%
Energy Efficient Products	\$6,847,841	138,868	22%
Home Performance	\$10,285,545	95,416	15%
Low-Income	\$5,285,630	7,660	1%
Energy Efficient Equipment – Small	\$9,405,207	108,313	17%
Energy Efficient Buildings – Small	\$2,234,506	57,067	9%
Mercantile Customer	\$6,345,080	86,639	14%
Energy Efficiency Equipment – Large	\$10,115,716	112,871	18%
Energy Efficient Buildings – Large	\$604,462	-	0%
Government Tariff Lighting	\$92,623	326	0%
Conservation Voltage Reduction	\$746,082	-	0%
Total	\$55,373,314	635,494	100%

Table 22: FirstEnergy Energy Efficiency Programs MW Impacts (2014)

Program Name	MW Savings	Share of Total Savings
Appliance Turn-In	5.40	6%
Energy Efficient Products	19.14	21%
Home Performance	11.25	13%
Low-Income	1.08	1%
Energy Efficient Equipment – Small	17.50	19%
Energy Efficient Buildings – Small	11.77	13%
Mercantile Customer	8.96	10%
Energy Efficiency Equipment – Large	14.63	16%
Energy Efficient Buildings – Large	0	0%
Government Tariff Lighting	.03	0%
Smart Grid Modernization Initiative	.12	0%
Total	89.88	100%

Table 23: FirstEnergy Demand Response Programs (2014)

Program Name	Costs	MW Savings	Share of Total Savings
Direct Load Control	\$1,925,192	12.33	1%
Demand Reduction	\$2,237	991.99	99%
Total	\$1,927,429	1,004.32	100%

Appendix B: Individual Utility Savings Tables

The following tables show the program impacts broken out by the individual FirstEnergy utilities (Ohio Edison, Cleveland Electric, Toledo Edison).

Table 24: Energy and Demand Impacts – Ohio Edison Company (2014-2018)

Program	2014		2015		2016		2017		2018	
	MWh	MW								
Residential										
Direct Load Control Program	22	7.25	52	14.66	195	8.50	-	-	-	-
Appliance Turn-In Program	14,868	2.88	305	0.06	-	-	23,734	4.58	19,781	3.82
Energy Efficient Products Program	76,718	10.22	7,380	1.02	-	-	41,290	5.14	45,834	6.12
Home Performance Program (EE Homes 2017)	50,153	5.76	8,786	1.59	5,522	1.23	53,034	6.24	76,284	8.96
Low-Income Program	2,929	0.41	2,627	0.37	2,652	0.38	2,951	0.41	3,734	0.52
Customer Action Program - Residential	-	-	-	-	-	-	51,920	14.03	76,546	17.13
Small Enterprise										
Energy Efficiency Equipment Program - Small	47,006	7.78	36,216	5.38	-	-	-	-	-	-
Energy Efficient Buildings Program - Small	32,809	6.77	1,334	0.06	-	-	-	-	-	-
Energy Solutions for Business - Small	-	-	-	-	-	-	66,909	10.78	91,766	14.45
Mercantile Customer Program										
Mercantile Customer Program	23,951	2.78	34,509	4.62	4,139	0.04	26,261	2.48	23,842	3.23
Mercantile Utility (Large Enterprise)										
Demand Reduction Program	-	407.33	-	440.59	-	361.94	-	305.61	-	344.75
Energy Efficient Equipment Program - Large	61,557	8.43	58,917	8.16	-	-	-	-	-	-
Energy Efficient Buildings Program - Large	-	-	5,480	0.68	-	-	-	-	-	-
Energy Solutions for Business - Large	-	-	-	-	-	-	29,781	4.21	71,348	9.70
Customer Action Program - Small	-	-	-	-	-	-	31,348	6.80	18,224	3.18
Customer Action Program - Large	-	-	-	-	-	-	8,332	1.25	-	-
Customer Action Program - All	-	-	130,745	28.85	105,976	20.20	-	-	-	-
Government Tariff Lighting Program										
Government Tariff Lighting Program	-	-	-	-	-	-	1	0.01	110	-
Transmission and Distribution										
Conservation Voltage Reduction Study	-	-	-	-	-	-	-	-	-	-
T&D Improvements	-	-	-	-	-	-	1,532	0.50	12,593	3.65
Smart Grid Modernization Initiative	-	-	-	-	-	-	-	-	-	-
Total Portfolio	310,013	459.6	286,351	506.0	118,484	392.3	337,093	362.0	440,062	415.5

