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May 15, 2014

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RE: *In the Matter of the Annual Portfolio Status Report Under Rule 4901:1-39-05(C), Ohio Administrative Code, by Ohio Power Company,* Case No. 14-0853-EL-EEC.

Dear Ms. McNeal:

Ohio Power Company ("OPCo," "the Company" or "AEP Ohio") submits the enclosed 2013 Portfolio Status Report, pursuant to Rule 4901:1-39-05(C), Ohio Administrative Code (OAC).

In Case Nos. 11-5568-EL-POR, et al., the Commission approved the Stipulation and Recommendation on March 21, 2012, and granted the requested waiver of Rule 4901:1-39-05(C), OAC, such that AEP Ohio may file its annual portfolio status report on May 15 instead of March 15 during each year of the EE/PDR Action Plan in order to provide sufficient time for adequate evaluation, measurement and verification of plan results.

Please note that the Report is broken into three volumes, due to the size of the supporting documentation. Volume I contains the narrative body of the Report; the supporting affidavit of Jon Williams (the compliance affidavit required by Rule 4901:1-39-05(C)(1)(c), OAC); and Report Appendices A through E. Volume II contains Report Appendices F through J and Volume III contains the remaining Report Appendices K through P.

Thank you for your attention to this matter.

Respectfully Submitted,

/s/ Steven T. Nourse
Steven T. Nourse

2013 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs

VOLUME I

2013 PORTFOLIO STATUS REPORT

AFFIDAVIT OF JON WILLIAMS

APPENDICES A - E

AEP OHIO®

A unit of American Electric Power

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INTRODUCTION

In Docket No. 08-888-EL-UNC, the Public Utilities Commission of Ohio ("the Commission") approved Rules for Energy Efficiency and Peak Demand Reduction Programs of electric utilities ("the Green Rules"). These Green Rules first became effective December 10, 2009. In accordance with Ohio Senate Bill 221 (S.B. 221), the Rules require that each electric utility in the Commission's jurisdiction implement energy efficiency and peak demand reduction programs and file an annual Portfolio Status Report, originally due March 15 of each year but extended to May 15 in the March 21, 2012 order in Docket Nos. 11-5568-EL-POR and 11-5569-EL-POR for AEP Ohio.

Per Ohio Administrative Code (OAC) 4901:1-39-05(C), these Status Reports are required to address all approved energy efficiency and peak demand reduction (EE/PDR) programs' performance over the prior calendar year. The Ohio Power Company ("the Company" or "AEP Ohio") filed a Program Portfolio Plan for 2012-2014 under Docket Nos. 11-5568-EL-POR and 11-5569-EL-POR, which the Commission approved March 21, 2012.

AEP Ohio submits this 2013 Portfolio Status Report in compliance with the above-cited Rules. In accordance with OAC 4901:1-39-05(C)(2)(b), AEP Ohio has contracted with Navigant Consulting, Inc. ("Navigant") to review the Company's programs; perform the impact and process evaluations; and provide evaluation, measurement, and verification reports.

This report is divided into three major sections: The first section covers how the Company has met all the requirements in the Green Rules in 2013 and achieved its S.B. 221 benchmark requirements. The second section reviews each of AEP Ohio's EE/PDR programs and how they have performed this past year. The third and final section contains Ohio Power Company's recommendations going forward for each of the programs.

Attached with this report are 16 appendices: Appendix A lists individual units incented and measures installed, at a detailed level, under each of Ohio Power Company's EE/PDR programs. Appendices B through O contain the Evaluation Reports of each program from Navigant. Finally, Appendix P covers transmission and distribution projects related to EE/PDR.

DEMONSTRATION OF COMPLIANCE

BENCHMARK UPDATES

AEP Ohio filed its Initial Benchmark Report on February 8, 2010[1] and has made regular updates in its intervening Portfolio Status Reports for both energy usage and peak demand. The Company has adjusted both its gross energy sales and peak demand to include the impacts of mercantile[2] customers' energy efficiency resource commitments and economic development. These adjusted figures are shown in Figures 1 and 2 below.

The annual benchmark target is calculated as the average of the prior three years' adjusted load, multiplied by yearly statutory benchmark requirements from S.B. 221. The amounts for 2013 are 0.9 percent incremental energy reduction and 4.0 percent cumulative demand reduction.

For purposes of this compliance filing for the 2013 benchmark adjustments for economic growth (and the Company's intention going forward), the Company has only included the associated kWh captured in the Economic Development Rider consistent with its pending application in Case No. 14-559-EL-ACP.

Figure 1 below shows the calculation of the adjusted 2013 benchmark for energy usage savings: 387.9 gigawatt-hours (GWh). Figure 2 shows the calculation for the adjusted 2013 benchmark for peak demand savings: 359.0 megawatts (MW).

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[1] Public Utilities Commission of Ohio, *In the Matter of the Initial Benchmark Report of Columbus Southern Power Company and Ohio Power Company*, Case No. 10-153-EL-EEC, February 8, 2010.

[2] "Mercantile customer" means a commercial or industrial customer if the electricity consumed is for nonresidential use and the customer consumes more than seven hundred thousand kilowatt hours per year or is part of a national account involving multiple facilities in one or more states. See Ohio Revised Code § 4928.01(A)(19).

FIGURE 1: ADJUSTED ENERGY USAGE BASELINES

Year	Actual Retail Sales	Econ. Devel. Adj.*	2009-12 Merc. Savings	2013 Merc. Savings	Adjusted Retail Sales
2010	47,439.2	-4,029.9	223.8	12.4	43,645.5
2011	48,433.3	-5,343.9	229.6	15.1	43,334.1
2012	46,906.1	-4,844.1	233.1	25.8	42,320.9
				Three-Year Average:	**43,100.2**
				Benchmark Rate:	**0.9%**
				2013 Benchmark Target:	**387.9**

All figures are in GWh.
*This adjustment differs from the AEPS baseline filed in 14-559-EL-ACP to reflect program participation.

FIGURE 2: ADJUSTED PEAK DEMAND BASELINES

Year	Coincident Peak Demand	Econ. Devel. Adj.	2009-12 Merc. Savings	2013 Merc. Savings	Adjusted Peak Demand
2010	9,176.0	-480.0	34.5	6.9	8,737.5
2011	9,881.0	-571.2	35.8	7.4	9,353.1
2012	9,408.0	-618.5	36.6	8.7	8,834.8
				Three-Year Average:	**8,975.1**
				Benchmark Rate:	**4.0%**
				2013 Benchmark Target:	**359.0**

All figures are in MW.

ACHIEVED SAVINGS

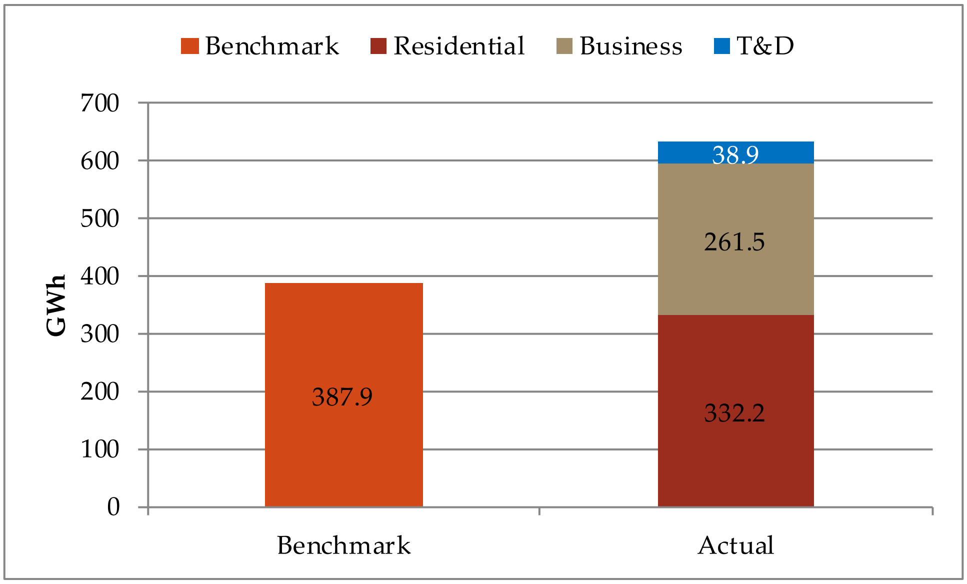
The Company has met all its EE/PDR benchmarks for both energy and demand savings for 2013, with all of Ohio Power's EE/PDR programs saving a combined 593.7 GWh of energy.[3]

AEP Ohio is also permitted to add savings resulting from transmission and distribution (T&D) projects that reduce losses. (See page 33.) In 2013, the Company saved 38.9 GWh of energy from T&D projects, yielding a grand total of 632.7 GWh, well above the benchmark target. Figure 3 below illustrates the breakout of these savings between residential programs, business programs, and T&D improvements. The majority of

[3] All achieved energy and demand savings figures in this report are *ex ante*.

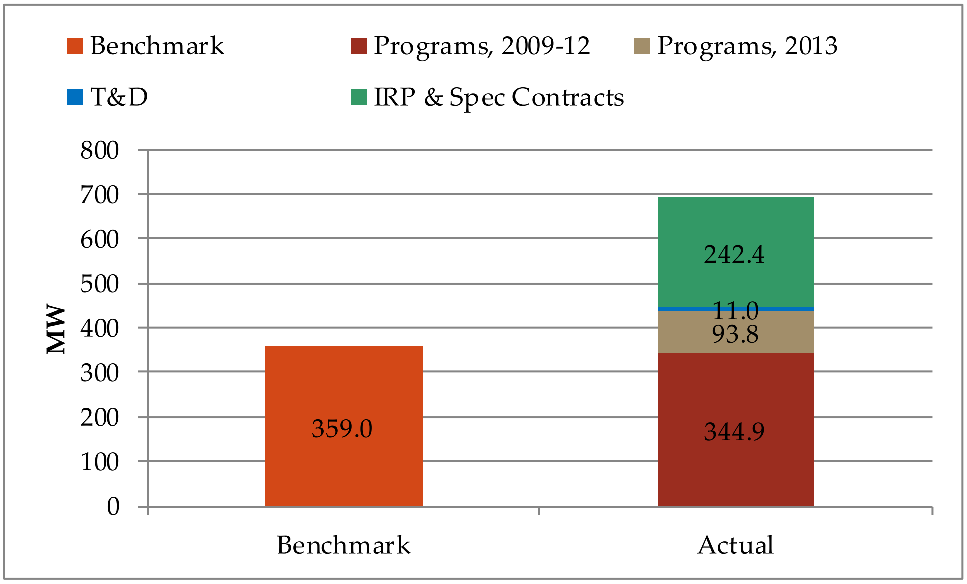
energy savings in 2013 came from residential programs (52.5 percent). Business programs and T&D projects accounted for 41.3 percent and 6.2 percent of the total, respectively.

FIGURE 3: ACHIEVED ANNUAL ENERGY SAVINGS, BY SEGMENT, 2013



The Company's portfolio yielded 93.8 MW in permanent peak demand reductions in 2013, shown in Figure 4 below. The cumulative permanent peak demand reduction impact of programs from 2009 through 2012 was 344.9 MW. Combined with other sources of demand reduction, including special contracts (36.5 MW), T&D projects (11.0 MW), and interruptible tariffs (205.9 MW), AEP Ohio reduced peak demand by 692.1 MW in total.

FIGURE 4: ACHIEVED PEAK DEMAND SAVINGS, BY SOURCE, 2013



COST EFFECTIVENESS

The Company's portfolio of EE/PDR programs has been cost-effective. There are four common tests to determine cost effectiveness, differing in which costs and benefits are included and for whom:

- **Participant Test (PCT):** Participation is cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
- **Utility Cost Test (UCT):** Programs are cost effective from this perspective if the costs avoided by the program's energy and demand savings are greater than the utility's EE/PDR program costs to promote the program, including customer incentives.
- **Ratepayer Impact Measure (RIM) Test:** Programs are cost effective from this perspective if their avoided costs are greater than the sum of the EE/PDR program costs and the "lost revenues" caused by the program.
- **Total Resource Cost (TRC) Test:** Programs are cost effective from this perspective if their avoided costs are greater than the sum of the measures cost and the EE/PDR program administrative costs.

Figure 5 below shows benefit-cost ratios for each of the cost effectiveness tests listed above. These ratios are based on *ex ante* savings estimates. A ratio higher than one indicates that net benefits are greater than net costs, and the portfolio is beneficial by the test's standards.

FIGURE 5: PORTFOLIO EX ANTE BENEFIT-COST RATIOS, 2013

Test	Benefit-Cost Ratio
Total Resource Cost	1.8
Participant Cost	4.4
Ratepayer Impact	0.5
Utility Cost	3.8

Total resource cost ratios for each individual program are shown in Figure 6 below. Again, a ratio greater than one indicates that the program's benefits exceed its costs. Note that the ratios presented in this table are based on *ex ante* savings estimates and may differ from the *ex post* figures contained in Appendices B through O.

FIGURE 6: TOTAL RESOURCE COST RATIOS, 2013

Program	Benefit-Cost Ratio
Efficient Products	2.6
Appliance Recycling	2.7
e^3 smart	2.4
In-Home Energy	0.5
Community Assistance	0.6
ENERGY STAR New Homes	1.0
Home Energy Reports	1.0
Prescriptive	1.2
Custom	1.5
Self-Direct	2.1
Business New Construction	2.2
Express	1.3
Retro-Commissioning	1.5
Data Center	1.0

BANKING OF ENERGY EFFICIENCY ACHIEVEMENTS

In accordance with the Order and Stipulation in Case Nos. 09-1089-EL-POR and 09-1090-EL-POR, AEP Ohio presents its banking methodology. The Company reserves the right to bank all achievement exceeding the benchmark. At a minimum for 2009-13, Ohio Power is banking all achievement in excess of 115 percent of benchmark, shown in Figure 7 below.

FIGURE 7: BANKING OF ENERGY EFFICIENCY ACHIEVEMENTS

Year	GWh
2009	141.9
2010	103.3
2011	148.7
2012	252.6
2013	186.5
Total	**833.0**

SUMMARY

In 2013, Ohio Power Company met its benchmark targets for both energy usage and peak demand. The Company's EE/PDR portfolio as a whole was cost effective.

PROGRAM ACTIVITY DESCRIPTIONS

This section of the report discusses program activity from January 1 through December 31, 2013. AEP Ohio operated sixteen programs this year, not counting T&D improvements:

Residential Programs:

- Efficient Products
- Appliance Recycling
- *e^{3}smart*
- In-Home Energy
- Community Assistance
- ENERGY STAR® New Homes
- Home Energy Reports

Business Programs:

- Prescriptive
- Custom
- Self-Direct
- Business New Construction
- Express
- Retro-Commissioning
- Continuous Energy Improvement
- Data Center
- Bid to Win

Figure 8 summarizes each program's direct costs to AEP Ohio; the number of participants or units sold; and estimated energy and demand savings. Descriptions of each program follow after.

FIGURE 8: SUMMARY OF DIRECT PROGRAM COSTS AND BENEFITS, 2013

Program	Customer Incentives	Third Party Costs	Utility Admin. Costs*	Total Costs	Number of Participants / Units	Coincident Peak MW Saved	Annual GWh Saved
Efficient Products	$8,911.7	$2,090.9	$1,076.3	$12,078.9	4,489,676	24.7	204.1
Appliance Recycling	2,309.0	948.5	358.0	3,615.4	19,392	4.2	26.2
e^3 *smart*	366.7	278.8	51.9	697.4	16,191	0.6	4.7
In-Home Energy	2,201.9	2,334.6	514.9	5,051.4	10,678	2.1	12.0
Community Assistance	9,671.6	1,919.7	1,148.2	12,739.6	11,453	1.5	16.7
ENERGY STAR New Homes	1,561.7	882.5	304.2	2,748.3	2,184	1.1	5.8
Home Energy Reports	0.0	2,132.0	261.7	2,393.7	235,893	8.1	62.6
Prescriptive	9,045.8	4,022.2	1,464.9	14,532.9	2,575	25.3	120.1
Custom	2,817.9	1,368.5	547.7	4,734.1	162	6.2	60.2
Self-Direct	1,220.2	578.0	209.1	2,007.2	128	9.0	27.3
Business New Construction	2,981.2	961.8	458.4	4,401.5	196	6.3	27.8
Express	2,489.5	307.6	339.8	3,136.8	930	2.8	10.5
Retro-Commissioning	187.8	499.6	126.0	813.5	19	0.4	4.7
Data Center	864.2	782.1	186.5	1,832.8	17	1.5	10.9
Bid to Win	0.0	334.8	51.5	386.2	0	0.0	0.0
Demand Response	0.0	0.0	0.3	0.3	0	0.0	0.0
Continuous Energy Improvement	0.0	1,361.4	180.3	1,541.7	0	0.0	0.0
Programs Total	**$44,629.1**	**$20,802.9**	**$7,279.9**	**$72,711.8**	**4,789,494**	**93.8**	**593.7**

Education and Media	4,712.1
Pilot Programs/Research and Development	852.1
Grand Total	**$78,276.0**

*Programs' utility administrative costs include allocated departmental costs.
All cost figures are in thousands of dollars. Columns may not total due to rounding.

RESIDENTIAL PROGRAMS

EFFICIENT PRODUCTS

This program provides incentives and marketing support through retailers to encourage purchases of ENERGY STAR®-approved lighting and appliances. The Efficient Products program contains three main savings paths: The first is customer rebates at the point of sale. Over 350 participating retailers in the Company's service territory are equipped to offer instant rebates on certain ENERGY STAR®-approved lighting devices. Other retailers without the capability to offer electronic markdowns may also offer retailer-reimbursed rebates on these same approved lighting products. These products include CFLs and LEDs. In addition, the program offers customers the opportunity to mail-in rebate applications for refrigerators, freezers, clothes washers, dehumidifiers, and heat pump water heaters. These applications are available from the retailer or on the AEP Ohio website. While not ENERGY STAR®-rated, AEP Ohio also offers rebates for high-efficiency electric water heaters. These rebates and incentives range from $1 each for 13-watt CFLs to $500 for heat pump water heaters. Retailers can also receive incentives for selling televisions at least 20 percent more efficient than the ENERGY STAR® 5.3 standard, in addition to mail-in rebates for customers purchasing such televisions.

AEP Ohio has also provided over 200 thousand CFLs to local food pantries along with informational pamphlets. Also included in program savings are CFLs installed through the *CFL Fundraiser with a Twist* pilot, in which community organizations received lamps and an incentive of $0.50 each to install them in community buildings. All of these incented products are included in Figure 9 below.

As available technologies and ENERGY STAR® standards continue to evolve over time, AEP Ohio maintains and regularly updates the list of qualifying devices.

In addition, AEP Ohio offers marketing support to retailers. These services include in-store signage to promote efficient devices and training for sales associates to help them understand the benefits of energy-efficient lights and appliances.

Figure 9 below shows the number of products for which AEP Ohio provided incentives or distributed for free in 2013. Please see Appendix A for a detailed measure listing.

FIGURE 9: EFFICIENT PRODUCTS INCENTED OR PROVIDED, 2013

Product	Number	MWh	kW
CFLs	4,341,984	191,173.4	22,860.4
LEDs	105,592	5,428.3	623.9
Appliances	42,100	7,521.3	1,187.1
Total	**4,489,676**	**204,123.1**	**24,671.4**

Energy and demand savings were calculated using the Draft Ohio Technical Resource Manual (TRM)[4] when calculations were presented. The Draft Ohio TRM does not provide energy savings for LEDs, electric water heaters, freezers, or televisions. Supplemental sources such as AEP Ohio's 2012-2014 Action Plan, the ENERGY STAR® website, or standard engineering calculations were employed in these cases.

The Company's 2012-2014 EE/PDR Action Plan[5] ("Action Plan") goals for 2013 were 126.1 GWh of savings in energy consumption, and 12.7 MW of savings from peak

[4] Public Utilities Commission of Ohio, *In the Matter of the Protocols for the Measurement and Verification of Energy Efficiency and Peak Demand Reduction Measures*, Case No. 09-512-GE-UNC, August 6, 2010.

[5] *In the Matter of the Application of Ohio Power Company for Approval of its Program Portfolio Plan and Request for Expedited Consideration*, Case Nos. 11-5568-EL-POR and 11-5569-EL-POR, November 29, 2011.

demand. Figure 10 below shows the Efficient Products program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 10: EFFICIENT PRODUCTS PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	204.1	126.1	161.8%
Demand Savings (MW)	24.7	12.7	193.6%
Program Costs ($M)	12.1	13.1	91.9%
First Year Cost per kWh Saved (¢)	5.9	10.4	

The Efficient Products program exceeded its goals for both energy and demand savings in 2013. The program saved 204.1 GWh of energy, 62 percent more than planned. The program also reduced peak demand by 24.7 MW, 94 percent more than planned. The program came in slightly below budget last year at $12.1 million, yielding an average first year cost of 5.9 cents per kWh saved.

Appliance Recycling

This program seeks to remove functioning but inefficient refrigerators and freezers from the power grid. Often, older appliances, especially refrigerators, remain in use as second or "backup" appliances—still plugged in and using an inordinate amount of energy. By removing these high-usage appliances from the grid, the Company reduces unnecessary load and usage. This program's primary focus is on these second refrigerators, but recycling for stand-alone freezers is also available. In return for recycling appliances, AEP Ohio paid the customer an incentive of $50 per unit in 2013.

Customers may enroll in the program either through the Company's website or over the phone and schedule an at-home pickup. (As a customer service, the program also allows customers to recycle windowsill room air conditioners if picked up at the same time as a refrigerator or freezer. Savings from air conditioners are not included in program totals.) Figure 11 below shows the number of appliances that were recycled through this program in 2013. Please see Appendix A for a detailed measure listing.

FIGURE 11: APPLIANCES RECYCLED, 2013

Appliances	Number	MWh	kW
Refrigerators	15,549	21,397.8	3,420.8
Freezers	3,843	4,782.2	768.6
Total	**19,392**	**26,180.0**	**4,189.4**

Note: Excludes 10 room air conditioners collected in 2013.

The Company's Action Plan goals for 2013 were 22.0 GWh of savings in energy consumption and 4.3 MW of savings from peak demand. Figure 12 below shows the Appliance Recycling program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 12: APPLIANCE RECYCLING PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	26.2	22.0	118.8%
Demand Savings (MW)	4.2	4.3	96.4%
Program Costs ($M)	3.6	3.3	111.2%
First Year Cost per kWh Saved (¢)	13.8	59.6	

Energy and demand savings were calculated using the Draft Ohio TRM.

The Appliance Recycling program met its goals for energy savings but missed its goals for demand savings for 2013. The program saved 26.2 GWh of energy, 19 percent above target. The program also reduced peak demand by 4.2 MW, slightly below goal. The program spent more than budgeted last year at $3.6 million, yielding an average first year cost of 13.8 cents per kWh saved.

e³smart

AEP Ohio offers an educational program covering energy efficiency for students in grades 5 through 12 in schools throughout the Company's service territory. It includes a curriculum designed to meet state and national science standards for this age group, teacher training, and supplies for classroom instruction. Students served by the program will learn about different forms of energy, their sources, and how electric power reaches their homes. Students are then given a box of energy-efficient devices—CFLs, LED night lights, low-flow showerheads, faucet aerators, weather-stripping, and door sweeps—to install at home with their parents' or guardians' supervision. Kits also include tools students can use to measure energy use and efficiency losses.

In the 2012-2013 school year, there were 20,389 kits distributed to students in *e³smart*. (Of these, 16,191 students installed measures and returned surveys.) Figure 13 below shows how many of which items were included in their kits. Please see Appendix A for a detailed measure listing.

FIGURE 13: ITEMS INCLUDED IN *e³smart* KITS, 2013

Item	Number	MWh	kW
CFLs	43,194	2,281.2	272.8
Door Sweeps	7,868	449.2	73.4
Faucet Aerators	8,563	209.8	26.2
Hot Water Temp. Setback	2,783	367.4	0.0
LED Night Lights	5,650	119.0	13.6
Low-Flow Showerheads	5,349	1,267.8	162.2
Weather-Stripping	7,219	28.2	67.4
Total	**80,626**	**4,722.5**	**615.5**

AEP Ohio's Action Plan goals for 2013 were 7.1 GWh of savings in energy consumption and 1.5 MW of savings from peak demand. Figure 14 below shows the *e³smart* program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 14: *e³smart* PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	4.7	7.1	66.9%
Demand Savings (MW)	0.6	1.5	42.1%
Program Costs ($M)	0.7	1.1	65.8%
First Year Cost per kWh Saved (¢)	14.8	15.0	

Energy and demand savings were calculated using the Draft Ohio TRM when calculations were available. The Draft Ohio TRM does not include calculations for door sweeps and weather-stripping. These measures are sourced from the 2012 Navigant program evaluation.

The *e³smart* program did not meet either its energy or demand goals for 2013. The program saved 4.7 GWh of energy, 33 percent below goal. The program also reduced peak demand by 0.6 MW, 58 percent below goal. The program came in under budget last year at 697.4 thousand, yielding an average first year cost of 14.8 cents per kWh saved.

IN-HOME ENERGY

This program takes a long-term approach to energy efficiency by helping residential customers analyze and reduce their energy use from a whole-house perspective, identifying inefficiencies, and offering appropriate remedies.

AEP Ohio offers three levels of service to customers: The least-involved, *Online Energy Checkups*, is a free online tool available on AEP Ohio's website that customers may use to quickly identify their home energy costs, receive recommendations on how to save, and learn how to qualify for a kit of free energy-saving items. AEP Ohio provided 3,359 kits to Energy Checkup participants in 2013. Another option, *In-Home Energy Assessments*, includes an in-home visit, visual inspection, prioritized suggestions for efficiency improvements, and installation of several energy-saving devices, such as CFLs, programmable thermostats, or low-flow showerheads, at a subsidized price. In 2013, 1,749 customers had In-Home Assessments. The most thorough service available is the *In-Home Energy Audit*, which provides a more comprehensive house inspection and a blower door test to find air leaks at a subsidized price. In 2013, 942 customers had In-Home Audits. (This third option's availability is generally limited to customers with all-electric homes or a specially-identified group with high electric usage.)

Additionally, program implementers work with property managers in multi-family housing complexes to schedule home assessments and installations with residents, as well as to identify potential savings in common areas. All multi-family housing in AEP Ohio's service territory is eligible to participate. This part of the program receives some marketing assistance from property manager associations around the state. In 2013, 111 properties had assessments.

Under all options, the Company offers incentives on selected energy efficiency improvements to make them more affordable. Figure 15 below shows how many measures were installed in 2013.

FIGURE 15: IN-HOME ENERGY MEASURES INSTALLED, 2013

Item	Number	MWh	kW
Air Sealing	29,461	204.9	126.2
Ceiling Fans	27	4.5	0.5
Central Air Conditioning	2,569	637.0	539.4
Faucet Aerators	11,648	238.4	29.7
Heat Pumps	800	899.9	179.4
HVAC Motors	3,849	514.7	133.1
HVAC Tuneups	236	28.8	8.3
Insulation	1,259	120.1	13.4
Lighting	209,479	7,545.1	899.9
Low-Flow Showerheads	5,457	1,164.8	149.0
Pipe Wrap	1,910	221.4	25.3
Thermostats	1,116	452.2	0.0
Window Film	6	0.2	0.2
Windows	366	14.6	4.2
Total	**268,183**	**12,046.7**	**2,108.7**

Please see Appendix A for a detailed measure listing.

AEP Ohio's Action Plan goals for 2013 were 10.8 GWh of savings in energy consumption and 0.7 MW of savings from peak demand. Figure 16 below shows the In-Home Energy program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 16: IN-HOME ENERGY PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	12.0	10.8	111.8%
Demand Savings (MW)	2.1	0.7	303.4%
Program Costs ($M)	5.1	5.7	88.3%
First Year Cost per kWh Saved (¢)	41.9	53.1	

Energy savings were calculated using the Draft Ohio TRM when calculations were available. The Draft Ohio TRM does not include calculations for thermostats, ECM motors, LED nightlights, draft stoppers, window film, and weather-stripping. In these cases, the Company used the 2012-14 Action Plan and the 2012 Navigant program evaluation.

The In-Home Energy program met its energy savings goals and greatly exceeded its demand savings goals. The program saved 12.0 GWh of energy, 12 percent above target. The program also reduced peak demand by 2.1 MW, more than three times the goal amount. The program came in below budget last year at $5.1 million, yielding an average first year cost of 41.9 cents per kWh saved.

Community Assistance

This program offers energy efficiency services to those AEP Ohio customers with limited income to assist them in reducing their electric energy use and making their utility bills more manageable. Residential customers with incomes up to 200 percent of the federal poverty level are eligible to participate.[6] The program offers services similar to those of the In-Home Energy program, such as home assessments, efficient lighting, appliance replacement, health and safety repairs, and weatherization, at no cost to the customer.

In 2013, 11,453 customers participated in the Community Assistance program. Figure 17 below shows which measures were installed. Please see Appendix A for a detailed measure listing.

FIGURE 17: MEASURES INSTALLED THROUGH COMMUNITY ASSISTANCE PROGRAM, 2013

Item	Number	MWh	kW
Appliance Recycling	60	81.2	8.0
Hot Water	11,126	377.0	97.6
HVAC	32	5.1	3.0
Insulation & Air Sealing	990	420.7	71.2
Lighting	170,973	6,720.8	781.9
Refrigerators & Freezers	8,971	8,868.8	505.8
Smart Strips	3,271	268.2	0.0
Sump & Well Pumps	6	0.9	0.0
Total	**195,429**	**16,742.8**	**1,467.5**

Note: This table only includes categories with associated energy or demand savings.

Ohio Power's Action Plan goals for 2013 were 12.4 GWh of savings in energy consumption and 1.2 MW of savings from peak demand. Figure 18 below shows the

[6] In 2013, this came to roughly $47,100 per year for a family of four. See U.S. Department of Health and Human Services, "2013 Poverty Guidelines," January 24, 2013, http://aspe.hhs.gov/poverty/13poverty.cfm.

Community Assistance program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 18: COMMUNITY ASSISTANCE PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	16.7	12.4	135.1%
Demand Savings (MW)	1.5	1.2	119.2%
Program Costs ($M)	12.7	10.9	116.4%
First Year Cost per kWh Saved (¢)	76.1	88.3	

Energy and demand savings were calculated using the Draft Ohio TRM when calculations were available. The Draft Ohio TRM does not include calculations for hot water temperature setbacks, sump pumps, well pumps, and smart strips. In such cases, AEP Ohio used the 2012 Navigant program evaluation, the Home Energy Savers website, and the 2012-2014 Action Plan.

The Community Assistance program exceeded both its energy and demand savings goals in 2013. The program saved 16.7 GWh of energy, 35 percent above target. The program also reduced peak demand by 1.5 MW, 19 percent above goal. The program came in slightly over budget last year at $12.7 million, yielding an average first year cost of 76.1 cents per kWh saved.

ENERGY STAR® New Homes

ENERGY STAR® New Homes seeks to effect the construction of single-family residences that meet specific ENERGY STAR® or EnergyPath standards. Such structures can use up to 35 percent less energy than residences built to the minimum code requirements. AEP Ohio will pay various incentives to participating builders of single-family residences to help offset incremental construction costs. In addition, builders receive training, marketing, and financial support, including site signage, consumer brochures, model home displays, advertising, and other consumer education tools. All new single-family residential construction that meets standards is eligible.

AEP Ohio has agreed to share program costs with Columbia Gas for gas-heated homes in those areas served by both companies. In 2013, this program incented the construction of 2,184 efficient single-family homes.

The Company's Action Plan goals for 2013 were 1.6 GWh of savings in energy consumption and 0.4 MW of savings from peak demand. Figure 19 below shows the

Residential New Construction program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 19: ENERGY STAR® NEW HOMES PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	5.8	1.6	364.0%
Demand Savings (MW)	1.1	0.4	290.3%
Program Costs ($M)	2.7	1.0	276.7%
First Year Cost per kWh Saved (¢)	47.2	64.3	

Energy and demand savings were calculated as the difference between a residence constructed at the applicable code and the as-built *REM/Rate* model. *REM/Rate* is software that analyzes energy usage in residential buildings.

The ENERGY STAR® New Homes program exceeded both its energy and demand savings goals in 2013. The program saved 5.8 GWh of energy, nearly four times the goal level. The program also reduced peak demand by 1.1 MW, nearly three times the target. The program came in over budget last year at $2.7 million, yielding an average first year cost of 47.2 cents per kWh saved.

Home Energy Reports

This program targets high-usage or low-income customers in the Company's service territory to receive a comparison mailing of how occupied homes of similar size and heating source use electricity. This is designed to spur these selected customers to save energy and use electricity more efficiently. Customers who wish to opt out of receiving these reports may call a toll-free number to do so. There are currently 235,893 customers receiving monthly reports.

Savings in this program are calculated through a quasi-experimental design, where metered energy usage for report recipients is compared against that of a control group. Each year, AEP Ohio analysts compare participation in other residential EE/PDR programs between these two groups to determine whether savings in these other programs are being double-counted. This year, a significant difference was found (α=0.05), indicating report recipients participated in other programs at higher levels than the control group. Savings in both energy and demand were therefore adjusted downward by 86,836.7 kWh and 15.0 kW, respectively.

AEP Ohio's Action Plan goals for 2013 were 40.6 GWh of savings in energy consumption and 5.4 MW of savings from peak demand. Figure 20 below shows the Home Energy Report program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 20: HOME ENERGY REPORT PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	62.6	40.6	154.2%
Demand Savings (MW)	8.1	5.4	150.3%
Program Costs ($M)	2.4	2.0	117.4%
First Year Cost per kWh Saved (¢)	3.8	5.0	

The Home Energy Report program exceeded both its energy and demand savings goals for 2013. The program saved 62.6 GWh of energy, 54 percent above goal. The program also reduced peak demand by 8.1 MW, 50 percent above goal. The program came in slightly above goal last year at $2.4 million, yielding an average first year cost of 3.8 cents per kWh saved; however, unlike other residential programs, this program has a one year measure life which causes it to be one of the least cost effective residential programs.

BUSINESS PROGRAMS

PRESCRIPTIVE

This program offers fixed incentives for the installation and implementation of certain pre-approved types of energy efficient lighting; heating, ventilation, and air conditioning (HVAC) systems; variable frequency drives (VFDs); motors; controls; refrigeration equipment; and compressed air systems, among other commercial- and industrial-grade equipment. Incentive amounts offered to customers range between 20 and 50 percent of the incremental cost to purchase energy-efficient equipment. All non-residential customers in AEP Ohio's service territory are eligible to participate.

In 2013, there were 2,575 projects completed in the Prescriptive program. Figure 21 below shows which measures were installed through these projects. A single project may involve multiple measures. Please see Appendix A for a detailed measure listing.

FIGURE 21: MEASURES INSTALLED THROUGH PRESCRIPTIVE PROGRAM, 2013

Type	Number	MWh	kW
Compressed Air	7,149	652.6	103.9
Food Preparation	16	140.9	13.8
HVAC	1,406,495	9,647.8	1,388.6
Battery Chargers	9	26.9	5.1
Lighting	7,001,664	102,916.1	22,893.4
Process & Misc. Motors	336	4,019.5	529.5
Refrigeration	12,002	2,677.9	365.4
Total	**8,427,671**	**120,081.8**	**25,299.8**

Note: Totals may differ slightly from those shown in Appendix A due to rounding.

The Company's Action Plan goals for 2013 were 215.6 GWh of savings in energy consumption and 35.9 MW of savings from peak demand. Figure 22 below shows the Prescriptive program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 22: PRESCRIPTIVE PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	120.1	215.6	55.7%
Demand Savings (MW)	25.3	35.9	70.4%
Program Costs ($M)	14.5	19.7	73.8%
First Year Cost per kWh Saved (¢)	12.1	9.1	

Energy and demand savings for prescriptive measures were calculated using the vendor-internal TRM which is filed with the Commission annually.

The Prescriptive program did not meet either its energy or demand goals for 2013. The program saved 120.1 GWh of energy, 44 percent below goal. The program also reduced peak demand by 25.3 MW, 30 percent below goal. The program came in below budget last year at $14.5 million, yielding an average first year cost of 12.1 cents per kWh saved.

CUSTOM

This program is for cost-effective energy efficiency improvements in existing buildings that reduce energy consumption or peak demand and have more complicated measures that are not included in the Prescriptive program. All non-residential customers in the Company's service territory are eligible to participate. Customers work closely with their Ohio Power account managers and other employees to determine measure eligibility and verify energy savings. Customers receive an incentive customized to the specific results of the energy savings technologies implemented. Program management will assist commercial and industrial customers with the analysis and selection of high-efficiency equipment or processes.

There were 162 Custom projects completed in 2013. Figure 23 below summarizes the measures installed in these projects. A single project may involve multiple measures. Please see Appendix A for a detailed measure listing.

FIGURE 23: MEASURES INSTALLED THROUGH CUSTOM PROGRAM, 2013

Type	Number	MWh	kW
Compressed Air	3,755	5,377.7	713.8
Food Preparation	76	306.2	43.9
HVAC	40	16,899.5	2,529.3
Lighting	5,383	1,685.5	150.9
Process & Motors	26	30,518.0	2,446.4
Refrigeration	112	140.4	15.0
Other/Miscellaneous	12	5,294.9	275.6
Total	**9,404**	**60,222.0**	**6,174.9**

The Company's Action Plan goals for 2013 were 68.3 GWh of savings in energy consumption and 9.1 MW of savings from peak demand. Figure 24 below shows the Custom program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 24: CUSTOM PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	60.2	68.3	88.2%
Demand Savings (MW)	6.2	9.1	67.8%
Program Costs ($M)	4.7	8.9	53.1%
First Year Cost per kWh Saved (¢)	7.9	13.0	

Energy and demand savings in the Custom program were computed using methodologies consistent with the Draft Ohio TRM.

The Custom program missed both its energy and demand savings goals for 2013. The program saved 60.2 GWh of energy, 12 percent below goal. The program also reduced peak demand by 6.2 MW, 32 percent below goal. The program came in much below budget in 2013 at $4.7 million, yielding an average first year cost of 7.9 cents per kWh saved.

SELF-DIRECT

This program is designed for large customers able to internally administer their own energy management initiatives. Participants design their own energy efficiency programs and submit an application documenting their energy savings. Customers may apply for inclusion in the Self-Direct program up to three years *after* implementing their energy efficiency measures. All applications are subject to approval by both Ohio Power and the Commission. If approved, participants may either receive a one-time payment, up to 75 percent of an equivalent incentive under the Prescriptive or Custom programs, or an equivalent EE/PDR rider exemption. (The accounts may not participate in any other EE/PDR programs while under such an exemption.)

Participation in this program is limited to mercantile customers. In 2013, Ohio Power submitted 128 Self-Direct applications to the Commission. Figure 25 below shows which measures were installed under these projects. A single project may involve multiple measures. For a detailed measure listing, see Appendix A.

FIGURE 25: MEASURES INCENTED THROUGH SELF-DIRECT PROGRAM, 2013

Type	Number	MWh	kW
Compressed Air	100	143.5	29.9
Food Preparation	12	23.0	0.4
HVAC	67,567	2,312.6	386.6
IT Equipment	4	68.7	3.2
Lighting	456,837	10,443.0	1,578.0
Process & Motors	88	11,528.2	6,677.3
Refrigeration	8	207.5	0.8
Other/Miscellaneous	2	2,546.8	306.3
Total	**524,618**	**27,273.3**	**8,982.5**

AEP Ohio's Action Plan goals for 2013 were 20.0 GWh of savings in energy consumption and 2.5 MW of savings from peak demand. Figure 26 below shows the Self-Direct program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 26: SELF-DIRECT PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	27.3	20.0	136.4%
Demand Savings (MW)	9.0	2.5	365.1%
Program Costs ($M)	2.0	3.0	66.9%
First Year Cost per kWh Saved (¢)	7.4	15.0	

Energy and demand savings in the Self-Direct program are calculated using the same methods employed in the Prescriptive and Custom programs.

The Self-Direct program exceeded both its energy and demand savings goals in 2013. The program saved 27.3 GWh of energy, 36 percent above goal. The program also reduced peak demand by 9.0 MW, more than three times the target level. The program came in under budget last year at $2.0 million, yielding an average first year cost of 7.4 cents per kWh saved.

BUSINESS NEW CONSTRUCTION

This program targets non-residential customers who are either building new facilities or making major renovations to existing sites, encouraging building owners, designers, and architects to exceed requirements in current construction practices and codes—specifically, measures that exceed the ASHRAE/IESNA 90.1-2004 minimum requirements. The program includes incentives for the installation of high-efficiency lighting, HVAC systems, building envelopes, industrial refrigeration equipment, and other equipment and controls. The New Construction program offers three tracks: prescriptive and custom, similar to what is offered in those respective programs, plus a "whole building" approach based on building simulation modeling. All non-residential customers building new facilities are eligible to participate.

There were 196 New Construction projects completed in 2013. Figure 27 below shows which measures were installed under these construction projects. A single project may involve multiple measures. A detailed measure list is available in Appendix A.

FIGURE 27: MEASURES INSTALLED THROUGH BUSINESS NEW CONSTRUCTION PROGRAM, 2013

Type	Number	MWh	kW
Compressed Air	594	236.1	49.2
HVAC	10,379	2,501.3	1,173.3
Lighting	3,888,445	15,439.5	3,423.7
Process	46	3,467.8	351.3
Refrigeration	1,775	639.7	71.4
Other/Miscellaneous	26	80.3	13.8
Whole Building Models	39	5,409.2	1,240.9
Total	**3,901,304**	**27,773.9**	**6,323.6**

The Company's Action Plan goals for 2013 were 10.0 GWh of savings in energy consumption and 1.2 MW of savings from peak demand. Figure 28 below shows the New Construction program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 28: BUSINESS NEW CONSTRUCTION PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	27.8	10.0	277.7%
Demand Savings (MW)	6.3	1.2	514.1%
Program Costs ($M)	4.4	1.0	440.1%
First Year Cost per kWh Saved (¢)	15.8	10.0	

Energy and demand savings were calculated using the same methods as employed in the Prescriptive and Custom programs, the ENERGY STAR® website, or with simulation calculations in projects using whole building models.

The Business New Construction program exceeded both its energy and demand savings goals for 2013. The program saved 27.8 GWh of energy, nearly three times the goal level. The program also reduced peak demand by 6.3 MW, more than five times the goal level. The program did come in over budget this year at $4.4 million, yielding an average first year cost of 15.8 cents per kWh saved.

EXPRESS

This program provides a streamlined, one-stop, turn-key energy efficiency service for small businesses. The program implementer first conducts a free on-site assessment to identify potential energy-saving opportunities. Based on recommendations from this assessment the implementer provides the participant with a proposal for installing energy efficiency measures. If the customer approves, the implementer then hires local contractors to perform the installation work. Once the work is completed, and after the customer has signed off on the work performed, the implementer bills the participant directly, after applying incentives from AEP Ohio. Incentive levels are generally higher in this program than in the Prescriptive or Custom programs, up to 80 percent of project cost. This program is designed for small business customers with annual energy consumption levels no greater than 200 MWh.

Figure 29 below shows the number of measures installed through the Express program. While HVAC and commercial refrigeration measures are also available through this program, no such measures were installed in 2013. Again, a single project may involve multiple measures. In total, there were 930 projects completed. See Appendix A for a complete listing of installed measures.

FIGURE 29: MEASURES INSTALLED THROUGH EXPRESS PROGRAM, 2013

Type	Number	MWh	kW
CFLs	1,718	263.6	78.6
LEDs	4,586	1,425.6	290.6
T5/T8	34,493	8,792.1	2,387.2
Controls	45	8.9	0.0
Total	**40,842**	**10,490.3**	**2,756.4**

The Company's Action Plan goals for 2013 were 10.6 GWh of savings in energy consumption and 1.8 MW of savings from peak demand. Figure 30 below shows the Express program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 30: EXPRESS PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	10.5	10.6	99.4%
Demand Savings (MW)	2.8	1.8	156.7%
Program Costs ($M)	3.1	3.6	86.3%
First Year Cost per kWh Saved (¢)	29.9	34.4	

Energy and demand savings are calculated using vendor-internal TRMs filed with the Commission annually.

The Express program just slightly missed its energy savings goals but exceeded its demand savings goals for 2013. The program saved 10.5 GWh of energy, just below goal. The program also reduced peak demand by 2.8 MW, 57 percent above goal. The program came in below budget last year at $3.1 million, yielding an average first year cost of 29.9 cents per kWh saved.

RETRO-COMMISSIONING

Differing from the capital-improvement-oriented programs above, Retro-Commissioning seeks to reduce energy use through low-cost or no-cost operational changes and improve the efficiency of buildings' existing systems. Examples of such systems include HVAC equipment optimization; lighting sensors and timers; and motor and process controls. The program targets medium to large commercial business customers, with an emphasis on office space and schools.