Table 25: Energy and Demand Impacts – Cleveland Electric (2014-2018)

Program	2014		2015		2016		2017		2018	
	MWh	MW	MWh	MW	MWh	MW	MWh	MW	MWh	MW
Residential										
Direct Load Control Program	12	4.12	29	8.31	102	4.80	-	-	-	-
Appliance Turn-In Program	9,738	1.87	231	0.04	-	-	15,510	3.03	13,779	2.66
Energy Efficient Products Program	42,816	6.21	7,127	0.95	-	-	32,138	3.96	43,840	5.70
Home Performance Program (EE Homes 2017)	27,813	3.39	5,321	1.11	3,449	0.88	37,005	4.71	46,310	6.11
Low-Income Program	3,981	0.57	3,222	0.47	2,602	0.37	3,659	0.53	2,341	0.33
Customer Action Program - Residential	-	-	-	-	-	-	37,296	10.06	54,922	12.29
Small Enterprise										
Energy Efficiency Equipment Program - Small	45,775	7.28	40,394	5.80	-	-	-	-	-	-
Energy Efficient Buildings Program - Small	17,158	3.51	2,742	0.01	-	-	-	-	-	-
Energy Solutions for Business - Small	-	-	-	-	-	-	68,331	11.99	82,067	14.26
Mercantile Customer Program										
Mercantile Customer Program	22,020	2.24	65,874	2.62	4,828	0.13	10,850	1.41	23,892	2.52
Mercantile Utility (Large Enterprise)										
Demand Reduction Program	-	298.73	-	349.93	-	355.51	-	368.03	-	307.34
Energy Efficient Equipment Program - Large	19,119	2.19	18,867	2.56	-	-	-	-	-	-
Energy Efficient Buildings Program - Large	-	-	-	-	-	-	-	-	-	-
Energy Solutions for Business - Large	-	-	-	-	-	-	16,275	3.03	23,340	3.36
Customer Action Program - Small	-	-	-	-	-	-	13,128	2.98	21,409	4.85
Customer Action Program - Large	-	-	-	-	-	-	370	0.16	-	-
Customer Action Program - All	-	-	112,456	26.09	80,205	17.38	-	-	-	-
Government Tariff Lighting Program										
Government Tariff Lighting Program	326	0.03	-	-	-	-	27	0.01	135	0.03
Transmission and Distribution										
Conservation Voltage Reduction Study	-	-	-	-	-	-	-	-	-	-
T&D Improvements	-	-	-	-	-	-	1789	0.65	3,763	1.11
Smart Grid Modernization Initiative	-4	0.12	-	-	2	0.01	0.3	0.01	0.2	-
Total Portfolio	188,754	330.3	256,263	397.9	91,188	379.1	236,378	410.6	315,798	360.6

Table 26: Energy and Demand Impacts - Toledo Edison (2014-2018)