The program offers two tracks for customers: *Retro-Commissioning Lite* is available for facilities between 50,000 and 150,000 square feet and peak demand of at least 125 kW. Program contractors will conduct short, targeted assessments of selected building systems and make recommendations for improvements. Participants who implement *all* recommendations with a two-year payback period or shorter will receive an incentive of 10¢ per affected square foot. *Retro-Commissioning Comprehensive* is available for facilities with more than 150,000 square feet and peak demand of at least 500 kW. Assessments on this program track are much more detailed and cover all operating building systems. Participants who implement *all* recommendations with a two-year payback period or shorter will receive a flat $5,000 incentive on *Lite* projects, or 10 cents per affected square foot on *Comprehensive* projects. *Comprehensive* projects can also earn an additional 5 cents per kWh saved from measures installed with a payback period longer than two years.

Figure 31 below shows which measures were implemented through the Retro-Commissioning program. A single project may involve multiple measures. In total, there were 19 projects completed in 2013. See Appendix A for a complete list of implemented measures.

FIGURE 31: MEASURES IMPLEMENTED THROUGH RETRO-COMMISSIONING PROGRAM, 2013

Type	Number	MWh	kW
HVAC Optimization & Tuneups	27	1,468.5	20.6
HVAC Scheduling	18	3,107.8	416.1
Other HVAC	6	160.8	0.0
Total	**51**	**4,737.1**	**436.7**

AEP Ohio's Action Plan goals for 2013 were 5.6 GWh of savings in energy consumption and 1.1 MW of savings from peak demand. Figure 32 below shows the Retro-Commissioning program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 32: RETRO-COMMISSIONING PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	4.7	5.6	85.3%
Demand Savings (MW)	0.4	1.1	38.4%
Program Costs ($M)	0.8	1.2	68.4%
First Year Cost per kWh Saved (¢)	17.2	21.4	

Energy and demand savings were modeled individually for each project by the program implementer. Draft Ohio TRM calculations are unavailable.

The Retro-Commissioning program missed both its energy and demand savings goals in 2013. The program saved 4.7 GWh of energy, 15 percent below goal. The program also reduced peak demand by 426 kW, 61 percent below goal. The program came in under budget last year at $813 thousand, yielding an average first year cost of 17.2 cents per kWh saved.

CONTINUOUS ENERGY IMPROVEMENT

The Continuous Energy Improvement program (CEI) is designed for large industrial customers using more than 10 GWh per year. Like Retro-Commissioning, CEI focuses on low-cost or no-cost measures to reduce usage, primarily through system efficiency and process optimization. Participants join a geographical cohort of 10 to 20 companies, with care taken to avoid placing competitors in the same cohort, to protect participants' trade secrets. Each participant will designate an internal team to act as *energy champions* and coordinate efforts within their companies to implement changes. Over a period of one year, energy champions will attend workshops and work closely with program implementers to understand how their facilities' loads change and identify opportunities for reducing energy usage. Program implementers, using information on electric consumption, weather, and participants' internal metrics (such as production levels), will develop a predictive model of energy usage for each participant. Subsequent usage levels below model predictions are counted as savings.

Incentives are structured to encourage participants to maintain their new energy practices after their first year is over. First-year energy savings pay an incentive of 2 cents per kWh. To the extent that these savings are sustained, participants can earn an additional 2 cents per kWh each in their second and third years.

There are currently 35 participating customers with a combined 50 accounts in four cohorts in the CEI program. In 2013, Ohio Power spent $1.5 million to administer the program. AEP Ohio did not count any energy or demand savings in CEI in 2013, but the Company anticipates savings in 2014 and onward. The Company further plans to conduct a full program evaluation next year once savings are acquired.

DATA CENTER

The Data Center program is a capital improvement program specially geared toward the unique needs of business IT operations and space. Such equipment can be highly energy-intensive, incorporate heavy HVAC loads, and have strict uptime requirements. Measures covered under this program may include ENERGY STAR® servers and telecommunications equipment; high-efficiency uninterruptable power supplies; high-efficiency power rectifiers; server virtualization; high-efficiency computer room air conditioner units; variable-speed drives on chilled water pumps; and airflow management and controls to optimize data center cooling. An additional track covers IT load growth when measured against an industry standard baseline.

Figure 33 below shows which measures were implemented through the Data Center program. A single project may involve multiple measures. In total, there were 17 projects completed. Please see Appendix A for a complete list of installed measures.

FIGURE 33: MEASURES IMPLEMENTED THROUGH DATA CENTER PROGRAM, 2013

Type	Number	MWh	kW
HVAC	67	2,466.7	512.5
IT Equipment*	743	7,003.7	830.8
Uninterruptable Power	16	1,428.1	166.2
Total	**826**	**10,898.4**	**1,509.5**

*Includes server virtualization.

The Company's Action Plan goals for 2013 were 6.0 GWh of savings in energy consumption and 0.7 MW of savings from peak demand. Figure 34 below shows the Data Center program's energy savings, demand savings, program costs, and average cost per first year energy savings during calendar year 2013.

FIGURE 34: DATA CENTER PROGRAM SUMMARY, 2013

	Actual	Goal	Percent of Goal
Energy Savings (GWh)	10.9	6.0	182.1%
Demand Savings (MW)	1.5	0.7	203.2%
Program Costs ($M)	1.8	1.4	130.3%
First Year Cost per kWh Saved (¢)	16.8	23.5	

Energy and demand savings were modeled individually for each project by the program implementer. Draft Ohio TRM calculations are unavailable.

The Data Center Program exceeded both its energy and demand savings goals for 2013. The program saved 10.9 GWh of energy, 82 percent above goal. The program also reduced peak demand by 1.5 MW, more than twice the goal level. The program came in over budget last year at $1.8 million, yielding an average first year cost of 16.8 cents per kWh saved.

Bid to Win

Bid to Win is a unique reverse bidding program in which non-residential customers and solution providers may offer their own proposals to implement large-scale energy efficiency projects, either at a single site or spread out among multiple sites. Bidding processes are conducted online, with competing bids placed in real time and the winning bid being that with the lowest cost per kilowatt-hour. The participant or participants with the winning bid or bids are then eligible to receive incentive payments for their projects' completion, up to $1 million.

In order to qualify, bidders must first respond to a Request for Qualifications, and all proposed projects must be pre-qualified as having a minimum 3 GWh of estimated energy savings, a payback period of at least one year, and an estimated useful life of at least ten years.

In October 2013, AEP Ohio conducted its first bidding process. The Company spent $386 thousand to administer the program. AEP Ohio is not counting energy or demand savings in Bid to Win in 2013, but the Company anticipates savings in 2014 and onward. The Company further plans to conduct a full program evaluation next year once savings are acquired.

TRANSMISSION AND DISTRIBUTION PROJECTS

Inherent in the operation of any electric power system is the electrical resistance of its various elements, such as conductors, transformers, or regulators. The greater the distance the power must travel from generation to end use, the greater the amount of power lost in this transfer. The Ohio Revised Code allows a utility to include transmission and distribution infrastructure improvements to reduce line losses to meet benchmarks,[7] and T&D projects are a major part of Ohio Power's plan for compliance. These projects include reconductoring, substation improvements, capacitor bank installation, and voltage regulator replacement.

- **Reconductoring** projects involve the replacement of existing wires with improved wires designed for lower losses at transmission or distribution voltages, lowering the system's resistance and the power lost over transmission to the end-user.
- **Substation improvements** typically include connecting previously unconnected T&D lines and the addition or upgrade of transformers and circuits, balancing loads between circuits, changing lines to multi-phase current, or the construction of altogether new substations. Such projects improve efficiency and reduce load losses by adding new transformation points closer to customers' loads. A greater portion of energy is carried in higher-voltage transmission lines than lower-voltage distribution lines.
- **Capacitor banks** reduce losses by improving system power factors closer to 100 percent.
- **Voltage regulators** assist in maintaining delivery voltage within the Commission's guidelines.

[7] Ohio Revised Code § 4928.66(A)(2)(d).

AEP Ohio had 28 distribution projects and 48 transmission projects completed in 2013 related to energy efficiency and peak demand reduction. These improvements prevented the loss of 38.9 GWh of energy and lowered peak demand by 11.0 MW. The report in Appendix P contains a complete list of the Company's 2013 T&D projects and their estimated impacts.

RECOMMENDATIONS TO THE COMMISSION

RESIDENTIAL PROGRAMS

EFFICIENT PRODUCTS

In 2013, this program has again surpassed the Plan goal of delivered kWh savings by a substantial margin. CFLs continue to provide the bulk of the savings with LEDs continuing to increase in market share with the Company's efforts to promote and educate customers on the benefits of LEDs. More custom CFLs were promoted via in-store markdowns and the online store. ENERGY STAR® certified appliances such as clothes washers, freezers, refrigerators, high efficiency electric water heaters, and electric heat pump water heaters continue to grow. AEP Ohio recommends that the program continue as described in the Plan.

APPLIANCE RECYCLING

The refrigerator/freezer recycling program surpassed plan year and customers continue to be pleased with the program. Because of the success of this program, AEP Ohio decided to pilot commercial customer refrigerator recycling efforts. The results have been favorable and AEP Ohio will continue the effort. JACO, AEP Ohio and some of the other state utilities promoted the "Oldest Refrigerator Pick-up" contest and 2 winners were named, one an AEP Ohio customer. The Company also celebrated its 50,000th unit recycled, ran internal employee contests, and increased the customer incentive from time to time to increase units recycled. AEP Ohio recommends the program continue as described in the Plan.

IN-HOME ENERGY

This program continues to grow in participants and energy savings. In 2013, AEP Ohio piloted multi-family direct installs and with success and customer requests expanded the effort. To maximize energy savings, a targeted marketing effort towards high energy intensity households (all electric) were identified. In addition, AEP Ohio partnered with Columbia Gas of Ohio and their contractor to add electric measure direct installs on gas assessments/audits and vice versa AEP Ohio's contractor installs some gas measures during assessments. The implementer will launch a new in-home audit tracking system in 2014, which will provide customers with more customer friendly educational components. AEP Ohio recommends this program continue as described in the Plan.

COMMUNITY ASSISTANCE

This program like previous years provides low income customers energy saving measures to reduce energy costs and provide more comfort. The number of homes completed increased from 8,579 in 2012 to 11,453 in 2013. Any customers who are enrolled in the Percentage of Income Payment Plan (PIPP), Home Weatherization Assistance Plan (HWAP) or Home Energy Assistance Program (HEAP) are eligible to participate in AEP Ohio's Community Assistance Program. AEP Ohio recommends the program continue as described in the Plan.

ENERGY STAR® NEW HOMES

The program finished 2013 extremely strong exceeding the targeted savings goal. AEP Ohio made several changes to the program to increase cost effectiveness and improve processes such as adjusting incentive payment amounts and driving lower Home Energy Rating scores, increased marketing and education efforts. The Company is working with vendors to find ways to include codes and standards education and awareness to support the program. AEP Ohio once again received the Energy Star New Homes program award in Washington DC. AEP Ohio recommends the program continue as described in the Plan.

HOME ENERGY REPORTS

In 2013, we have almost 236,000 customers participating and receiving home energy reports. In addition, this program provides an opportunity to educate our customers on all the residential energy efficiency programs they can participant in. AEP Ohio and the contractor attempted to add customers via opt-in. However, they were not successful and the Company made a decision to continue with opt-out. AEP Ohio recommends the program continue as described in the Plan.

e³smart

This program continues to receive high satisfaction from teachers and students and over 20,000 students participated in 2013. AEP Ohio recommends the program continue as described in the Plan.

BUSINESS PROGRAMS

PRESCRIPTIVE

The Prescriptive program began June 1, 2009, focused in the first year on prescriptive lighting only. In addition and according to the Plan, AEP Ohio expanded the list of prescriptive measures in 2010 under this program beyond lighting, to include HVAC, motors, drives and other cost effective measures to simplify and market this program effectively. Over 200 prescriptive measures are currently offered. AEP Ohio recommends that the program continue as described in the Plan.

CUSTOM

The Custom program began June 1, 2009 and 2010 showed a significant increase in customer participation. No changes are recommended to the Custom program. The Custom program is designed to be a “kitchen sink” program to handle customer energy efficiency projects not addressed through other business programs. Two specific needs were identified in 2009 and developed in 2010 as targeted marketing efforts. One was a direct install program for small businesses since AEP Ohio was receiving so few applications in this important customer segment. This effort was ultimately developed as the Express program. The second need was for a focused program to address agricultural energy efficiency needs. Work continues with the Collaborative and the Ohio Farm Bureau and has produced a concentrated marketing effort for this segment that began at the end of 2012. Additional target segments may also be explored to engage more non-participants in AEP Ohio programs. Each targeted marketing effort will be monitored and listed as a subset of the Custom Program to track performance and participation. Since 2011, measures which show increased usage as technology develops, such as LED lighting, are moved to the Prescriptive Program to remove barriers to participation. AEP Ohio recommends that the program continue as described in the Plan.

DEMAND RESPONSE

The demand response program is used to supplement the peak demand reductions achieved from EE/PDR programs. Prior to 2012 and the merger of CSP and OPCo additional demand response was needed in CSP. Post-merger, additional customer agreements were not needed to gain customer commitments for supplemental peak demand reduction. No changes are recommended to the demand response program.

Self-Direct

The Self Direct program should continue as designed in 2014. This program has achieved significant impacts and participation since 2009. The Self Direct program has also helped drive participation in other programs through its unique allowance of previously completed projects and the option of either the payment of an energy efficiency credit or an exemption from the EE/PDR Rider. No changes are recommended to the Self Direct program.

Business New Construction

The New Construction program started in 2011 with strong participation. In 2013, participation continued to increase as customer recognition of the program increased. New Construction continues to increase as the economy stabilizes and energy savings from new construction is a good opportunity for long lived savings. No changes are recommended to the New Construction Program.

Express Program

The Express program started as a Pilot under the Custom program in 2010. In 2011, there was strong participation by small business customers that did not have staff or strong understanding of energy efficiency. In 2012, the program again had strong participation. The program changed in 2012 from a program marketed by local contractors, to a program with dedicated program marketing staff that would present signed contracts and materials to local contractors for installation. Results show a higher participation rate with the 2012 change. No changes are recommended to the Express program.

Retro-Commissioning

The Retro-Commissioning program is a new program launched in early 2013. This program seeks to obtain energy savings through the identification and implementation of low-cost, operational adjustments that improve the efficiency of existing buildings' operating systems by optimizing the systems to meet the building's requirements, with a focus on building controls and HVAC systems. Activity in 2012 was registering and training local retro-commissioning service providers (RSPs). Trained RSPs started to grow the program throughout 2013. No changes are recommended for the Retro-commissioning program.

CONTINUOUS IMPROVEMENT

The Continuous Improvement program is a new program launched in early 2013. This program seeks to facilitate a comprehensive and enduring strategic approach to energy reduction at key customer facilities. Activity in 2012 was to enlist large industrial customers into the program. Strong enlistment throughout 2013 indicates high acceptance of the program. No changes are recommended to the Continuous Improvement program.

DATA CENTER

The Data Center program is a new program launched in early 2013. This program is designed to assist customers in addressing energy efficiency opportunities in both new and existing data centers (facilities used to house computer systems and associated components). Activity in 2012 was the design and launch of the program. Activity with data centers in 2013 indicates good acceptance of the program. No changes are recommended to the Data Center program.

BID TO WIN

The Bid to Win program is a new program launched in late 2013. This program seeks to introduce a competitive bidding approach to EE/PDR by using elements of competition and timing to fit customers' schedules for capital improvements to enhance business customer interest. The first bidding processes were held in late 2013. AEP Ohio recommends that the program continue as described in the Plan.

SUPPORTING AFFIDAVIT

AFFIDAVIT OF JON F. WILLIAMS

State of Ohio :
: ss
County of Franklin :

Jon F. Williams, being first duly cautioned and sworn, states as follows:

1. I am the Manager of Energy Efficiency and Peak Demand Reduction for AEP Ohio.

2. I am responsible for the design, development and implementation of customer programs relating to Energy Efficiency (EE) and Peak Demand Reduction (PDR) for AEP Ohio, including overseeing compliance with the EE/PDR mandates of Senate Bill 221 (SB 221) and the rules adopted by the Public Utilities Commission of Ohio (Commission) for inclusion in Ohio Administrative Code Chapter 4901:1-39 (Green Rules).

3. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio's energy baseline to be used for the 2013 reporting year is 43,100.2 GWh.

4. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio's 0.90% EE benchmark for the 2013 reporting year is 387.9 GWh.

5. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio complied with the EE benchmark for the 2013 reporting year.

6. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio's demand baseline to be used for the 2013 reporting year is 8,975.1 MW.

7. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio's 4.0% PDR benchmark for the 2013 reporting year is 359.0 MW. On that basis, AEP Ohio could achieve compliance for 2013 by either implementing

programs (including programs offered through a tariff) designed to achieve a peak demand reduction of 359.0 MW in 2013 or if peak demand is less than 8,616.1 MW (*i.e.,* 8,975.1 MW less 359.0 MW).

8. Based on my understanding of SB 221 and the Commission's Green Rules, AEP Ohio complied with the PDR benchmark for the 2013 reporting year.

FURTHER AFFIANT SAYETH NAUGHT.

Jon F. Williams

Sworn to before me and subscribed in my presence this 13 day of May, 2014.

Michelle L Kisha
Notary Public

NOTARIAL SEAL
STATE OF OHIO

MICHELLE L KISHA
NOTARY PUBLIC - OHIO
MY COMMISSION EXPIRES 1-21-2018

TABLE OF APPENDICES

APPENDIX A

APPENDIX A -- Ohio Savings Terms FINAL **12/31/2013**

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Efficient Products	CFL 7W	14,777	22	0.0026	321,801	38.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 9W	91,542	28	0.0033	2,563,104	306.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 10W	83,229	31	0.0037	2,589,274	309.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 11W	24,459	34	0.0041	837,018	100.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 12W	10,850	37	0.0045	405,055	48.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 13W	1,941,093	41	0.0049	79,861,508	9,549.8	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 14W	1,034,923	44	0.0052	45,087,396	5,391.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 15W	162,778	47	0.0056	7,596,093	908.3	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 16W	12,340	50	0.0060	614,241	73.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 17W	716	53	0.0063	37,867	4.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 18W	90,172	56	0.0067	5,049,490	603.8	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 19W	119,827	59	0.0071	7,082,908	847.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 20W	102,870	62	0.0074	6,400,620	765.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 22W	85	43	0.0052	3,687	0.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 23W	447,823	46	0.0055	20,650,450	2,469.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 25W	685	78	0.0093	53,276	6.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 26W	186,157	54	0.0065	10,125,707	1,210.8	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 27W	166	57	0.0068	9,453	1.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 28W	1,092	87	0.0104	95,123	11.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 29W	124	90	0.0108	11,187	1.3	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 30W	173	68	0.0081	11,738	1.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 32W	10,830	100	0.0119	1,077,938	128.9	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 33W	588	103	0.0123	60,366	7.2	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 40W	436	86	0.0103	37,534	4.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 42W	2,582	107	0.0128	276,133	33.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 55W	854	171	0.0205	146,125	17.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 65W	44	128	0.0152	5,640	0.7	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 68W	769	212	0.0253	162,682	19.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 7W	12	59	0.0067	708	0.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 8W	15,755	58	0.0069	911,892	109.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 9W	975	73	0.0088	71,626	8.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 10W	2,225	72	0.0087	160,977	19.3	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 11W	956	71	0.0085	68,102	8.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 12W	8,736	68	0.0082	595,380	71.2	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 13W	15,170	68	0.0081	1,024,929	122.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 14W	25,269	65	0.0077	1,631,942	195.2	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 15W	4,118	67	0.0080	274,523	32.8	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 17W	3,070	64	0.0077	197,946	23.7	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 18W	142	63	0.0076	9,009	1.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 19W	6	62	0.0067	374	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED 20W	4,412	61	0.0073	270,097	32.3	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED Mini Lights	24,746	9	0.0000	210,845	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	TV	1820	102	0.0281	185,538	51.1	2012 to 2014 Plan - Exhibit B, Page 189
	Clothes Washer	18,151	226	0.0318	4,103,305	577.0	Draft Ohio 2010 Technical Reference Manual - Page 59
	Dehumidifier	1,581	207	0.0471	327,285	74.5	Draft Ohio 2010 Technical Reference Manual - Page 64
	Electric Water Heater	88	183	0.0139	16,095	1.2	2012 to 2014 Plan - Exhibit B, Page 190
	Freezer	2,299	67	0.0076	153,765	17.6	Energy Star website
	Heat Pump Water Heater	256	1,693	0.2308	433,302	59.1	Draft Ohio 2010 Technical Reference Manual - Page 86
	Refrigerator	17,905	120	0.0212	2,302,036	406.6	Draft Ohio 2010 Technical Reference Manual - Page 53
	TOTAL				**204,123,090**	**24,671.4**	

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Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Appliance Recycling	Room Air Conditioner	10	0	0.0000	0	0.0	
	Freezer	3843	1,244	0.2000	4,782,229	768.6	Draft Ohio 2010 Technical Reference Manual - Page 23
	Refrigerator	15549	1,376	0.2200	21,397,756	3,420.8	Draft Ohio 2010 Technical Reference Manual - Page 23
	TOTAL				**26,179,986**	**4,189.4**	
In Home Retrofit	Programmable Thermostat	1116	405	0.0000	452239.58	0.0	2012 to 2014 Plan - Exhibit B, Page 190
	Energy Star Air Source Heat Pump	773	1,016	0.2134	785554.76	165.0	Draft Ohio 2010 Technical Reference Manual - Page 33
	Energy Star AC Replacement	2569	248	0.2099	637034.19	539.4	Draft Ohio 2010 Technical Reference Manual - Page 30
	Ductless Mini Splits (Ductless Heat Pumps)	3	807	0.1273	2419.56	0.4	Draft Ohio 2010 Technical Reference Manual - Page 33
	GS ENERGY STAR Heat Pump	24	4,662	0.5871	111886.09	14.1	Draft Ohio 2010 Technical Reference Manual - Page 82
	Furnace with ECM Motor or ECM Motor Replacement	3849	134	0.0346	514713.10	133.1	2012 to 2014 Plan - Exhibit B, Page 190
	Duct Sealing	16	1,158	0.0302	18531.31	0.5	Draft Ohio 2010 Technical Reference Manual - Page 108
	RCA Tune up	236	123	0.0351	28810.11	8.3	Draft Ohio 2010 Technical Reference Manual - Page 26
	Faucet Aerator	11648	20	0.0026	238431.06	29.7	Draft Ohio 2010 Technical Reference Manual - Page 89
	Shower Heads	5457	213	0.0273	1164828.31	149.0	Draft Ohio 2010 Technical Reference Manual - Page 93
	Direct Install Pipe Insulation	1910	116	0.0132	221384.84	25.3	Draft Ohio 2010 Technical Reference Manual - Page 97
	CFL Torchieres	5	42	0.0050	209.17	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 40
	Direct Install CFL 13W	123594	38	0.0045	4699099.45	561.9	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	Direct Install CFL 14W Globe	19599	41	0.0049	799643.85	95.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	Direct Install CFL 20W	7031	59	0.0070	412037.72	49.3	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	Direct Install CFL 23W	11135	43	0.0051	475654.71	56.9	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	Direct Install CFL 9W Globe	27800	26	0.0031	730934.76	87.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	PIN Based CFL Fixture (Indoor)	18	40	0.0048	718.11	0.1	Based on Draft Ohio 2010 Technical Reference Manual - Page 43
	Direct Install LED Night Light	20297	21	0.0024	426806.47	48.7	Based on 2012 Navigant Evaluation Result
	Energy Star Ceiling Fan	27	167	0.0190	4509.00	0.5	Draft Ohio 2010 Technical Reference Manual - Page 48
	Air Sealing	806	136	0.0111	109294.32	9.0	Draft Ohio 2010 Technical Reference Manual - Page 104
	Draft Stoppers	26436	2	0.0021	44060.00	55.1	2012 to 2014 Plan - Exhibit B, Page 190
	Energy Star Window Replacement	366	40	0.0114	14553.42	4.2	Draft Ohio 2010 Technical Reference Manual - Page 115
	Window Film	6	37	0.0367	221.86	0.2	2012 to 2014 Plan - Exhibit B, Page 190
	Weatherstripping	2203	15	0.0280	33045.00	61.7	2012 to 2014 Plan - Exhibit B, Page 190
	Attic Insulation	935	104	0.0089	97283.09	8.3	Draft Ohio 2010 Technical Reference Manual - Page 36
	Wall Insulation	324	70	0.0159	22794.80	5.1	Draft Ohio 2010 Technical Reference Manual - Page 100
	TOTAL				**12,046,699**	**2,109**	

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Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Energy Star New Homes	Energy Star Home	2,184	2,667	0.5077	**5,824,102**	**1,108.9**	Residential Energy Modeling
E3Smart	HW Heater Temp Setback	2783	132	0.0000	367,356	0.0	Based on 2012 Navigant Evaluation Result
	Faucet Aerator	8563	25	0.0031	209,794	26.2	Draft Ohio 2010 Technical Reference Manual - Page 89
	Low-Flow Showerhead	5349	237	0.0303	1,267,766	162.2	Draft Ohio 2010 Technical Reference Manual - Page 93
	CFL 13W	23839	57	0.0068	1,357,921	162.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	CFL 23W	19355	48	0.0057	923,323	110.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	LED Nightlight	5650	21	0.0024	119,046	13.6	Based on 2012 Navigant Evaluation Result
	Door Sweep	7868	57	0.0093	449,184	73.4	Based on 2012 Navigant Evaluation Result
	Weather Stripping	7219	4	0.0093	28,154	67.4	Based on 2012 Navigant Evaluation Result
	TOTAL				**4,722,544**	**615.5**	
Behavioral	Behavioral	235,893	265	0.0345	**62,585,076**	**8,132.0**	Proprietary Regression Model
Low Income	Efficient Freezer	1,639	1,045	0.0178	1,712,755	29.2	Underlying Draft Ohio 2010 Technical Reference Manual - Page 23
	Efficient Refrigerator	7,332	976	0.0650	7,156,032	476.6	Underlying Draft Ohio 2010 Technical Reference Manual - Page 23
	Recycled Freezer	19	1,244	0.1990	23,636	3.8	Draft Ohio 2010 Technical Reference Manual - Page 23
	Recycled Fridge	21	1,376	0.2030	28,896	4.3	Draft Ohio 2010 Technical Reference Manual - Page 23
	Air Source Heat Pump	19	215	0.1137	4,093	2.2	Draft Ohio 2010 Technical Reference Manual - Page 33
	Central Air Conditioner	1	73	0.0000	73	0.0	Draft Ohio 2010 Technical Reference Manual - Page 30
	Remove Space Heater	20	1,435	0.0000	28,708	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 33
	Duct Sealing	55	149	0.1351	8,206	7.4	Draft Ohio 2010 Technical Reference Manual - Page 108
	Duct Insulation	12	77	0.0698	924	0.8	Underlying Draft Ohio 2010 Technical Reference Manual - Page 36
	Hot Water Temp Setback	63	146	0.0000	9,198	0.0	Based on 2012 Navigant Evaluation Result
	Faucet Aerator	3,529	27	0.0034	96,530	12.1	Draft Ohio 2010 Technical Reference Manual - Page 89
	Low Flow Showerhead	2,747	58	0.0271	160,415	74.3	Draft Ohio 2010 Technical Reference Manual - Page 93
	Electric Water Heater	55	346	0.0137	19,024	0.8	Draft Ohio 2010 Technical Reference Manual - Page 123
	Hot Water Pipe Insulation	4,454	16	0.0018	70,740	8.1	Draft Ohio 2010 Technical Reference Manual - Page 97
	Hot Water Tank Wrap	278	76	0.0086	21,093	2.4	Draft Ohio 2010 Technical Reference Manual - Page 131
	Exterior CFL 23W	953	43	0.0000	40,703	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 11
	Exterior CFL 13W	3,577	38	0.0000	136,212	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 12
	Exterior CFL 20W	3,190	47	0.0000	149,515	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 13
	Exterior CFL 20W	1,310	53	0.0000	69,076	0.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 14
	Interior CFL 23W	12,804	37	0.0056	475,541	71.2	Based on Draft Ohio 2010 Technical Reference Manual - Page 15
	Interior CFL 3-Way	2,843	67	0.0070	191,561	20.0	Based on Draft Ohio 2010 Technical Reference Manual - Page 16
	Interior CFL Candelabra	9,837	26	0.0028	259,303	27.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 17
	Interior CFL 13W	113,421	38	0.0046	4,319,072	517.5	Based on Draft Ohio 2010 Technical Reference Manual - Page 18
	Interior CFL 20W	23,038	47	0.0063	1,079,791	145.6	Based on Draft Ohio 2010 Technical Reference Manual - Page 19
	Sump Pump	4	157	0.0000	628	0	http://hes-documentation.lbl.gov
	Well Pump	2	157	0.0000	314	0.0	http://hes-documentation.lbl.gov
	Smart Strip	3,271	82	0.0000	268,222	0.0	2014 to 2014 Plan - Exhibit B, Page 190
	Air Sealing	220	1,657	0.0222	364,618	5	Draft Ohio 2010 Technical Reference Manual - Page 104
	Attic Insulation	187	56	0.1334	10,473	25.0	Draft Ohio 2010 Technical Reference Manual - Page 36
	Foundation Insulation	45	60	0.0543	2,697	2.4	Based on Draft Ohio 2010 Technical Reference Manual - Page 36
	Mobile Home Insulation	442	72	0.0650	31,736	28.7	Draft Ohio 2010 Technical Reference Manual - Page 126
	Wall Insulation	41	73	0.0660	2,985	2.7	Draft Ohio 2010 Technical Reference Manual - Page 100
	TOTAL				**16,742,770**	**1,467.5**	

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Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Custom	Engel Injection Molding machine with servo hydraulic pumps	1	587,837	46.9700	587,837	47.0	
	1000 cm Cycling refrigerated dryer and (1) high efficiency after filter	1	60,408	5.9700	60,408	6.0	
	(1) MM580 ton, (2) 950 ton, and (1) 560 ton Milacron Injection Molding machine with servo hydraulic pumps	1	343,111	26.1400	343,111	26.1	
	(17) 250w LED fixtures	1	46,233	3.6200	46,233	3.6	
	(2) 20HP air compressors with air receivers, dryer	1	48,588	8.0400	48,588	8.0	
	(4) MS950 ton Milcacron Injection Molding machine with servo hydraulic pumps	1	635,318	24.0200	635,318	24.0	
	1 60HP Variable Freq Drive Air Compressor and 1 50HP Load no load Air Compressor	1	91,716	39.3700	91,716	39.4	
	1) 2-stage VFD 350hp	1	112,585	40.1100	112,585	40.1	
	1000 cfm cycling dryer	1	7,056	0.8400	7,056	0.8	
	12.7 kW Husky HMEDL180E	1	153,044	23.8100	153,044	23.8	
	1-75HP Atlas Copco VSD compressor, 1-75HP fixed speed Atlas Copco compressor with new piping system and ManagAir control system.	1	121,918	20.1600	121,918	20.2	
	2 Pentair Intellilflo Variable Speed Pool Pumps (2 at 0.75HP each)	1	2,726	0.1800	2,726	0.2	
	2 stage rotary screw - 250HP	1	345,827	40.2800	345,827	40.3	
	2000 cfm cycling dryer	1	4,620	1.4500	4,620	1.5	
	250 HP water pump with VSD	1	850,574	100.9900	850,574	101.0	
	350hp w/VFD	1	99,620	1.4100	99,620	1.4	
	500 T Hybrid molding machine	1	269,416	27.1100	269,416	27.1	
	500 ton plate and frame heat exchanger installation for free ecooling during cold weather	1	604,614	0.0000	604,614	0.0	
	5000 cfm extenally heated Desiccant dryer ith /EMC	1	159,068	15.4400	159,068	15.4	
	6.3 kW Husky HMEDL180E	1	93,436	17.3000	93,436	17.3	
	75hp motor w/VFD	1	133,156	4.6300	133,156	4.6	
	A new digital control system is added to allow the compressor to load and unload appropriately, based on the needs of the plant	1	765,335	193.1600	765,335	193.2	
	AC motor with VFD	1	2,512	0.0000	2,512	0.0	
	Automated Set Back capabilities, Load Resets, updated Outdoor Air temperature sensing, and improved building envelope.	3	84,350	15.1000	253,049	45.3	
	Beverage Machine Controls	7	1,612	0.0000	11,284	0.0	
	CO2 sensors will reduce ventilation based on level of occupancy or CO2 in the space. Outdoor air can reduced from 20% to 5%. The runtime of the fans will be reduced by controls that allow temperature	2	24,124	0.0000	48,248	0.0	
	Compressed Air Receiver	417	449	0.0475	187,200	19.8	
	Cycling Air Dryer	3,000	3	0.0005	10,248	1.4	
	Dephenolation system	1	510,884	58.3200	510,884	58.3	
	Dryer Replacement	1	100,195	10.3200	100,195	10.3	

All Custom Measures are individually calculated using meth
methodology consistent with the Draft Ohio 2010 Technic
Technical Reference Manual. All Custom Measures are indiv
individually calculat

APPENDIX A -- Ohio Savings Terms FINAL **12/31/2013**

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Custom cont.	Eccentric Bottom Tap hole EBT, less impurities. Oxygen injection added at multiple locations. Use reduced to 380 kWh/ton.	1	7,253,671	1989.7200	7,253,671	1,989.7	
	Energy Management System	3	754,194	0.0000	2,262,582	0.0	
	LED	751	654	0.1542	491,289	115.8	
	Energy Star mini-fridges	1	45,500	5.1900	45,500	5.2	
	Existing system with demand flow control	1	710,962	98.6700	710,962	98.7	
	measured	1	249,608	35.6600	249,608	35.7	
	Gym fan VFD installed. DCV setup in Gym space using CO2sensor New BAS installed with controll sequence modifications New unit and plant controllers installed	3	427,223	90.1433	1,281,670	270.4	
	Heat pads	1	24,710	0.0000	24,710	0.0	
	High Efficiency Chiller	1	113,179	14.2800	113,179	14.3	
	Improvements to many of the production components are intended to increase production to 2/82 gallons per bushel. Throughput should also increase by 10%	1	5,003,307	707.2300	5,003,307	707.2	
	Ingersoll Rand NVC1200 cycling air dryer	1	12,456	(0.7400)	12,456	(0.7)	
	Install new 300 HP Ingersol Rand Rotary Screw Compressor-2-Stage in place of Joy Twistair	1	221,872	28.6400	221,872	28.6	
	Install Waterside Economizer on Chillers to Provide Free Cooling of Process Chilled Water During Winter	1	673,645	0.0000	673,645	0.0	
	Installing two (2) 250-HP VFDs on the line to allow reduction of speed to match production.	1	153,691	27.7400	153,691	27.7	
	Instead of a 180 ton chiller, provide process cooling via an open-loop geothermal system. See attached for calculations on an estimate of the savings.	1	163,453	20.4300	163,453	20.4	
	Interior LED Lighting	580	80	0.0149	46,365	9	
	Interior Occupancy Sensor	4,040	3	0.0000	10,227	0.1	
	LED Hi Bay (147 W)	4	270,919	5.3550	1,083,676	21.4	
	LED Refrigeration Case Lighting in Freezers and Co	104	216	0.0320	22,454	3.3	
	Line 3 barrel cooling using air cooled system (using fan blowers)	1	22,035	4.4500	22,035	4.5	
	Low Pressure Drop Filter	328	15	0.0031	4,913	1.0	
	New 9390 Eaton ESS UPS	1	35,471	4.1000	35,471	4.1	
	New aeration equipment with water treatment diffusers	1	839,120	120.4900	839,120	120.5	
	New T5/T8 Fluorescent Fixtures	7	1,094	0.1800	7,661	1.3	
	New VRF heating / cooling system in each building (Serves classroom and admin spaces), new Distech building automation system, and occupancy sensors in every classroom to turn off lights	1	84,331	0.0000	84,331	0.0	
	retrofit pumps with VFDs, new Distech building automation system, and occupancy sensors in every classroom to turn off lights	1	45,550	0.0000	45,550	0.0	
	New VRF heating / cooling system in each building, retrofit pumps with VFDs, new Distech building automation system, retrofit (4) existing constant volume air handling units to be a variable volume ai	4	298,854	0.0000	1,195,416	0.0	
	No Loss Condensate Drain	7	1,197	0.2614	8,379	1.8	
	No-Loss Low Pressure Drop Filter	1	31,680	3.8100	31,680	3.8	
	NVC800 800 cfm cycling air dryer	1	4,768	0.5800	4,768	0.6	
	Prem.Eff. 250 HP motor and 250-HP VFL driving the exhaust fan (damper removed)	1	60,013	72.3400	60,013	72.3	

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:al Reference Manual. All Custom Measures are individually calculated u
idually calculated using methodology consistent with the Draft Ohio 20
:ed using methodology consistent with the Draft Ohio 2010 Technical R

APPENDIX A -- Ohio Savings Terms FINAL 12/31/2013

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Custom cont.	Process Reliability Improvement Project	1	10,019,329	0.0000	10,019,329	0.0	
	rod drawing 100W and seal plate drawing0W unless pressure is applied to the seal plate, it will heat instantaneously.	76	4,028	0.5775	306,152	43.9	
	Remisafe open hinged doors refrofit on to the cases.	1	106,614	11.7200	106,614	11.7	
	and VFDs to allow reduction of speed to match production	1	59,107	10.5300	59,107	10.5	
	Replace the motor housing, shaft, and redid the blade design for the ID Fan	1	303,496	34.6000	303,496	34.6	
	Ton; 9 at 25-Ton; 5 at 20-Ton; and 5 at 17-Ton) - with EC motors	1	2,458,506	280.7100	2,458,506	280.7	
	plenum	1	789,158	54.1900	789,158	54.2	
	Retrofit VFD to the 350 HP pump	1	505,285	50.6500	505,285	50.7	
	Rotary Screw air compressors are to be replaced with a 125 hp variable speed compressor to meet the needs of the facility.	1	165,702	19.1700	165,702	19.2	
	Snack Machine Controls	4	387	0.0000	1,548	0.0	
	The customer will operate a 5 HP rotary compressor, repalcing the 25 HP machine. The 5 HP will reduce the demand and eliminate the wasted energy	1	39,361	14.9200	39,361	14.9	
	The entire DDG conveyor system will be replaced and reconfigured. The resulting system will allow the plant to increase production of methanol.	1	2,647,919	92.4800	2,647,919	92.5	
	removed and replaced with digital controls. Additionally the automation system has been updated and re-programmed.	1	560,500	0.0000	560,500	0.0	
	removed and replaced with digital controls. Additionally the automation system has been updated and re-programmed.	13	142,146	0.0000	1,847,902	0.0	
	The plant will be re-engineered to utilize other available capacity, and thus, the neeed for the 2200 HP moter can be eliminated	1	6,050,014	702.1800	6,050,014	702.2	
	Three 700 HP centrifugal units will replace the entire compressed air system. Operating under similar conditions. Two compressors will be in service all the time and one is used as back up.	1	1,743,859	118.9900	1,743,859	119.0	
	speed air compressor Max Flow: 1,060 CFM Average Flow: 911 CFM Max KW: 185.3 KW Estimated Ave KW: 157.50	1	704,651	82.3800	704,651	82.4	
	tuned up HVAC equipment, VFD on motors, energy management system, heat trace system	1	1,703,584	0.0000	1,703,584	0.0	
	VFD for HVAC	6	27,288	5.9733	163,725	35.8	
	VFD with 2 800HP Motors	1	796,805	243.2600	796,805	243.3	
	VSD Compressor	1	425,324	46.8100	425,324	46.8	
	TOTAL				**60,222,022**	**6,175.0**	

al. All Custom Measures are individually calculated using
using methodology consistent with the Draft Ohio 2010
10 Technical Reference Manual. All Custom Measures are
eference Manual.

APPENDIX A -- Ohio Savings Terms FINAL **12/31/2013**

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
New Construction	Injection Molding Equipment	3	461119	22.7567	1,383,357	68.3	All Custom Measures are individually calculated using methodology consistent with the Draft Ohio 2010 Technical Reference Manual.
	Energy Star residential appliances	1	17928	1.9200	17,928	1.9	Energy Star website
	Whole Building - <30%	29	151822	33.3855	4,402,830	968.2	Individually modeled by Implementer
	Whole Building - e10 and <20%	5	85957	27.1680	429,785	135.8	Individually modeled by Implementer
	Whole Building - e20 and <30%	5	115323	27.3760	576,617	136.9	Individually modeled by Implementer
	Floating Head Pressure Control	330	496	0.0639	163,739	21.1	Vendor Internal TRM - Compressed Air
	Low Pressure Drop Filter	434	15	0.0032	6,501	1.4	Vendor Internal TRM - Compressed Air
	Air Cooled Chiller	4	9365	7.7525	37,458	31.0	Vendor Internal TRM - Cooling
	Air Source Heat Pump	127	1110	0.7104	140,911	90.2	Vendor Internal TRM - Cooling
	Energy Management System	10,000	2	0.0000	23,100	0.0	Vendor Internal TRM - Cooling
	Ground Source Heat Pump	29	653	0.3907	18,950	11	Vendor Internal TRM - Cooling
	Oversized Condenser for Refrigeration	83	120	0.1200	9,960	10.0	Vendor Internal TRM - Cooling
	PTAC/PTHP	33	116	0.0664	3,844	2.2	Vendor Internal TRM - Cooling
	Room Air Conditioner	12	10252	8.6367	123,021	103.6	Vendor Internal TRM - Cooling
	Water Cooled Chiller	10	111443	77.6650	1,114,431	776.7	Vendor Internal TRM - Cooling
	Combination Oven	2	18432	3.5350	36,864	7.1	Vendor Internal TRM - Food Service
	Steam Cookers	2	4419	1.0000	8,838	2.0	Vendor Internal TRM - Food Service
	Daylighting Controls	150,709	1	0.0008	170,699	115.5	Vendor Internal TRM - Lighting
	Interior Lighting Power Density	3,736,302	4	0.0009	14,977,761	3,264.9	Vendor Internal TRM - Lighting
	EC Motor for Reach-in Refrigerator cases	424	474	0.0492	200,775	20.9	Vendor Internal TRM - Motors and Drives
	Efficient Motors	21	793	0.1329	16,659	2.8	Vendor Internal TRM - Motors and Drives
	Non HVAC VSD < 200HP	43	48475	6.5833	2,084,415	283.1	Vendor Internal TRM - Motors and Drives
	VFD for HVAC	81	12711	1.8307	1,029,597	148.3	Vendor Internal TRM - Motors and Drives
	VSD for Air Compressor	160	1435	0.2990	229,600	47.8	Vendor Internal TRM - Motors and Drives
	Anti-Sweat Heater Controls	736	294	0.0340	216,384	25.0	Vendor Internal TRM - Refrigeration
	ENERGY STAR Solid Door Refrigerator	6	638	0.0733	3,829	0.4	Vendor Internal TRM - Refrigeration
	Evaporator Fan Controls - EC Motor	4	915	0.1050	3,660	0.4	Vendor Internal TRM - Refrigeration
	Ice Maker	4	1294	0.2275	5,176	0.9	Vendor Internal TRM - Refrigeration
	LED Refrigeration Case Lighting	1,434	203	0.0302	291,029	43.3	Vendor Internal TRM - Refrigeration
	Lighting Controls for Freezers and Coolers with Doors	271	170	0.0096	46,178	2.6	Vendor Internal TRM - Refrigeration
	TOTAL				**27,773,899**	**6,323.6**	