Program	2014		2015		2016		2017		2018	
	MWh	MW	MWh	MW	MWh	MW	MWh	MW	MWh	MW
Residential										
Direct Load Control Program	3	0.96	7	2.01	28	1.14	-	-	-	-
Appliance Turn-In Program	3,728	0.69	51	0.01	-	-	5,389	1.06	4,952	0.96
Energy Efficient Products Program	19,334	2.71	2,074	0.31	-	-	11,558	1.41	14,933	1.90
Home Performance Program	17,450	2.09	1,798	0.82	1,365	0.69	13,482	1.53	14,930	1.92
Low-Income Program	751	0.10	2,144	0.30	1,291	0.18	1,349	0.19	1,798	0.25
Customer Action Program - Residential	-	-	-	-	-	-	14,906	4.09	22,244	5.01
Small Enterprise										
Energy Efficiency Equipment Program - Small	15,531	2.45	21,823	2.63	-	-	-	-	-	-
Energy Efficient Buildings Program - Small	7,100	1.49	64	0.01	-	-	-	-	-	-
Energy Solutions for Business - Small	-	-	-	-	-	-	24,181	3.61	41,294	6.19
Mercantile Customer Program										
Mercantile Customer Program	40,668	3.93	18,613	3.63	-	-	9,419	0.78	2,924	0.36
Mercantile Utility (Large Enterprise)										
Demand Reduction Program	-	285.94	-	117.75	-	124.46	-	138.69	-	150.23
Energy Efficient Equipment Program - Large	32,195	4.01	36,573	4.15	15	-	-	-	-	-
Energy Efficient Buildings Program - Large	-	-	11,373	1.49	-	-	-	-	-	-
Energy Solutions for Business - Large	-	-	-	-	-	-	16,038	2.69	33,526	5.12
Customer Action Program - Small	-	-	-	-	-	-	3,254	0.93	6,986	1.50
Customer Action Program - Large	-	-	-	-	-	-	7	-	-	-
Customer Action Program - All	-	-	34,717	8.17	33,172	6.80	-	-	-	-
Government Tariff Lighting Program										
Government Tariff Lighting Program	-	-	-	-	53	0.01	7	-	45	0.01
Transmission and Distribution										
Conservation Voltage Reduction Study	-	-	-	-	-	-	-	-	-	-
T&D Improvements	-	-	-	-	-	-	304	0.10	3,507	1.07
Smart Grid Modernization Initiative	-	-	-	-	-	-	-	-	-	-
Total Portfolio	136,760	304.4	129,237	141.3	35,924	133.3	99,894	155.1	147,139	174.5

Table 27: Energy and Demand Impacts - Combined Utilities (2014-2018)

Program	2014		2015		2016		2017		2018	
	MWh	MW	MWh	MW	MWh	MW	MWh	MW	MWh	MW
Residential										
Direct Load Control Program	37	12.33	88	24.98	325	14.44	-	-	-	-
Appliance Turn-In Program	28,334	5.44	587	0.11	-	-	44,633	8.67	38,512	7.44
Energy Efficient Products Program	138,868	19.14	16,581	2.28	-	-	84,986	10.51	104,607	13.72
Home Performance Program (EE Homes 2017)	95,416	11.24	15,905	3.52	10,336	2.80	103,521	12.48	137,524	16.99
Low-Income Program	7,661	1.08	7,993	1.14	6,545	0.93	7,959	1.13	7,873	1.10
Customer Action Program - Residential	-	-	-	-	-	-	104,122	28.18	153,712	34.43
Small Enterprise										
Energy Efficiency Equipment Program - Small	108,312	17.51	98,433	13.81	-	-	-	-	-	-
Energy Efficient Buildings Program - Small	57,067	11.77	4,140	0.08	-	-	-	-	-	-
Energy Solutions for Business - Small	-	-	-	-	-	-	159,421	26.38	215,127	34.90
Mercantile Customer Program										
Mercantile Customer Program	86,639	8.95	118,996	10.87	8,967	0.17	46,530	4.67	50,658	6.11
Mercantile Utility (Large Enterprise)										
Demand Reduction Program	-	992.00	-	908.27	-	841.91	-	812.33	-	802.32
Energy Efficient Equipment Program - Large	112,871	14.63	114,357	14.87	15	-	-	-	-	-
Energy Efficient Buildings Program - Large	-	-	16,853	2.17	-	-	-	-	-	-
Energy Solutions for Business - Large	-	-	-	-	-	-	62,094	9.93	128,214	18.18
Customer Action Program - Small	-	-	-	-	-	-	47,730	10.71	46,619	9.53
Customer Action Program - Large	-	-	-	-	-	-	8,709	1.41	-	-
Customer Action Program - All	-	-	277,918	63.11	219,353	44.38	-	-	-	-
Government Tariff Lighting Program										
Government Tariff Lighting Program	326	0.03	-	-	53	0.01	35	0.02	290	0.04
Transmission and Distribution										
Conservation Voltage Reduction Study	-	-	-	-	-	-	-	-	-	-
T&D Improvements	-	-	-	-	-	-	3,625	1.25	19,863	5.83
Smart Grid Modernization Initiative	(4)	0.12	-	-	2	0.01	0.3	0.01	0	-
Total Portfolio	635,527	1,094.2	671,851	1,045.2	245,596	904.7	673,365	927.7	902,999	950.6

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