APPENDIX A -- Ohio Savings Terms FINAL 12/31/2013

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Prescriptive	VSD on Dairy Vacuum Pump	10	2,409	0.4400	24,090	4.4	Vendor Internal TRM - Agriculture
	Compressed Air Engineered Nozzle	5	2,418	0.3360	12,090	1.7	Vendor Internal TRM - Compressed Air
	Compressed Air Leak Repair 24hr Operation	141	1,400	0.1730	197,680	24.4	Vendor Internal TRM - Compressed Air
	Compressed Air Receiver	400	62	0.0000	24,960	0.0	Vendor Internal TRM - Compressed Air
	Cycling Air Dryer	5,270	26	0.0036	135,017	18.7	Vendor Internal TRM - Compressed Air
	Low Pressure Drop Filter	1,145	15	0.0032	17,152	3.6	Vendor Internal TRM - Compressed Air
	No Loss Condensate Drain	8	931	0.2025	7,448	1.6	Vendor Internal TRM - Compressed Air
	Air Cooled Chiller	15	24,786	13.5320	371,790	203.0	Vendor Internal TRM - Cooling
	Air Source Heat Pump	157	903	0.6558	141,841	103.0	Vendor Internal TRM - Cooling
	Air-Side Economizer	6	21,490	0.0000	128,938	0.0	Vendor Internal TRM - Cooling
	Energy Management System	1,405,729	2	0.0000	2,861,684	0.0	Vendor Internal TRM - Cooling
	Occupancy Sensor Control for HVAC Systems	309	489	0.1581	151,245	48.9	Vendor Internal TRM - Cooling
	PTAC/PTHP	13	175	0.0992	2,270	1.3	Vendor Internal TRM - Cooling
	Water Cooled Chiller	4	8,024	6.4825	32,098	25.9	Vendor Internal TRM - Cooling
	Beverage Machine Controls	10	1,612	0.0000	16,120	0.0	Vendor Internal TRM - Food Service
	Combination Oven	4	18,432	1.6975	73,727	6.8	Vendor Internal TRM - Food Service
	Daylighting Controls	211,424	1	0.0000	181,844	10.5	Vendor Internal TRM - Food Service
	Steam Cookers	2	25,545	3.5250	51,090	7.1	Vendor Internal TRM - Food Service
	Exterior CFL	280	242	0.0000	67,745	0.0	Vendor Internal TRM - Lighting
	Exterior LED	7,012	1,126	0.0074	7,893,348	52.0	Vendor Internal TRM - Lighting
	Exterior LED Signs	3	274	0.0300	821	0.1	Vendor Internal TRM - Lighting
	Exterior LED traffic lights	28	607	0.0693	16,991	1.9	Vendor Internal TRM - Lighting
	Exterior Non-Standard Lighting	76	865	0.0000	65,764	0.0	Vendor Internal TRM - Lighting
	Exterior Pulse Start	54	481	0.0000	25,998	0.0	Vendor Internal TRM - Lighting
	Exterior T8/T5 Fluorescent Fixture w/Electronic Ballast	55	2,197	0.0000	120,809	0.0	Vendor Internal TRM - Lighting
	Garage CFL	13	391	0.0000	5,087	0.0	Vendor Internal TRM - Lighting
	Garage LED	221	1,192	0.1361	263,518	30.1	Vendor Internal TRM - Lighting
	Garage T5 Fluorescent Fixtures	572	746	0.0851	426,533	48.7	Vendor Internal TRM - Lighting
	Garage T8 Fluorescent Fixtures	20	153	0.0175	3,066	0.4	Vendor Internal TRM - Lighting
	Garage T8/T5 Fluorescent Fixture w/Electronic Ballast	168	101	0.0115	16,898	1.9	Vendor Internal TRM - Lighting
	Interior CFL	5,166	211	0.0455	1,089,703	234.8	Vendor Internal TRM - Lighting
	Interior Delamping	26,047	141	0.0417	3,659,965	1,086.6	Vendor Internal TRM - Lighting
	Interior LED	70,272	316	0.0667	22,211,624	4,690.5	Vendor Internal TRM - Lighting
	Interior Non-Standard Lighting	29,592	317	0.0801	9,388,906	2,371.0	Vendor Internal TRM - Lighting
	Interior Occupancy Sensor	6,125,742	1	0.0003	6,862,160	1,732.2	Vendor Internal TRM - Lighting
	Interior T5 Fluorescent Fixtures	43,170	663	0.1665	28,631,289	7,186.3	Vendor Internal TRM - Lighting
	Interior T8 Fluorescent Fixtures	240,038	56	0.0158	13,506,613	3,796.4	Vendor Internal TRM - Lighting
	Interior T8/T5 Fluorescent Fixture w/Electronic Ballast	8,707	951	0.1893	8,281,902	1,647.9	Vendor Internal TRM - Lighting
	New T5 Fluorescent Fixtures	174	820	0.0000	142,635	0.0	Vendor Internal TRM - Lighting
	Time Clocks	232,831	0	0.0000	101,233	2.2	Vendor Internal TRM - Lighting
	High Frequency Battery Charger	9	2,994	0.5656	26,946	5.1	Vendor Internal TRM - Misc.
	Efficient Motors	6	1,055	0.1917	6,328	1.2	Vendor Internal TRM - Motors and Drives
	Non HVAC VSD < 200HP	320	12,466	1.6375	3,989,115	524.0	Vendor Internal TRM - Motors and Drives
	VFD for HVAC	262	22,740	3.8420	5,957,934	1,006.6	Vendor Internal TRM - Motors and Drives
	VSD for Air Compressor	180	1,435	0.2990	258,300	53.8	Vendor Internal TRM - Motors and Drives
	Anti-Sweat Heater Controls	247	294	0.0340	72,618	8.4	Vendor Internal TRM - Refrigeration
	EC Motor for Walk-in Cooler and Freezer	1,139	418	0.0422	475,995	48.1	Vendor Internal TRM - Refrigeration
	ENERGY STAR Solid Door Refrigerator	12	637	0.0725	7,641	0.9	Vendor Internal TRM - Refrigeration
	Evaporator Fan Controls - EC Motor	58	915	0.1045	53,070	6.1	Vendor Internal TRM - Refrigeration
	Ice Maker	4	1,052	0.1850	4,206	0.7	Vendor Internal TRM - Refrigeration
	LED Refrigeration Case Lighting	10,120	196	0.0292	1,978,785	295.6	Vendor Internal TRM - Refrigeration
	Lighting Controls for Freezers and Coolers	414	170	0.0096	70,546	4.0	Vendor Internal TRM - Refrigeration
	Solid Door Freezer	8	1,884	0.2150	15,070	1.7	Vendor Internal TRM - Refrigeration
	TOTAL				**120,130,245**	**25,299.8**	

APPENDIX A -- Ohio Savings Terms FINAL **12/31/2013**

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Self Direct	Dryer Project	1	2,487,848	295.3300	2,487,848	295.3	
	Effcient Motors	1	348,568	79.5800	348,568	79.6	
	Efficient Computer Monitors	1	17,467	0.0000	17,467	0.0	All Custom Measures are individually calculated using methodology consistent with the Draft Ohio 2010 Technical Reference Manual.
	Efficient Computer Server System	1	5,585	1.3300	5,585	1.3	
	Efficient Computer Servers	1	16,197	1.8500	16,197	1.9	
	Efficient Motor Upgade	5	79,346	9.5760	396,731	47.9	
	Efficient Thin Client PCs	1	29,426	0.0000	29,426	0.0	
	Power Factor Correction Capacitor Banks	1	11,029	5880.0000	11,029	5,880.0	
	Process Machinery Equpment	8	335,533	15.8050	2,684,266	126.4	
	Process Motor	6	1,192,757	69.0600	7,156,540	414.4	All Custom Measures are individually calculated using methodology consistent with the Draft Ohio 2010 Technical Reference Manual.
	Process Motors	2	135,268	15.0500	270,535	30.1	
	Refrigeration Control System	1	202,569	0.0000	202,569	0.0	
	VFD for Process Motor	66	15,290	2.7055	1,009,111	178.6	
	Whole Building - e20 and <30%	1	58,966	10.9400	58,966	10.9	Individually modeled by Implementer
	VSD For Compressor	100	1,435	0.2990	143,500	30	Vendor Internal TRM - Compressed Air
	Air Cooled Chiller	8	11,062	7.9100	88,498	63.3	Vendor Internal TRM - Cooling
	Air Source Heat Pump	102	388	0.2837	39,579	28.9	Vendor Internal TRM - Cooling
	Energy Management System	67,307	2	0.0000	155,479	0.0	Vendor Internal TRM - Cooling
	Ground Source Heat Pump	3	1,568	0.5533	4,705	1.7	Vendor Internal TRM - Cooling
	HVAC Control System	2	62,463	0.0000	124,926	0.0	Vendor Internal TRM - Cooling
	Occupancy Sensor Control for HVAC Systems	5	99,523	0.0220	497,616	0.1	Vendor Internal TRM - Cooling
	PTAC/PTHP	70	183	0.1043	12,824	7.3	Vendor Internal TRM - Cooling
	Room Air Conditioner	17	2,157	1.0676	36,665	18.2	Vendor Internal TRM - Cooling
	VFD For HVAC	51	17,883	3.0388	912,017	155.0	Vendor Internal TRM - Cooling
	Water Cooled Chiller	1	91,739	32.5500	91,739	32.6	Vendor Internal TRM - Cooling
	Beverage Machine Controls	11	1,612	0.0000	17,732	0.0	Vendor Internal TRM - Food Service
	Hot Holding Cabinet	1	5,293	0.3900	5,293	0	Vendor Internal TRM - Food Service
	Exterior LED	7,434	793	0.0877	5,897,866	652.3	Vendor Internal TRM - Lighting
	Exterior New T5/T8 Fluorescent Fixtures	8	505	0.0000	4,038	0.0	Vendor Internal TRM - Lighting
	Interior CFL	5,004	188	0.0379	939,430	189.7	Vendor Internal TRM - Lighting
	Interior Daylighting Controls	94,727	1	0.0009	85,150	80.8	Vendor Internal TRM - Lighting
	Interior Delamping	123	155	0.0345	19,018	4.2	Vendor Internal TRM - Lighting
	Interior LED	939	1,057	0.1087	992,665	102.1	Vendor Internal TRM - Lighting
	Interior Lighting Power Density	216,275	4	0.0010	865,188	206.7	Vendor Internal TRM - Lighting
	Interior New T5/T8 Fluorescent Fixtures	1,595	607	0.1320	967,562	210.6	Vendor Internal TRM - Lighting
	Interior Non-Standard Lighting Measure	138	343	0.0485	47,384	6.7	Vendor Internal TRM - Lighting
	Interior Occupancy Sensor	127,514	1	0.0001	123,235	14.0	Vendor Internal TRM - Lighting
	Interior T8	2,530	91	0.0163	230,049	41.3	Vendor Internal TRM - Lighting
	Interior T8/T5 New Fluorescent Fixture w/Electronic Ballas	455	495	0.1416	225,032	64.4	Vendor Internal TRM - Lighting
	LED Traffic Lights	95	488	0.0557	46,390	5.3	Vendor Internal TRM - Lighting
	Ice Maker	4	752	0.1400	3,010	0.6	Vendor Internal TRM - Refrigeration
	Solid Door Refrigerator	3	637	0.0733	1,911	0.2	Vendor Internal TRM - Refrigeration
	Total				**27,273,338**	**8,982.4**	

APPENDIX A -- Ohio Savings Terms FINAL 12/31/2013

Program	Measure	Participation Count	Ex Ante Per unit kWh impact	Ex Ante Per unit kW impact	Gross Ex Ante kWh Savings	Gross Ex Ante kW Savings	Source Document
Express	Occupancy Sensor Control	45	198	0.0000	8,904	0.0	Vendor Internal TRM - Lighting
	Exterior CFL	99	547	0.1058	54,136	10.5	Vendor Internal TRM - Lighting
	Exterior LED	866	751	0.1660	650,261	143.7	Vendor Internal TRM - Lighting
	LED Exit sign	1,163	274	0.0265	318,609	30.8	Vendor Internal TRM - Lighting
	Garage LED	7	807	0.2029	5,646	1.4	Vendor Internal TRM - Lighting
	Garage T5 Linear Fluorescent	459	504	0.1125	231,312	51.6	Vendor Internal TRM - Lighting
	Garage T8 Linear Fluorescent	1,468	558	0.1598	813,109	232.7	Vendor Internal TRM - Lighting
	Interior CFL	1,619	130	0.0423	209,478	68.1	Vendor Internal TRM - Lighting
	Interior LED	2,550	177	0.0450	451,123	114.6	Vendor Internal TRM - Lighting
	Interior T8 Linear Fluorescent	32,566	238	0.0646	7,747,676	2,102.9	Vendor Internal TRM - Lighting
	TOTAL				**10,490,256**	**2,756.4**	
RetroCommissioning	Occupancy sensors	3	19,746	0.0000	59,238	0.0	Individually modeled by Implementer
	Temperature setback	1	1,958	0.0000	1,958	0.0	Individually modeled by Implementer
	Thermostat Calibration	1	10,254	0.0000	10,254	0.0	Individually modeled by Implementer
	Equipment optimization	15	74,410	0.0000	1,116,149	0.0	Individually modeled by Implementer
	Equipment tuneup	4	21,839	0.0000	87,355	0.0	Individually modeled by Implementer
	Motor optimization	8	33,126	2.5750	265,010	20.6	Individually modeled by Implementer
	Duct sealing	1	89,393	0.0000	89,393	0.0	Individually modeled by Implementer
	Schedule optimization	18	172,653	23.1167	3,107,763	416.1	Individually modeled by Implementer
	TOTAL				**4,737,119**	**436.7**	
Data Center	Ductwork	20	2,298	0.2600	45,959	5.2	Individually modeled by Implementer
	Computer Room Air Conditioner	25	27,186	2.3840	679,662	59.6	Individually modeled by Implementer
	Computer Room Air Handler	7	45,434	5.1857	318,040	36.3	Individually modeled by Implementer
	HVAC Equipment Optimization	1	744,682	321.8000	744,682	321.8	Individually modeled by Implementer
	Split DX System	1	112,076	25.0000	112,076	25.0	Individually modeled by Implementer
	HVAC/equipment/variable frequency drive	13	43,557	4.9692	566,237	64.6	Individually modeled by Implementer
	Computer Server	2	15,888	1.8000	31,775	3.6	Individually modeled by Implementer
	IT/equipment/virtualization	157	26,936	2.8745	4,228,955	451.3	Individually modeled by Implementer
	IT/hardware/server	584	4,697	0.6437	2,742,936	375.9	Individually modeled by Implementer
	Uninterruptable Power Source	15	76,121	8.9000	1,141,812	133.5	Individually modeled by Implementer
	Process Optimization	1	286,303	32.7000	286,303	32.7	Individually modeled by Implementer
	TOTAL				**10,898,437**	**1,509.5**	

APPENDIX B

NAVIGANT

EFFICIENT PRODUCTS PROGRAM

2013 Evaluation Report

Prepared for:
AEP Ohio

AEP OHIO®
A unit of American Electric Power

May 9, 2014

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Executive Summary

This report describes the results of an evaluation of the 2013 AEP Ohio Efficient Products Program. This Executive Summary provides a high-level description of the program summary, key impact findings, conclusions, and recommendations stemming from these findings. Detailed methodology and findings are described in the body of the report following the Executive Summary.

Program Summary

The objective of the AEP Ohio Efficient Products Program is to produce long-term energy and demand savings in the residential market by increasing the number of energy-efficient lighting products and appliances sold through retail sales channels. The program provides financial incentives to encourage customers to purchase and install energy-efficient lighting and appliances in their homes. Compared to 2012, the only major change to the Efficient Products Program was the transition of the television component from a mid-stream incentive to a downstream rebate. Additionally, a variety of product incentive amounts were modified slightly for certain periods during the year, the selection of LEDs discounted by the program was expanded, and a number of retailers were added to the program. The program is described in more detail in section 1.1.

Key Impact Findings

Table ES-1 shows the 2013 program goals, *ex ante* savings claimed by the program, and *ex post* audited savings. The audited energy and demand savings for 2013 were 203,412 MWh and 24.45 MW, respectively. The realization rate for 2013 was 1.00 for energy and 0.99 for demand. The audited energy and demand savings were 161 percent and 192 percent of the 2013 program goals.

Table ES-1. 2013 Program Savings and Realization Rate

	2013 Program Goals	*Ex Ante* Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)	Percent of Goal
Energy Savings (MWh)	126,146	204,123	203,412	1.00	161%
Demand Savings (MW)	12.74	24.67	24.45	0.99	192%

Table ES-2 shows the breakdown of energy savings by product type. Lighting made up 96 percent of energy savings with almost 94 percent from CFLs.

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Table ES-2. Audited Energy Savings for the 2013 Efficient Products Program

Product Category	Energy Savings (MWh)	Percent of Total Savings
CFLs	191,173	93.98%
LEDs	4,395	2.16%
Holiday Lights	282	0.14%
Total Savings for Lighting Products	**195,850**	**96.28%**
Clothes Washers	4,104	2.02%
Refrigerators	2,299	1.13%
Heat Pump Water Heaters	433	0.21%
Dehumidifiers	327	0.16%
Televisions	239	0.12%
Freezers	149	0.07%
Electric Water Heaters	11	0.01%
Total Savings for Appliances	**7,562**	**3.72%**
Savings Grand Total	**203,412**	**100.00%**

Table ES-3 shows demand savings broken down by product type. More than 95 percent of demand savings were from lighting products with more than 93 percent from CFLs.

Table ES-3. Audited Demand Savings for the 2013 Efficient Products Program

Product Category	Demand Savings (MW)	Percent of Total Savings
CFLs	22.86	93.50%
LEDs	0.44	1.80%
Holiday Lights	-	0.00%
Total Savings for Lighting Products	**23.30**	**95.30%**
Clothes Washers	0.58	2.37%
Refrigerators	0.41	1.68%
Dehumidifiers	0.07	0.29%
Heat Pump Water Heaters	0.06	0.25%
Televisions	0.01	0.03%
Freezers	0.02	0.09%
Electric Water Heaters	< 0.01	< 0.01%
Total Savings for Appliances	**1.15**	**4.70%**
Savings Grand Total	**24.45**	**100.00%**

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Conclusions from Program Year 2013

The 2013 evaluation of the Efficient Products Program resulted in five main conclusions.

1. **Audited savings differed from *ex ante* values from some products, but overall realization rates remained close to 1.** Where the Draft Ohio TRM was used, audited values matched *ex ante* values from program tracking data. For products that were not covered by the Draft TRM, the evaluation team used an independent research-based savings approach, which resulted in different audited values for holiday lights, general purpose LEDs, freezers, televisions, and electric water heaters. However, due to the smaller proportion of savings for these products (compared to CFLs), the realization rates for the overall energy and demand savings were 1.00 and 0.99, respectively.

2. **The LED discounts are becoming more popular over time.** The program discounted about 80,000 general purpose LEDs in 2013, more than twice as many as were discounted in 2012. LEDs are responsible for the second-highest portion of savings, accounting for nearly three percent of both energy and demand savings in 2013. While this is still very small compared to CFLs, it is a large increase from previous years, when LED savings accounted for less than one percent of program savings. AEP Ohio continues to expand the discounted LED offerings as well as the number of retailers who carry these products. According to research conducted in 2011, AEP Ohio customers are willing to pay a maximum of $8.76 on average for LEDs, about $3 more than for specialty CFLs, which illustrates a willingness to pay a premium for this lamp type, to a certain extent. AEP Ohio is focusing on adjusting incentives to overcome the cost barriers associated with LED purchases in the future.

3. **Overall, intercept survey respondents who purchased program-discounted lighting reported high levels of satisfaction with the program and the discount amount.** Specifically, 98 percent of respondents reported being at least somewhat satisfied with the program, and 95 percent of respondents who were aware of the discount reported being at least somewhat satisfied with the discount amount. Satisfaction with the program did not vary based on the type of lighting purchased (CFL or LED), nor with the intended setting of installation (residential or business).

4. **Customer participation in the water heater rebates presents a challenge to the program.** The number of rebated electric water heaters (n = 88) was especially low, and program staff identified issues with over 150 customers who had applied for rebates for non-qualifying units. A special promotional increase in the rebate amount from $50 to $100 did not have much effect on rebate activity. It is possible that the in-store point-of-purchase marketing approach may not be the best approach to motivate customers to choose energy-efficient water-heaters. AEP Ohio is currently considering how best to reach out to plumbing contractors to market the program to their customers. Considering the large energy savings per unit, there are significant potential savings that could be captured by expanding the number of participants who apply for these rebates.

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5. **Available information for rebate customers' home heating type does not include the level of granularity required by the Draft Ohio TRM.** In particular, calculations for savings from heat pump water heaters rely on information regarding whether a customer's home is heated by electric resistance heating, heat pump, or a fossil fuel source (e.g., natural gas). Data used by AEP Ohio only contain information regarding whether the heating source is electric or natural gas, and assumes that all customers with electric heating are using electric heat pumps. The evaluation team does not have data to gauge the accuracy of this assumption. Because per-unit savings for heat pump water heaters are relatively large, gaining clarity on this issue seems worthwhile for this measure.

Recommendations for Program Improvements

The 2013 evaluation of the Efficient Products Program resulted in four recommendations.

1. **Continue to expand the LED component of the program.** Given that cost is the number one barrier for LEDs, continuing to incent this technology will be key to continued adoption. Discounting a variety of LEDs will expand market adoption, and continuing to incorporate LED lighting in memorandums of understanding (MOUs) with a wide variety of retailers (regardless of size) will help ensure partnering retailer satisfaction.

2. **Update the approach used to calculate savings for products not in the Draft Ohio TRM.** In particular, we recommend a model-matching approach to calculate savings for freezers, televisions, and electric water heaters. The model-matching approach based on the efficiency of the units incented is more precise, compared to the current *ex ante* method of applying a single per-unit value for these products.

3. **Continue to investigate ways to increase participation in water heater rebates by engaging plumbing contractors or energy auditors to be reliable advocates for efficient water heater technologies and the Efficient Products rebates.** Plumbing contractors are typically the individuals in the water heater supply chain who recommend specific technologies to the end users. It is unclear whether contractors are aware of the rebates, or if they have sufficient awareness and knowledge of energy efficient water heater technologies. Either AEP Ohio or the evaluation team could conduct reviews of peer programs for best practices in reaching out to contractors, or primary research (i.e., surveys, interviews, focus groups) with this group of market actors to understand how best to educate and motivate them to be active in the program. Additionally, AEP Ohio could explore the possibility of having energy auditors promote the water heater rebates and provide information about qualifying units to customers through the In-Home Program.

4. **Consider ways to determine home heating type for heat pump water heater rebate participants with more granularity.** One simple way to do this would be to add a question to the rebate form for heat pump water heaters asking customers to indicate whether their home heating is electric resistance (e.g., baseboard heat, electric wall heaters), electric heat pump, or fossil fuel (e.g., natural gas, oil, propane).

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1 Introduction

This section provides a description of the AEP Ohio Efficient Products Program, as well as a brief discussion of the underlying program theory and logic. In addition, this section describes minor differences in how the 2013 program is implemented compared to the 2012 program, along with a description of the objectives of this evaluation.

1.1 Program Description

The objective of the AEP Ohio Efficient Products Program is to produce long-term energy and demand savings in the residential market by increasing the number of energy-efficient lighting products and appliances sold through retail sales channels. The program provides financial incentives to encourage customers to purchase and install energy-efficient lighting and energy-efficient appliances in their homes. The program targets all residential customers. Retail partners are recruited to promote these products by displaying marketing materials in their stores and retail sales associates are provided training to help promote the program to customers.

The program implementation contractor, Applied Proactive Technologies (APT), provides turnkey implementation services, including recruiting manufacturers and retailers to participate in the program, designing and placing marketing materials in participating store locations, conducting promotional activities, and training participating retail staff at both independent and corporate retailers. APT also conducts regular store visits to confirm that qualifying products are correctly labeled and that marketing materials are displayed. A subcontractor to APT, Energy Federation, Inc. (EFI) handles the tracking of participation and sales data, payment of invoices to manufacturers and retailers for the lighting component of the program, and payment of rebates to customers for the appliance portion of the program.

In 2013, the program provided incentives to retailers and manufacturers for ENERGY STAR®-qualified lighting, including CFLs, general purpose LEDs, and LED holiday lights. Incentives are passed directly to the customer at participating retail locations, in the form of markdowns or instant coupons used at the point of purchase. The program provides discounts for a variety of lighting manufacturers and lamp types, including standard and specialty CFLs, covered A-shape and globe, reflector, 3-way, and dimmable CFLs. Compared to 2012, the lighting component of the program offered an expanded selection of discounted general purpose LEDs. Another change was including LED lighting in the MOUs with more partnering retailers in 2013. Additionally, the maximum LED incentive was reduced from $15 to $10 per unit, and incentive amounts for LEDs were capped at 50 percent of the original retail value.

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In addition to providing discounts and rebates on lighting products, the program also includes two additional lighting activities: (1) CFL giveaways available to customers who submit an appliance rebate, and (2) CFL giveaways through food banks.[1]

In 2013, AEP Ohio offered rebates on the same appliances as in 2012: clothes washers, dehumidifiers, refrigerators, freezers, high efficiency electric water heaters, and electric heat pump water heaters. Additionally, the television component of the program was converted to a downstream mail-in rebate, available to customers for the purchase of any ENERGY STAR television. In 2013, rebates were offered in the amounts shown in Table 1-1.[2] All rebates were offered from January through December of 2013, with the exceptions of dehumidifiers and televisions, which were both offered for part of the year. Higher promotional rebate amounts were offered during the latter part of the year for electric water heaters and heat pump water heaters. To qualify for a rebate, customers purchased a qualifying appliance and complete a mail-in form, which they then submitted along with their product receipt and a copy of their utility bill to EFI.

Table 1-1. Program Appliance Rebate Amounts in 2013

Appliance Type	2013 Rebate Amount	Special Rebate Offers/ Time Periods
Clothes Washers	$50	
Dehumidifiers [a]	$25	Rebate not available from mid-February to July 1
Freezers	$50	
Refrigerators	$50	
High Efficiency Electric Water Heater	$50	$100 rebate from 9/1 to 12/31
Electric Heat Pump Water Heater	$300	$500 rebate from 9/1 to 12/31
Televisions	$25	Rebate available from 6/1 to 12/31

[a] Dehumidifier rebates were not available from mid-February to July 1 because retailers had not yet updated their stock to reflect the updated ENERGY STAR specification that went into effect on October 1, 2012.

APT provided training to in-store retail staff in 2013 so that they were knowledgeable about the program and equipped to promote the rebates and/or lighting discounts to customers. Lighting discounts were primarily marketed via displays at participating retailer locations. For appliance rebates, APT placed

[1] In previous years, the program also included CFL giveaways through the Metropolitan Housing Authority (MHA) and the "Fundraiser with a Twist" pilot, which provides community organizations (i.e., youth groups, schools, and religious organizations) with a supply of CFLs and $0.50 for each CFL that they install in the community. These activities were not fully counted in previous years, and are thus being attributed to 2013 savings.

[2] In 2012, televisions were incented through a mid-stream approach, with a $25 incentive paid directly to retail partners for televisions that exceeded the ENERGY STAR specification by 20 percent.

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point-of-purchase marketing materials (e.g., "clings" or stickers placed on qualifying appliances) in the retail stores. Additionally, in 2013, Lowe's and Home Depot added shelf channel inserts (strips inserted into the metal channels in shelves above the appliances) to aid in the marketing of the appliances. The appliance rebates also were promoted via the AEP Ohio website, bill inserts, outreach at community events, press releases, newsletters, electronic employee communications, and as a component of AEP Ohio's larger energy efficiency television and print marketing campaign.

In 2013, the program aimed to reduce energy usage by 126 GWh and peak demand by 12.74 MW. These goals account for 57 percent of AEP Ohio's 2013 consumer portfolio energy goal and 48 percent of the consumer portfolio demand goal. The vast majority of 2013 savings (96 percent of energy and 95 percent of demand) are from lighting. Of the savings from lighting, CFLs accounted for the vast majority (97 percent of lighting energy savings and 98 percent of lighting demand savings).

1.1.1 2013 Program Differences Compared to 2012

Although the core program processes and basic program theory of the 2013 program was very similar to 2012, there were a number of minor differences in the components and products offered in 2013, as follows:

Lighting

- The maximum per-unit incentive for LEDs was reduced from $15 to $10, up to 50 percent of the original retail value of the unit.
- The overall selection of LED models available with an incentive was expanded.
- Dollar Tree began participating in the program.
- Two newly partnering Ace Hardware stores were brought into the markdown component of the program, rather than the coupon component, which has been the typical method of participation for this retailer in the past.

Appliance Rebates

- Televisions were changed from a mid-stream incentive to a downstream rebate.
- The program eligibility standard for televisions was changed to simply ENERGY STAR; previously it was ENERGY STAR +20 percent.
- Due to the change from mid-stream to downstream, the television program is now offered at a number of different retailers.
- As part of the television rebates, an option was added on the rebate form for customers to indicate if they were interested in advanced power strips. APT sent information on advanced power strips to customers who were interested.
- Dehumidifier rebates were unavailable from mid-February to July 1 because retailer stock did not meet the most up-to-date ENERGY STAR specifications.
- Rebate amounts for both types of water heaters were temporarily increased during the fourth quarter.
- Shelf channel inserts (strips inserted into the metal channels in shelves above the appliances) were included at two retailers to aid in the marketing of the appliances.

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1.1.2 Program Theory

The basic program theory for lighting and appliance rebates remained unchanged: providing financial incentives encourages customers to purchase and install energy-efficient lighting and energy-efficient appliances in their homes, resulting in decreased energy usage and peak demand.

The exception is the television component of the program, which was modified from a midstream incentive paid to retailers to a downstream, mail-in rebate provided to customers who purchase an ENERGY STAR television. The program theory behind this downstream approach is the same as the program theory behind the other appliance rebates: providing a financial incentive to customers for the purchase of an ENERGY STAR television encourages them to buy a more efficient product than they would have otherwise, resulting in energy and demand savings for AEP Ohio.

1.2 *Evaluation Objectives*

This report presents the findings from the impact and process evaluations of the 2013 AEP Ohio Efficient Products Program. The objectives of the evaluation were to: (1) quantify energy and peak demand savings impacts in 2013 for these products, (2) determine key process-related program strengths and weaknesses, and (3) provide recommendations to improve the program. Specific research questions follow.

1.2.1 Research Questions

The evaluation sought to answer the following key research questions:

Impact Questions

1. How many CFLs and LEDs discounted through this program were sold, by category (wattage, size, specialty lamp types)? How many appliances were rebated through the program, by type?
2. What values are appropriate for the key impacts parameters? How are these different from past evaluations?
    a. What impact parameters are appropriate for LED vs. CFL lighting products? In particular, what are baseline lamp wattages, installation rates, coincidence factors, and hours of use for these different lighting products? In what room types are LEDs most commonly installed?
    b. What is the availability of 100-watt, 75-watt, 60-watt, and 40-watt standard incandescent lamps in the AEP Ohio service territory? For the 2013 evaluation, how does this influence the baseline wattage for 100-watt and 75-watt equivalent CFLs?
3. What are the energy (kWh) and summer peak demand (kW) savings per-unit, for each of the program products?
4. What are the annual energy (kWh) and summer peak demand (kW) impacts resulting from the program? Did the program meet its energy and demand goals?
5. What were the realization rates for the program? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante)* savings.)
6. What is the cost effectiveness of this program?

Process Questions

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1. How do participants become aware of the discounts for lighting? To what extent does the AEP Ohio discount influence the customer's purchasing decisions?
2. What is the customer experience and satisfaction with the lighting discounts and products covered by the program?
3. What are key barriers to the purchase of CFLs and LEDs discounted through the program?
4. What is the program theory and logic for rebated televisions?
5. Has the program as implemented changed from the original plan? If so, how, why, and was this an advantageous change?
6. What are the current program challenges and how are these being addressed?
7. What are the opportunities for program improvement?

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2 Methodology

This chapter describes the methodology used to complete the process and impact evaluations. Audited (*ex post*) energy and demand savings were independently estimated by the evaluation team. For some products (i.e., CFLs, clothes washers, dehumidifiers, refrigerators, and heat pump water heaters), methods and assumptions are outlined in the Draft Ohio Technical Reference Manual (TRM),[3] and the evaluation team assessed AEP Ohio's application of these assumptions to calculate audited savings. For other products (LEDs, holiday strings, freezers, televisions, and electric water heaters), methods are not outlined in the TRM and the evaluation team independently reviewed the methods and assumptions used by AEP Ohio to calculate audited savings. The evaluation team applied independent research-based calculations to determine audited savings for LEDs, holiday strings, freezers, televisions and electric water heaters. For these products, an overview of all audited savings values and methods are presented in the body of this report, with a more detailed discussion contained in the Appendix. The evaluation team also calculated adjusted energy and demand savings, which are based on primary data collected, and in some cases, a review of secondary data sources. The methods and results of the adjusted savings analysis are presented in the Appendix and are meant to serve as a comparison to, and test of, the appropriateness of assumptions specified in the TRM and/or assumptions specified by AEP Ohio in calculating *ex ante* savings.

Table 2-1 summarizes the various activities undertaken for this evaluation. The evaluation team analyzed new program documentation for 2013 (the 2013 marketing plan, the updated program website, and the new television mail-in rebate form) and reviewed program tracking data, which contain information on all the lighting and appliances incented or given away through the Efficient Products Program. The evaluation team also conducted a brief secondary literature review to assess any new studies relevant to the calculation of adjusted savings.

Primary data collection efforts included in-depth telephone interviews with program staff at AEP Ohio and the program implementers (APT and EFI). In order to understand the availability of different lighting products to AEP Ohio customers, the evaluation team conducted a lighting shelf survey at both participating and non-participating lighting retailers. Additionally, the evaluation team conducted an in-store intercept survey of lighting participants. Both the shelf surveys and in-store intercepts informed the calculation of adjusted savings.

[3] *State of Ohio Energy Efficiency Technical Reference Manual.* Prepared for the Public Utilities Commission of Ohio by Vermont Energy Investment Corporation, August 6, 2010.

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Table 2-1. Summary of Data Review and Data Collection Activities

Data Collection Type	Targeted Population	Supported Evaluation Activities
Tracking Data Review	All program participants	Impact Evaluation
Program Documentation Review	Any new program documentation	Process Evaluation
Secondary Literature Review	Any new published studies relevant to the evaluation of lighting or appliances	Impact Evaluation (adjusted savings)
In-depth Telephone Interviews	Program staff	Process Evaluation
Lighting Shelf Surveys	Participating and non-participating lighting retailers	Impact Evaluation (adjusted savings)
In-store Intercept Surveys	Participating lighting purchasers	Impact (adjusted savings) and Process Evaluation

2.1 *Tracking Data Review*

Because the program tracking data is critical for determining program impacts, the evaluation team completed a thorough review of the tracking data, which included four separate databases. Three databases were for lighting, including one for lighting products discounted through markdowns and another that contained products discounted through coupons. Another database contained lighting “giveaways” through food banks, as well as CFLs installed through the "Fundraiser with a Twist" pilot. The fourth database contained appliances, including television rebates. Additionally, there were some televisions sold through the mid-stream incentive mechanism at the end of 2012 that were not invoiced until 2013; these units were contained in the same database as lighting discounted through markdowns.

The evaluation team ran frequencies on each key variable to identify any missing data or inconsistencies. The evaluation team discovered some tracking data errors and inconsistencies, but these were resolved through discussion with AEP Ohio. This included the count of holiday lighting, home heating type assumed for heat pump water heaters, and Energy Independence and Security Act (EISA) - related adjustments for LED savings. These issues were resolved and therefore are not discussed in the remainder of the report.

2.2 *Program Documentation Review*

The evaluation team focused the program documentation review on aspects of the 2013 program that were new, including:

- The rebate form for televisions
- The 2013 Efficient Products marketing plan
- Revised pages of the AEP Ohio Efficient Products Program website.
- The 2012-2014 Energy Efficiency/Peak Demand Reduction Action Plan.[4]

[4] *AEP Ohio 2012 to 2014 Energy Efficiency/Peak Demand Reduction (EE/PDR) Action Plan, Vols. 1 and 2*, November 29, 2011.

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These documents were reviewed to understand the details of the 2013 program and to inform customer surveys.

2.3 *Secondary Literature Review*

The evaluation team reviewed published reports and technical reference manuals regarding calculations of savings impacts for efficient products. In particular, the literature review focused on the Draft Ohio TRM. The evaluation team also reviewed other TRMs (including the 2013 Efficiency Vermont TRM[5], the Mid-Atlantic TRM Version 3.0[6], and the 2013 Rhode Island TRM[7]), the Uniform Methods Project protocols,[8] ENERGY STAR appliance savings calculators, ENERGY STAR standards, federal appliance standards, and secondary sources related to lighting interactive effects.[9]

2.4 *In-Depth Telephone Interviews*

In order to answer the key process evaluation research questions, the evaluation team conducted a series of in-depth interviews, as summarized in Table 2-2. The purpose of these interviews was to understand changes in program implementation, collect feedback on research priorities, and understand staff members' experiences with the program.

Table 2-2. In-Depth Telephone Interviews

Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
AEP Ohio Program Staff	Contacts from AEP Ohio	Program Manager Consumer Programs and Marketing Manager	2	October 2013
APT Program Staff	Contacts from AEP Ohio	Program Manager Senior Manager	2 (Conducted as a joint interview)	October 2013

2.5 *Lighting Shelf Surveys*

The evaluation team conducted a lighting shelf survey at both participating and non-participating lighting retailers. The evaluation team targeted 70 store visits to allow for a minimum of 90 percent confidence and +/- 10 percent precision at the store level. To construct a sample frame, the evaluation team compiled a list of non-participating potential lighting retailers with multiple locations throughout

[5] Accessed at: http://www.greenmountainpower.com/upload/photos/371TRM_User_Manual_No_2013-82-5-protected.pdf
[6] Accessed at: http://www.neep.org/Assets/uploads/files/emv/emv-products/TRM_March2013Version.pdf
[7] Accessed at: http://www.nationalgridus.com/non_html/eer/ri/Rhode%20Island%20TRM_PY2013_final.pdf
[8] *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* See http://www.nrel.gov/docs/fy13osti/53827.pdf
[9] These include the 2013 DEER Update Study: Update Approach and the Uniform Methods Protocol "Residential Lighting Evaluation Protocol."

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Ohio. Using this list and the list of retailers participating in the lighting markdown program supplied by AEP Ohio, the evaluation team then used a set of geographic criteria to identify participating and non-participating stores in proximity to four metropolitan areas: Columbus, Canton, Chillicothe, and Lima. To determine how many stores would be surveyed in each area, the evaluation team divided the 70 store visits proportionally based on the total number of participating and non-participating stores in each geographic area. Each store was visited twice—once in July/August and once in December—to compare the availability of specific wattages over time. Table 2-3 summarizes the sampling and timing for the lighting shelf surveys.

Table 2-3. Lighting Shelf Surveys

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
Lighting Shelf Surveys	Participating and Non-Participating Retailers	Participating Retailers Contained in Lighting Sales Data Provided by AEP Ohio; Nonparticipating Lighting Retailers in AEP Ohio Service Territory Identified by the Evaluation Team	Stratified sample of participating and nonparticipating retailers offering lighting products to consumers in the AEP Ohio service territory	70	Wave 1: July/August 2013 Wave 2: December 2013

2.6 *In-store Intercept Surveys*

The evaluation team conducted in-store intercepts with participating customers at retail locations participating in the lighting markdowns. Based on completion rates achieved in previous evaluations, the evaluation team targeted 24 retail locations with the goal of achieving 100 completed intercept surveys, to ensure evaluation results that are statistically valid at a 90 percent confidence level with a precision of better than +/- 10 percent (90/10). The sample design was constructed so that it was representative of the retailers where program lighting products are sold. To design the sample frame, the evaluation team analyzed the most recent markdown sales data provided by AEP Ohio to determine where lighting sales occurred. To determine the target number of store visits for each retailer, the evaluation team multiplied the percentage of sales for each retailer by 24 (the total number of planned store visits). The team conducted the in-store intercepts alongside the in-store lighting demonstrations conducted by APT. APT scheduled the demonstrations at various store locations, adhering to the specific number of visits per retailer required by the sample design. The evaluation completed intercepts at 23 of the 24 targeted store locations. One of the targeted retailers did not have stock when the intercepts were being completed in early 2014. Completion rates were greater than anticipated and 136 surveys were completed, exceeding the target of 100. This response rate resulted in a precision of +/- 7.05 percent.

Since the store visit sampling plan was designed using preliminary data from mid-year, the evaluation team examined the final dataset to determine if the visited stores were representative of lighting participation throughout the entire 2013 program year. The evaluation team found that the distribution of part-year sales by retailer was fairly similar to full-year sales data, and for ease of interpretation, un-

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weighted results are presented in this report. Table 2-4 summarizes the sampling and timing for the in-store intercepts.

Table 2-4. Primary Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-store Intercept Surveys	Program Participants	Customers Purchasing Program Lighting at Participating Retail Locations	Customers purchasing program CFLs or LEDs during APT's in-store lighting demonstrations	136	November 2013 - February 2014

2.7 *Audited Savings Evaluation Methods*

For half of the products offered through the Efficient Products Program, assumptions and methods for calculating savings are specified in the Draft Ohio TRM. The evaluation applied TRM assumptions to calculate audited savings for these products: CFLs, clothes washers, dehumidifiers, refrigerators, and heat pump water heaters. However, several products are not covered by the TRM (LEDs, holiday strings, freezers, electric water heaters, and televisions). For these products the evaluation team calculated savings using an independent research-based savings approach, which is overviewed in the body of the report in Section 3. The full methodology for these products is based on the adjusted savings approach and appears in the Appendix.

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3 Detailed Evaluation Findings

3.1 Program Activity

The evaluation team analyzed program data from all lighting and appliances submitted during 2013 to summarize program activity. This section is divided into two sub-sections: 1) lighting and 2) appliances. Table 3-1 summarizes program activity across all products.

Table 3-1. Efficient Products 2013 Activity

Product	Number of Units in 2013
CFLs	4,341,984
LEDs	80,846
LED Holiday Lights	24,746
Total Lighting Products	**4,447,576**
Clothes Washers	18,151
Refrigerators	17,905
Freezers	2,299
Televisions	1,820
Dehumidifiers	1,581
Heat Pump Water Heaters	256
Electric Water Heaters	88
Total Appliances	**42,100**

3.1.1 Lighting Activity

The evaluation team used program data for all of the lighting products invoiced during 2013 to characterize this component of the program including lighting products discounted through the markdown and coupon delivery mechanisms, as well as CFLs distributed through food banks, fundraisers, and given away to appliance rebate participants. The 2013 program tracking data showed a total of 4,447,576 lighting products. CFLs were by far the greatest number of lighting products, accounting for nearly 98 percent of all lighting units, as shown in Table 3-2. Of all CFLs in 2013, 95 percent were markdown CFLs.

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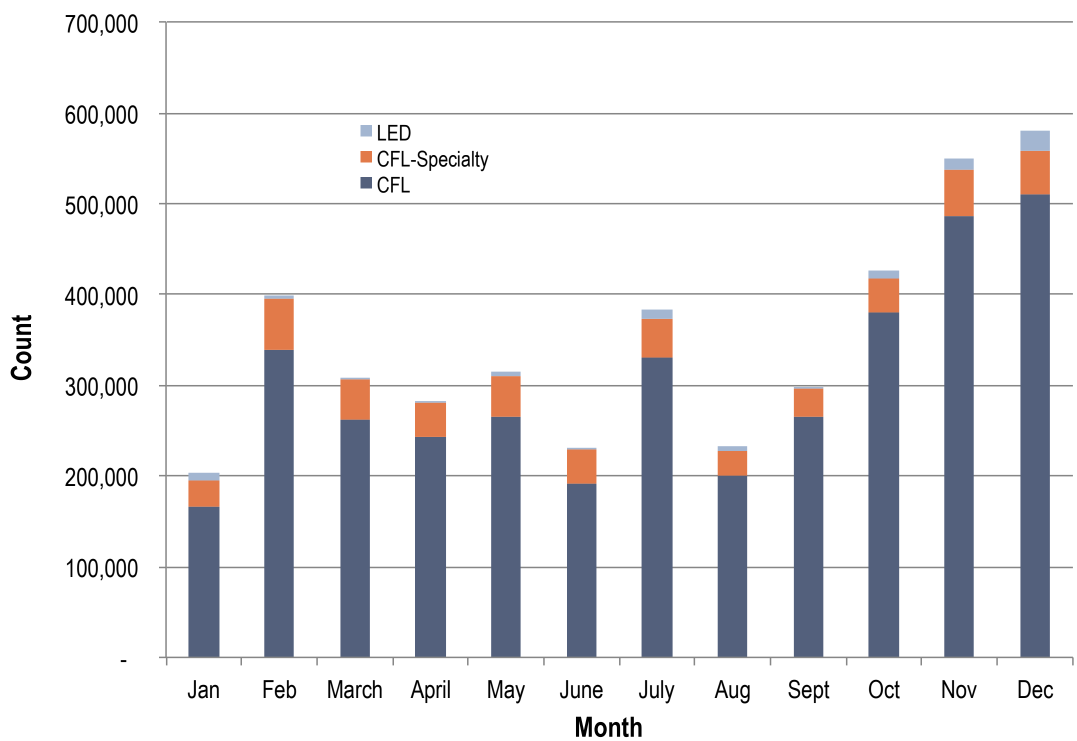
Table 3-2. Lighting Product 2013 Program Activity

Lighting Product Type	Markdown [(a)]	Coupon	Food Bank	Fundraiser-with-a-Twist	Total Units in 2013	Percent
CFLs	4,127,545	3,402	201,696	9,341	4,341,984	97.63%
LEDs	80,846	-	-	-	80,846	1.82%
LED Holiday	24,746	-	-	-	24,746	0.56%
Total	**4,233,137**	**3,402**	**201,696**	**9,341**	**4,447,576**	**100%**

a. The Markdown data file also contained CFLs given away to appliance rebate participants.
Note. Due to rounding, totals do not add to 100 percent.

Figure 3-1 shows the distribution of 2013 sales for program CFLs and LEDs by month from the markdown and coupon lighting data only.

Figure 3-1. Lighting Products Discounted by Month Invoiced



3.1.2 Appliance Rebate Activity

The number of appliances incented varied from a low of 88 units for electric water heaters to 18,151 for refrigerators. The units per month for each appliance type are shown in Figure 3-2. Participation was much higher for some appliances (clothes washers, refrigerators) than for others (heat pump water

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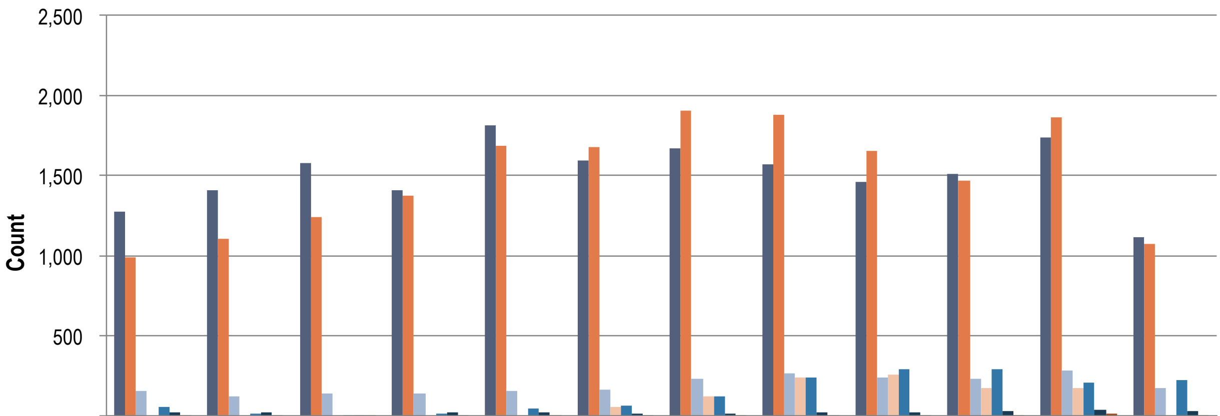
heaters, electric water heaters). The television rebate started in June 2013. Similarly, the dehumidifier monthly unit counts reflect that rebates were not widely available between mid-February and July 1.[10]

Figure 3-2. Distribution of Efficient Products Appliance Rebates by Month



	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CW	1,277	1,411	1,581	1,411	1,811	1,595	1,671	1,572	1,460	1,508	1,739	1,115
RF	990	1,103	1,245	1,376	1,686	1,679	1,909	1,877	1,652	1,465	1,865	1,071
FR	153	121	141	142	154	168	230	268	238	229	283	172
TV	-	-	-	-	1	57	126	244	254	177	173	3
DH	57	11	8	15	46	62	120	239	294	294	211	224
HPWH	18	21	6	22	19	11	13	25	20	29	41	31
EWH	6	8	5	8	2	9	8	8	4	9	13	8

3.2 *Lighting Impact Findings*

This section provides a description of detailed impact findings for 2013 CFLs, LEDs, and holiday lighting. Audited energy savings for the lighting portion of the AEP Ohio Efficient Products Program were 195,846 MWh and *ex post* audited demand savings for lighting were 23.29 MW. For each lighting product, the methodology is described first, followed by a description of key impact parameters, and then energy and demand savings for each product. Total savings values for all lighting products are summarized at the end of this section.

3.2.1 CFL Impacts

The TRM specifies deemed values for CFLs based on CFL wattages and delta watts multipliers, which capture the differences in wattages between various types of CFLs and their incandescent equivalents. The equations used to calculate energy and demand savings are specified in Equation 3-1 and Equation 3-2. For TRM energy savings, the in-service rate (ISR) is 0.86, the estimated hours of use per day (HOU) is 2.85, a factor of 365 converts to hours per year, and the interactive effect on energy use is captured by the waste heat factor (WHF_E) of 1.07. For demand savings, the in-service rate (ISR) is the same, 0.86, the

[10] Rebate forms for dehumidifiers had been removed from stores and from the website due to retailers having outdated stock that did not match the new ENERGY STAR specifications; however some customers submitted previously obtained forms during this time.

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estimated coincidence factor (CF) is 0.11, and the interactive effect on demand is captured by the waste heat factor (WHF_D) of 1.21.

Equation 3-1. TRM-Specified Energy Savings for CFLs

$$\text{Annual kWh Savings} = (\text{CFLWatts} * \text{DeltaWattsMultiplier}) * \text{ISR} * \text{HOU} * 365 * \text{WHF}_E / 1000$$

Equation 3-2. TRM-Specified Demand Savings for CFLs

$$\text{Summer Coincident Peak kW Savings} = (\text{CFLWatts} * \text{DeltaWattsMultiplier}) * \text{ISR} * \text{CF} * \text{WHF}_D / 1000$$

The Draft Ohio TRM specifies that the deemed delta watts multipliers are to change over time, to account for the effects of EISA on incandescent wattages, as summarized in Table 3-3. However, the methodology used by AEP Ohio for calculating CFL savings deviates somewhat from this aspect of the TRM. The AEP Ohio methodology assumes that incandescent lighting will be available in the market place for one full year after being phased-out because of EISA. Thus, AEP Ohio uses the 2012 delta watts multiplier for standard CFLs in 2013. The only difference between the 2012 and 2013 TRM values is for delta watts in the 16-20 watt range (75-watt equivalents). For these 16-20 watt CFLs, AEP Ohio uses a 75-watt incandescent for the baseline (i.e., 2012 delta watts multiplier of 3.25) rather than a 53-watt efficient halogen (i.e., 2013 delta watts multiplier of 2.00). Additionally, for specialty CFLs, AEP Ohio assumes the delta watts multiplier from before EISA was implemented in 2011, because EISA does not affect the baseline for specialty CFLs.

The AEP Ohio methodology is supported in part by the shelf surveys completed by the evaluation team in 2012 and in 2013 (see Appendix), which found that EISA impacted wattages were still available for purchase until about one year after the phase-out.

Table 3-3. TRM-Specified Values for the Delta Watts Multiplier for CFLs

CFL Wattage	Delta Watts Multiplier			
	2009 - 2011	2012	2013	2014 and Beyond
15 or less	3.25	**3.25**	3.25	2.05
16 – 20	3.25	**3.25**	2.00	2.00
21 or greater	3.25	**2.06**	2.06	2.06

Source: State of Ohio Energy Efficiency Technical Reference Manual (2010)

The key impact parameter for 2013 program is the wattage of discounted CFLs, or CFLWatts, as shown in the equations above. The distribution of 2013 incented CFL wattages is shown in Figure 3-3. The most common CFL wattages were 13 and 14 watts.

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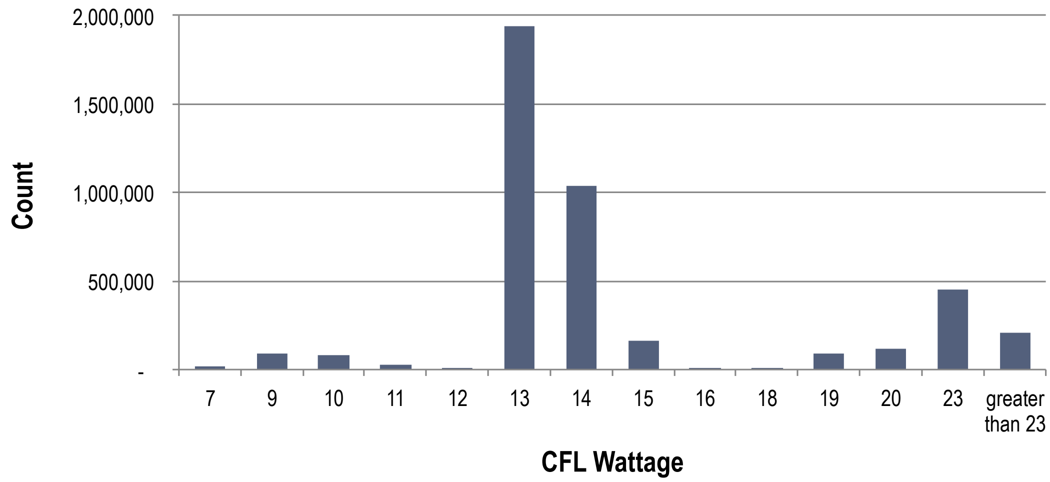
Figure 3-3. Distribution of Program CFL Wattage



The mean wattage of program discounted CFLs observed in the program tracking data in 2013 was 15.27 watts, calculated using the wattage and quantities from the tracking data shown in Table 3-4
.

Table 3-4. Calculation of Watt$_{PROG}$ for Program CFLs

CFLS	Markdown	Coupon	Foodbank/Fundraiser	Weighted Average
Watt Program	15.37	17.75	13.16	15.27
Quantity	4,127,545	3,402	211,037	-

The evaluation team calculated the total audited savings for CFLs and then divided by the number of units to determine the per-CFL 2013 energy and demand savings, as shown in Table 3-5.

Table 3-5. Audited Energy and Demand Savings for Program Year 2013 CFLs

	Number of Units	Total Audited Savings	Per-Unit Savings
Energy (kWh)	4,341,984	191,173,373 kWh	44.03
Demand (kW)	4,341,984	22,860 kW	0.0053

3.2.2 LED Impacts

LEDs are not included in the Draft Ohio TRM. Instead, AEP Ohio uses the difference between program LED wattages and equivalent baseline wattages to calculate annual energy savings and coincident peak demand savings. The equations used to calculate *ex ante* energy and demand savings are specified in Equation 3-3 and Equation 3-4. In the calculation of *ex ante* savings, AEP Ohio uses an installation rate (ISR_{LED}) equal to 1.00 for LEDs; because of the higher cost of LEDs, AEP Ohio assumes that customers will not put them in storage but will instead install them right away. The *ex ante* hours of use (HOU_{LED}) value is 1,040.25, which is equivalent to the 2.85 hours per day included in the Draft Ohio TRM for CFLs.

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The *ex ante* coincidence factor (CF_{LED}) is the same value used for CFLs, 0.11. For *ex ante* savings, interactive effects are captured through waste heat factors, which represent the cooling savings resulting from decreased heat output from more efficient program products. AEP Ohio uses the interactive effects values specified in the TRM for CFLs; the energy waste heat factor (WHF_E) is 1.07; the demand waste heat factor (WHF_D) is 1.21.

Equation 3-3. *Ex Ante* Energy Savings for LEDs

$$\text{Annual kWh Savings} = (\mathit{BaselineWattage} - \mathit{ProgramWattage}) \times ISR_{LED} \times HOU_{LED} \times WHF_E$$

Equation 3-4. *Ex Ante* Demand Savings for LEDs

$$\text{Summer Coincident Peak kW Savings} = (\mathit{BaselineWattage} - \mathit{ProgramWattage}) \times ISR_{LED} \times CF_{LED} \times WHF_D$$

Table 3-6 presents the baseline wattage values used by AEP Ohio to calculate *ex ante* savings for each program wattage range. The average baseline wattage for LEDs was 69.81 watts.

Table 3-6. *Ex Ante* LED Baseline Wattage, by Program Measure Wattage

Program LED Measure Wattage	*Ex Ante* Baseline Wattage	Count
7 to 8	60	15,767
9 to 11	75	4,156
12 to 20	72	60,923
Total	-	**80,846**

Note. The baseline for 12 to 20 watt LEDs is assumed to be a 72W efficient halogen, because 100W incandescents have not been manufactured since January 1, 2012 under EISA. EISA also prohibited the manufacturing of 75W incandescents as of January 1, 2013. However, incandescents are assumed to be available in the market place for one full year after phase-out, and thus 75W incandescents are used as the baseline for 9 to 11W LEDs.

The evaluation team followed a similar approach to calculate audited energy and demand savings. However, the evaluation team used different parameter values based on our independent research results. The differences in savings parameters for *ex ante* and audited savings are summarized Table 3-7. Whereas the average baseline wattage for *ex ante* LED savings was 69.81 watts, the average baseline wattage for audited LED savings was 65.82, based on baseline wattage found in the Uniform Methods Project protocols. The evaluation team used an installation rate (ISR_{LED}) equal to 0.971 for LEDs. This is based on the fact that preliminary results of an in-home customer lighting survey showed some LEDs in storage, suggesting that the ISR is less than 1.0. Because the specific ISR for LEDs in Ohio is unknown, the evaluation team used the ISR for CFLs (see the research-based methodology in the Appendix), discounted to account for future years' installations, as a conservative estimate. We used an hours of use (HOU_{LED}) value of 985.5, which is equivalent to the 2.7 hours per day, and a coincidence factor (CF_{LED}) of 0.087; both of these values were taken from participant surveys conducted for a previous evaluation. For interactive effects, the evaluation team was not able to identify a specific value for LEDs; therefore, we

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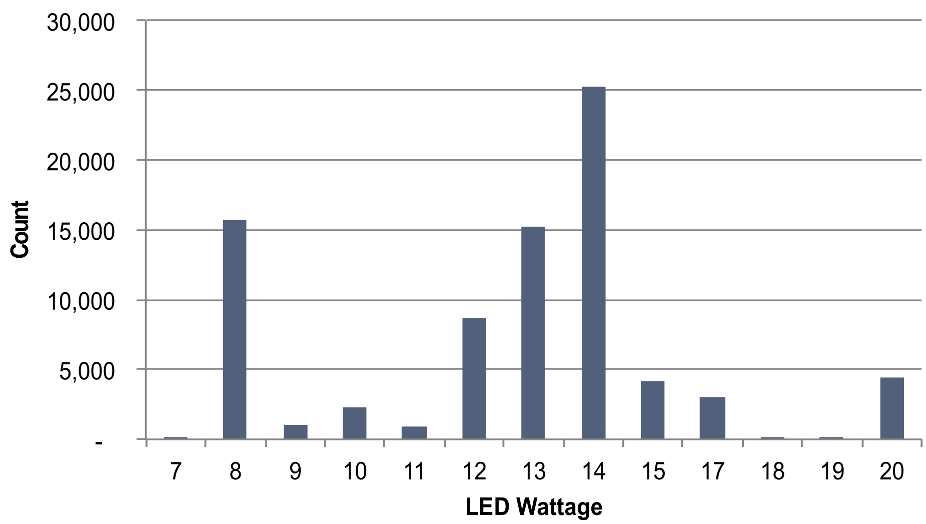
used the same waste heat factors as in the Draft Ohio TRM approach for CFLs, adjusted to account for the percentage of Ohio homes with central air conditioning. More detail on the audited savings approach is contained in the Appendix.

Table 3-7. Key *Ex Ante* and Audited Parameters for LEDs

Parameter Description	Parameter	*Ex Ante* Value	Audited Value
Program Wattage	$Watt_{PROG}$	12.71	12.72
Standard Wattage	$Watts_{STD}$	69.81	65.82
In-Service Rate	ISR	1.00	0.971
Hours of Use	HOU	1,040.25	985.5
Coincidence Factor	CF	0.11	0.087
Waste Heat Factor Energy	WHF_E	1.07	1.07
Waste Heat Factor Demand	WHF_D	1.21	1.20

The Efficient Products Program discounted 80,846 LEDs in 2013, almost three times as many LEDs as 2012 (27,170). The mean wattage of program discounted LEDs was 12.7 watts, with a range of 7 to 20 watts; the distribution of discounted LEDs by wattage is shown in Figure 3-4.

Figure 3-4. Distribution of Program LED Wattages



The evaluation team calculated the audited savings for LEDs and then divided by the number of units to determine the per-LED 2013 energy and demand savings, as shown in Table 3-8.

Table 3-8. Audited Energy and Demand Savings for LEDs

	Number of Units	Total Audited Savings	Per-Unit Savings
Energy	80,846	4,395,185 kWh	54.36
Demand	80,846	435 kW	0.0054

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3.2.3 Holiday Light Impacts

To calculate *ex ante* savings for LED holiday string lights, AEP Ohio uses a wattage difference between program holiday strings and baseline holiday strings to determine energy savings. The equation used to calculate *ex ante* energy savings is specified in Equation 3-5.

Equation 3-5. *Ex Ante* Energy Savings for LED Holiday Lights

$$\text{Annual kWh Savings} = (\textit{BaselineWattage} - \textit{ProgramWattage}) \times ISR_{HOL} \times HOU_{HOL}$$

AEP Ohio uses a value of *BaselineWattage* of 0.408W per bulb. AEP Ohio assumes a 100-count string of incandescent holiday lights uses 40.8 watts total, or 0.408 watts per individual bulb.[11] The value of *ProgramWattage* is determined from the tracking data values. AEP Ohio assumed that all LED Holiday Strings purchased through the program are used during the holiday season, so ISR_{HOL} is 1.00. The hours of use (HOU_{HOL}) value is 350; AEP Ohio assumed that holiday lights are in use for 35 days at 10 hours per day. The evaluation team was not able to identify a specific source for this value of 350 hours.

For program holiday lights, the evaluation team calculated audited savings using an approach similar to the *ex ante* savings method used by AEP Ohio, which relies on the difference between baseline and program unit wattage (Equation 3-5). However, the evaluation team used parameter values based on a DOE source[12] that varied slightly from those used by AEP Ohio.

Table 3-9 illustrates key *ex ante* and audited parameters. The evaluation team used a standard wattage value of 0.40, based on an NSTAR estimate of a 40W string of 100 bulbs or 0.40 watts per bulb.[13] For hours of use, the audited value of 480 is based on U.S. DOE estimates; usage of LED holiday string lights is assumed to be 12 hours per day for 40 days in November and December (480 hours per year). These sources and differences are discussed in greater detail in the Appendix.

Table 3-9. Key *Ex Ante* and Audited Parameters for LED Holiday lights

Parameter Description	Parameter	*Ex Ante* Value	Audited Value	Units
Program Wattage	$Watt_{PROG}$	0.069	0.069	Watts
Standard Wattage	$Watt_{STD}$	0.408	0.40	Watts
In-Service Rate	ISR	1	1	-
Hours of Use	HOU	350	480	Hours/year
Coincidence Factor	CF	0	0	-

[11] Taken from [http://www.christmaslightsetc.com/pages/how-much-power.htm#Meassize].
[12] http://energy.gov/energysaver/articles/led-lighting
[13] https://www.nstar.com/residential/energy_efficiency/holiday-lights.asp

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The evaluation team calculated the audited savings for LED holiday strings and then divided by the number of units to determine the *average* per-string 2013 energy savings, as shown in Table 3-10. There are no peak demand savings from holiday lights, because they are not expected to be in use during the peak summer season.

Table 3-10. Audited Energy and Demand Savings for 2013 Holiday Strings

	Number of Units	Total Audited Savings	Per-Unit Savings
Energy (kWh)	24,746	282,344	11.41
Demand (kW)	24,746	0	0

3.2.4 Total Lighting Impacts and Realization Rates

The audited 2013 energy savings for lighting product sales was 195,850 MWh; nearly 98 percent of those savings were from CFLs, as shown in Table 3-11.

Table 3-11. Total Audited Energy Savings for 2013 Lighting

Lighting Product	Number of Units	Total Audited Energy Savings (MWh)	Average Per-Unit Energy Savings (kWh)	Percent of Savings
CFLs	4,341,984	191,173	44.0	97.6%
LEDs	80,846	4,395	54.4	2.2%
Holiday Lights	24,746	282	11.4	0.1%
Total	**4,447,576**	**195,850**	**-**	**100.00%**

Note. Due to rounding, totals do not add to 100 percent.

The audited demand savings for 2013 lighting product sales were 23.30 MW; more than 98 percent of those savings are from CFLs, as shown in Table 3-12.

Table 3-12. Total Audited Demand Savings for 2013 Lighting

Lighting Product	Number of Units	Total Audited Demand Savings (MW)	Average Per-Unit Demand Savings (kW)	Percent of Savings
CFLs	4,341,984	22.86	0.0053	98.1%
LEDs	80,846	0.44	0.0054	1.9%
Holiday Lights	24,746	0	0	0%
Total	**4,447,576**	**23.30**	**-**	**100.0%**

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As shown in Table 3-13, lighting realization rates were 100 percent for energy and 99 percent for demand. The relatively small difference in audited energy savings and *ex ante* energy savings is due to the difference in *ex ante* and audited calculations for LEDs and holiday lights, as explained in Section 3.2.2 and Section 3.2.3.

Table 3-13. Lighting Realization Rates

Lighting Product	Ex Ante Energy (MWh)	Ex Ante Demand (MW)	Audited Energy (MWh)	Audited Demand (MW)	Realization Rate Energy	Realization Rate Demand
CFLs	191,173	22.86	191,173	22.86	1.00	1.00
LEDs	5,218	0.62	4,395	0.44	0.84	0.71
Holiday Lights	211	-	282	-	1.34	-
Total Lighting	**196,602**	**23.48**	**195,850**	**23.30**	**1.00**	**0.99**

3.3 *Appliance Impact Findings*

This section provides a detailed description of impact findings for the 2013 appliance rebates. The 2013 appliance rebates resulted in audited energy savings of 7,563 MWh and audited demand savings of 1.15 MW. The following sections discuss the impact parameters for each of the rebated appliances:

» Clothes Washers
» Dehumidifiers
» Freezers
» Refrigerators
» Televisions
» Heat Pump Water Heaters
» Electric Water Heaters

After impact parameters are reviewed for each appliance, the savings for all appliances are discussed.

3.3.1 Clothes Washer Impact Parameters

According to the Draft Ohio TRM, savings for clothes washers are deemed for two levels of efficiency, ENERGY STAR or CEE Tier 3, using the per-unit savings shown in Table 3-14.

Table 3-14. TRM-Specified Savings Values for Clothes Washers

Efficiency Level	Per-Unit Energy Savings	Per-Unit Demand Savings
ENERGY STAR	202 kWh	0.028 kW
CEE Tier 3	233 kWh	0.033 kW

Source: State of Ohio Energy Efficiency Technical Reference Manual (2010)

Most of the savings were from CEE Tier 3 washers as shown in Table 3-15.

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Table 3-15. TRM Qualification of Program-Rebated Clothes Washers

TRM Qualification	Units	Percent
ENERGY STAR (CEE Tier 1)	4,024	22%
ENERGY STAR (CEE Tier 2)	1	>1%
CEE Tier 3	14,126	78%
Total	**18,151**	**100.0%**

3.3.2 Dehumidifier Impact Parameters

According to the Draft Ohio TRM, dehumidifiers that meet ENERGY STAR criteria as of 10/1/2006 are eligible. Savings are deemed based on the capacity of the dehumidifier using the ranges shown in Table 3-16.

Table 3-16. TRM-Specified Savings Values for Dehumidifiers

Capacity (pints/day)	Per-Unit Energy Savings (kWh)	Per-Unit Demand Savings (kW)
≤ 25	54	0.012
> 25 to ≤ 35	117	0.027
> 35 to ≤ 45	213	0.048
> 45 to ≤ 54	297	0.068
> 54 to ≤ 75	185	0.042
> 75 to ≤ 185	374	0.085

Source: State of Ohio Energy Efficiency Technical Reference Manual (2010)

In 2013, AEP Ohio customers submitted rebate forms for 1,581 dehumidifiers. The mean capacity for program-rebated dehumidifiers was 55.4 pints, with capacity distributed as shown in Table 3-17.

Table 3-17. Capacity of Program Rebated Dehumidifiers

Capacity (pints/day)	Count	Percent of Program Units
≤ 25	10	1%
> 25 to ≤ 35	216	14%
> 35 to ≤ 45	233	15%
> 45 to ≤ 54	396	25%
> 54 to ≤ 75	726	46%
> 75 to ≤ 185	0	0%
Total	**1,581**	**100%**

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3.3.3 Freezer Impact Parameters

AEP Ohio customers submitted rebate forms for 2,299 freezers during 2013. For *ex ante* savings, AEP Ohio calculated freezer savings using 67 kWh per-unit for energy and 0.0076 kW for demand. AEP Ohio derived the per-unit value for energy savings by subtracting the average annual energy use for freezers meeting the ENERGY STAR specification (488 kWh) and the average annual energy use for comparable standard freezers (555 kWh).[14] The kW peak value is equivalent to 67 kWh divided by 8,760 hours, the number of hours in one year.

For program freezers, the evaluation team calculated audited savings using a similar approach to the *ex ante* approach used by AEP Ohio, which relies on the difference in annual unit energy consumption estimates for baseline and program units. However, where AEP Ohio used unit energy consumption values based on the average of all the freezer models included in the ENERGY STAR qualified list, the audited calculations relied on model number matching of rebated units. The evaluation team determined unit energy consumption by matching individual models from program tracking data to the ENERGY STAR products list. Furthermore, the evaluation team applied a peak demand factor (DF_{FRZ}) to calculate demand, based on metering results from 2013. A full description of the evaluation team's energy and demand calculations for freezers can be found in the Appendix.

The difference in key parameter values for *ex ante* and audited calculations are shown below, in Table 3-18

Table 3-18. Key *Ex Ante* and Audited Parameters for Freezers

Parameter Description	Parameter	*Ex Ante* Value	Audited Value	Units
Energy Consumption- Standard Unit	UEC_{STD}	555	614.41	kWh/year
Energy Consumption- Energy-Efficient Unit	UEC_{EE}	488	549.49	kWh/year
Peak Adjustment Demand Factor	DF_{FRZ}	None	1.28	-
Part Use Factor	PUF	None	1	-

3.3.4 Refrigerator Impact Parameters

AEP Ohio customers submitted rebate forms for 17,905 refrigerators during 2013. For refrigerators, the TRM deems savings values based on whether they meet ENERGY STAR or CEE Tier 2 specifications. Savings are also based on the configuration of the unit using the criteria shown in Table 3-19.

[14] These values were derived from the ENERGY STAR website, and are current as of March 19, 2014. Available at [http://www.energystar.gov/productfinder/product/certified-residential-freezers/results].

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Table 3-19. TRM-Specified Savings Values for Refrigerators

Efficiency Level	Refrigerator Configuration	Per-Unit Energy Savings (kWh)	Per-Unit Demand Savings (kW)
ENERGY STAR	Bottom Freezer	119	0.021
	Top Freezer	100	0.018
	Side by Side	142	0.025
CEE Tier 2	Bottom Freezer	149	0.026
	Top Freezer	124	0.022
	Side by Side	177	0.031

Source: State of Ohio Energy Efficiency Technical Reference Manual (2010)

Table 3-20 shows the distribution of program units by unit configuration and ENERGY STAR/CEE Tier level. The TRM does **not** include savings estimates for Tier 3 units, so in the table, Tier 3 units are included within the Tier 2 category. This approach likely underestimates savings for Tier 3 units, which are more efficient than Tier 2 units. Note that the evaluation team calculated slightly different counts for some of the categories shown.

Table 3-20. Consumption and Average Savings of Program-Rebated Refrigerators

Efficiency Level	Refrigerator Configuration	*Ex Ante* Count	Audited Count
ENERGY STAR	Bottom Freezer	4,208	4,211
	Top Freezer	4,628	4,629
	Side by Side	3,399	3,396
CEE Tier 2 (a)	Bottom Freezer	3,150	3,149
	Top Freezer	416	416
	Side by Side	1,565	1,565
Other	Other	539	539
Total	**-**	**17,905**	**17,905**

a. "Tier 2" = Tier 2 + Tier 3

3.3.5 Television Impact Parameters

AEP Ohio customers purchased and submitted rebate forms for 1,035 televisions in 2013. They purchased an additional 785 televisions through the program's Markdown component.

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The TRM does not cover televisions. For *ex ante* savings, AEP Ohio calculated television savings using 102 kWh per-unit for energy and 0.0281 kW for demand. They took these values from the 2012-2014 AEP Ohio EE/PDR Action Plan.[15]

For program televisions, the evaluation team calculated audited savings by matching individual model numbers from program tracking data to the ENERGY STAR products list. This model matching was used to determine unit energy consumption for both the qualified unit and the listed baseline in standby and operating mode. Audited energy and demand calculations used this matched data in an engineering-based calculation. A more detailed description of these audited calculation equations for televisions are presented in the Appendix.

Key differences in the parameters used for *ex ante* and audited television savings are summarized in Table 3-21.

Table 3-21 Key *Ex Ante* and Audited Parameters for Televisions

Parameter Description	Parameter	*Ex Ante* Savings Value	Audited Savings Value	Units
Energy Consumption- Standard Unit	UEC_{STD}	102	131	kWh/year
Energy Consumption- Energy-Efficient Unit	UEC_{EE}	0.0281	0.0037	kWh/year
Coincidence Factor	CF	None	0.169	-

3.3.6 Electric Water Heater Impact Parameters

AEP Ohio customers purchased and submitted rebate forms for 88 electric water heaters in 2013. Ex-ante savings for electric water heaters are determined by AEP Ohio using 182.9 kWh per-unit for energy and 0.0139 kW for demand. These values reportedly came from the 2012-2014 AEP Ohio EE/PDR Action Plan; however, the Plan value for energy is actually 182.4 kWh.[16]

For program electric water heaters, the evaluation team calculated audited savings using an engineering-based approach that takes into account the efficiency of program-rebated models as well as the federal standard for a model of equivalent capacity. This approach resulted in different values for *ex ante* and audited unit energy and demand savings, as summarized in Table 3-22. A detailed description of this engineering-based approach can be found in the Appendix.

[15] See page C-10 of Volume 2.

[16] See page C-11 of Volume 2. AEP Ohio has corrected these values for 2014.

Key differences in the values used for *ex ante* and audited electric water heaters savings are summarized in Table 3-22. The parameters presented for audited savings (see kWh, EF_{EE}, EF_{STD}, and CF) are different from those used in *ex ante* savings due to the different methodologies.

Table 3-22 Key *Ex Ante* and Audited Parameters for Electric Water Heaters

Parameter Description	Parameter	*Ex Ante* Value	Audited Value
Per-Unit Energy Savings	-	182.9	-
Per-Unit Demand Savings	-	0.0139	-
Heating Load, Typical Water Heater	kWh	-	3.46
Efficiency – Energy-Efficient Unit	EF_{EE}	-	0.95
Efficiency – Standard Unit	EF_{STD}	-	0.92
Coincidence Factor	CF	-	0.28

3.3.7 Heat Pump Water Heater Impact Parameters

In 2013, AEP Ohio customers submitted rebate forms for 256 heat pump water heaters. For heat pump water heaters, deemed savings values specified in the TRM depend on the type of home heating system where the new equipment is installed. Per-unit savings values are shown in Table 3-23.

Table 3-23. TRM-Specified Savings Values for Heat Pump Water Heaters

Home Heating System	Per-Unit Energy Savings (kWh)	Per-Unit Demand Savings (kW)
Electric Resistance Heat	499	0.068
Heat Pump	1,297	0.180
Fossil Fuel	2,076	0.280

Source: State of Ohio Energy Efficiency Technical Reference Manual (2010)

The home heating type breakdown for participants is shown in Table 3-24. According to AEP Ohio's assumptions, all homes with "electric" heating are considered to be heat pump for the purposes of determining energy and demand savings. This assumption that all electrical heat is a heat pump may overestimate savings for the AEP Ohio population, based on 2009 data from the EIA, which suggests a mix of electric resistance and heat pump sources.[17]

[17] "Table HC6.9 Space Heating in U.S. Homes in Midwest Region, Divisions, and States, 2009," http://www.eia.gov/consumption/residential/data/2009/

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Table 3-24. Home Heating Type for Heat Pump Water Heaters

Home Heating Type	Number of Units	Percent of Units
Heat Pump	126	49.2%
Fossil Fuel	130	50.8%
Total	**256**	**100.0%**

3.3.8 Total Appliance Impacts

With 42,113 qualifying-rebated appliances, the appliance rebates resulted in 2013 audited savings of 7,563 MWh and 1.15 MW. Around half of the appliance energy savings (55 percent) and demand savings (49 percent) came from clothes washers. Figure 3-5 shows the relative contribution of each appliance to total appliance savings.

Figure 3-5. Relative Contribution to Appliance Rebate Savings, by Appliance Type

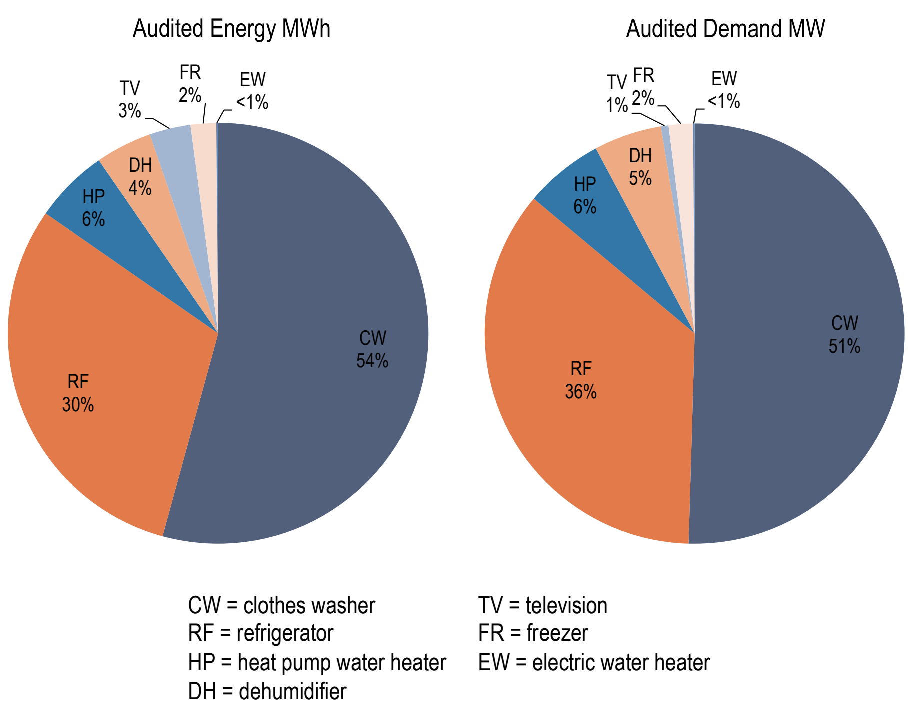

Table 3-25 shows the total and per-unit audited energy savings. While heat pump water heaters were only about 6 percent of overall appliance energy savings, they had the highest per-unit energy savings value (1,693 kWh).

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Table 3-25. Audited Energy Savings for the Appliance Rebates

Appliance Type	Number of Qualified Units	Total Audited Energy Savings (MWh)	Percent of Total Savings	Per-Unit Energy Savings (kWh)
Clothes Washers	18,151	4,104	54.3%	226
Refrigerators	17,905	2,299	30.4%	128
Heat Pump Water Heaters	256	433	5.7%	1,691
Dehumidifiers	1,581	327	4.3%	207
Televisions	1,820	239	3.2%	131
Freezers	2,299	149	2.0%	65
Electric Water Heaters	88	11	0.1%	125
Total Appliances	**42,100**	**7,562**	**100.0%**	**-**

Table 3-26 shows the overall audited demand savings and demand savings per unit from the appliance rebates. As with energy savings, heat pump water heaters have the highest per-unit demand savings value (0.23 kW).

Table 3-26. Audited Demand Savings for the Appliance Rebates

Appliance Type	Number of Qualified Units	Total Audited Demand Savings (MW)	Percent of Total Savings	Per-Unit Demand Savings (kW)
Clothes Washers	18,151	0.579	50.4%	0.03
Refrigerators	17,905	0.406	35.4%	0.02
Heat Pump Water Heaters	256	0.059	5.1%	0.23
Dehumidifiers	1,581	0.075	6.5%	0.05
Televisions	1,820	0.007	0.6%	< 0.01
Freezers	2,299	0.022	1.9%	0.01
Electric Water Heaters	88	< 0.001	0.1%	< 0.01
Total Appliances	**42,100**	**1.148**	**100.0%**	**-**

The audited savings for the appliance rebate portion of the program were 101 percent of the *ex ante* energy savings and 97 percent of *ex ante* demand savings (see Table 3-27). These appliance realization rates do not equal 1.00 because the evaluation team used independent audited savings approaches for televisions, freezers and electric water heaters.

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Table 3-27. Realization Rates for AEP Ohio Efficient Products Appliance Rebates

Appliance	*Ex Ante* Claimed Savings		Audited Savings		Realization Rates	
	MWh	MW	MWh	MW	Energy	Demand
Clothes Washers	4,103	0.58	4,104	0.58	1.00	1.00
Refrigerators	2,302	0.41	2,299	0.41	1.00	1.00
Heat Pump Water Heaters	433	0.06	433	0.06	1.00	1.00
Dehumidifiers	327	0.07	327	0.07	1.00	1.00
Televisions	186	0.05	239	0.01	1.29	0.13
Freezers	154	0.02	149	0.02	0.97	1.24
Electric Water Heaters	16	< 0.01	11	< 0.01	0.69	0.28
Total Appliances	**7,521**	**1.19**	**7,562**	**1.15**	**1.01**	**0.97**

3.4 *Combined Impacts of the Efficient Products Program*

The 2013 AEP Ohio Efficient Products Program had audited energy savings of 203,412 MWh, with 96 percent from lighting products. The program also had 24.45 MW in peak demand savings, with 95 percent from lighting products. Total savings from the program are summarized in Table 3-28.

Table 3-28. Total Efficient Products Audited Savings

Product	Audited Savings			
	MWh	% of Total Savings	MW	% of Total Savings
Lighting Products	195,850	96.3%	23.30	95.3%
Appliances	7,562	3.7%	1.15	4.7%
Total	**203,412**	**100%**	**24.45**	**100%**

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3.5 Program Realization Rates

As shown in Table 3-29, the AEP Ohio Efficient Products Program in 2013 had realization rates of 1.00 for energy and 0.99 for demand based on *ex ante* estimates and audited calculations for products purchased in 2013.

Table 3-29. Total Realization Rate for Efficient Products

Product Category	*Ex Ante* Claimed Savings		Audited Savings		Realization Rates	
	MWh	MW	MWh	MW	Energy	Demand
Lighting Products	196,602	23.48	195,850	23.30	1.00	0.99
Appliances	7,521	1.19	7,562	1.15	1.01	0.97
Total	**204,123**	**24.67**	**203,412**	**24.45**	1.00	0.99

3.6 Process Findings

The process evaluation of the Efficient Products Program was based on feedback from program staff and customers participating in the lighting component of the program. Customers purchasing program-discounted lighting were surveyed at participating stores after they had made their purchasing decision to better understand the participant perspective. The evaluation team did not collect feedback from appliance rebate participants or program non-participants, because these groups had been surveyed in past years.

Overall, the program continues to run smoothly. Survey respondents reported high satisfaction with both the discount lighting program (98 percent at least somewhat satisfied) and the discount amount (95 percent at least somewhat satisfied).

Among participating customers, there was a moderate level of awareness of the lighting discounts. Specifically, at the time of the purchase decision, 83 percent of survey respondents were aware of the discount, and 71 percent were aware that the discount was provided by AEP Ohio, which is an increase from the last time this was measured in 2011. However, only 4 percent of respondents were aware of the AEP Ohio lighting discounts before entering the store, suggesting that there is very limited awareness of the AEP Ohio lighting discount outside of the store aisle.

While the program is successful in achieving its stated goals and operating effectively, the process evaluation revealed one potential program challenge: low participation in rebates for electric water heaters. Program staff hypothesized that this could be due to a lack of awareness of efficient water heating technologies and the Efficient Products Program among local plumbing contractors, as well as customers not understanding the Energy Factor requirements for the rebated water heaters.

Despite these challenges, there are opportunities for program improvement in the future, as suggested by program staff, including: (1) providing a wider variety of LEDs and incentivizing them appropriately through the program, and (2) educating and cultivating relationships with plumbing contractors to increase sales of water heaters. Additionally, interviews with staff highlighted the opportunity to integrate electronic rebate processing into the program, and encouraging more partnering retailers to advertise the rebates on their websites.

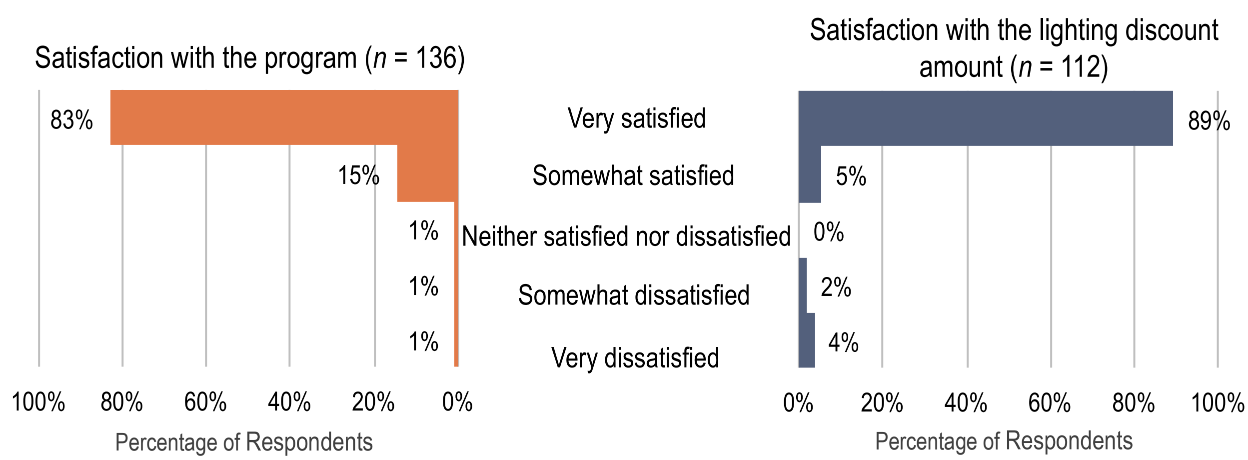
This section describes the findings from the process evaluation in detail, organized into the following sub-sections:

- Lighting Discount Participant Satisfaction
- Lighting Discount Program Awareness
- Participant Purchasing and Installation Intentions
- Barriers to Installation of Energy Efficient Lighting
- Current Program Challenges and Opportunities for Improvement

3.6.1 Lighting Discount Participant Satisfaction

Intercept survey respondents who purchased program-discounted lighting reported high levels of satisfaction with the program and the discount amount, as shown in Figure 3-6. Specifically, 98 percent of respondents reported being at least somewhat satisfied with the program, and 95 percent of respondents who were aware of the discount (n = 112) reported being at least somewhat satisfied with the discount amount. Satisfaction with the program did not vary based on the type of lighting purchased (CFL or LED), nor with the intended setting of installation (residential or business).

Figure 3-6. Satisfaction with the Program and Discount Amount



Note. The 24 participants who were unaware of the discount were not asked satisfaction with the discount. Due to rounding, totals do not add to 100 percent.

Survey respondents were asked to provide the reasoning behind the response they provided for satisfaction with the program in an open-ended question.[18] The responses fell into the following categories:

[18] Directly following the question regarding satisfaction with the AEP Ohio lighting discounts, survey respondents were asked, "Why did you give it that rating?"

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- 77 percent mentioned satisfaction with the discount as being the reason for their high satisfaction with the program (n = 105).
    - Of these, 68 respondents specifically mentioned the good value of the products as a result of the discount and 37 respondents mentioned that they liked saving money—both on the cost of the light bulb and the light bulbs' associated energy savings.
- 9 percent mentioned satisfaction with the lighting products themselves (e.g., the durability of CFLs, long life of the light bulbs) as their reason for being satisfied with the program (n = 12).
- 4 percent mentioned their satisfaction with the in-store demonstrations and the knowledge imparted by APT staff (n = 5).

3.6.2 Lighting Discount Program Awareness

According to AEP Ohio and APT staff, marketing for the Efficient Products' lighting discounts consisted primarily of in-store marketing as in previous years. They also reported that the lighting discounts have been integrated into the television and print campaign that showcased the entire suite of energy efficiency programs to customers. There has been a concerted effort to align the program's collateral with that of AEP Ohio's on-going advertising campaigns so that messaging is consistent.

At the time of the purchase decision, 83 percent (n = 112) of lighting intercept survey respondents were aware that the lighting they were purchasing was discounted, while 71 percent (n = 97) of customers were aware that the discount was provided by AEP Ohio. Interestingly, all 20 respondents who purchased LEDs were aware of the discount, and all but one knew the discount was provided by AEP Ohio. Of CFL-purchasers (n = 117), 80 percent were aware of the discounts, and 68 percent were aware that AEP Ohio provides the discount. Awareness was greater than that reported in the last intercept survey in 2011, which found that 71 percent of respondents were aware of the discount and 60 percent knew it was provided by AEP Ohio.[19]

Customers who were aware of the lighting discount (n = 112) were asked about their awareness of AEP Ohio's role in the discount and when they learned of the discount. Figure 3-7 presents the responses for these respondents. The vast majority of those who were aware of the discount also knew it was provided by AEP Ohio (87 percent) and had learned about the discount in-store (94 percent). This suggests that the program as it is currently operating aligns with the underlying program theory by intervening at the point where lighting decisions are made—in-store at the point of purchase. Despite this, the fact that nearly a third of participating customers were unaware of the discount or AEP Ohio's role at the time of purchase points to the fact that there are still opportunities to better publicize the products in-store.

[19] In 2011, the intercept survey was only conducted with CFL-purchasers. There were no statistically significant differences when comparing 2013 CFL-purchasers to the 2011 survey respondents for either awareness of discount (x^2 (1)= 2.661, p = 0.066) or AEP Ohio's role in the discount (x^2 (1)= 0.006, p = 0.550).

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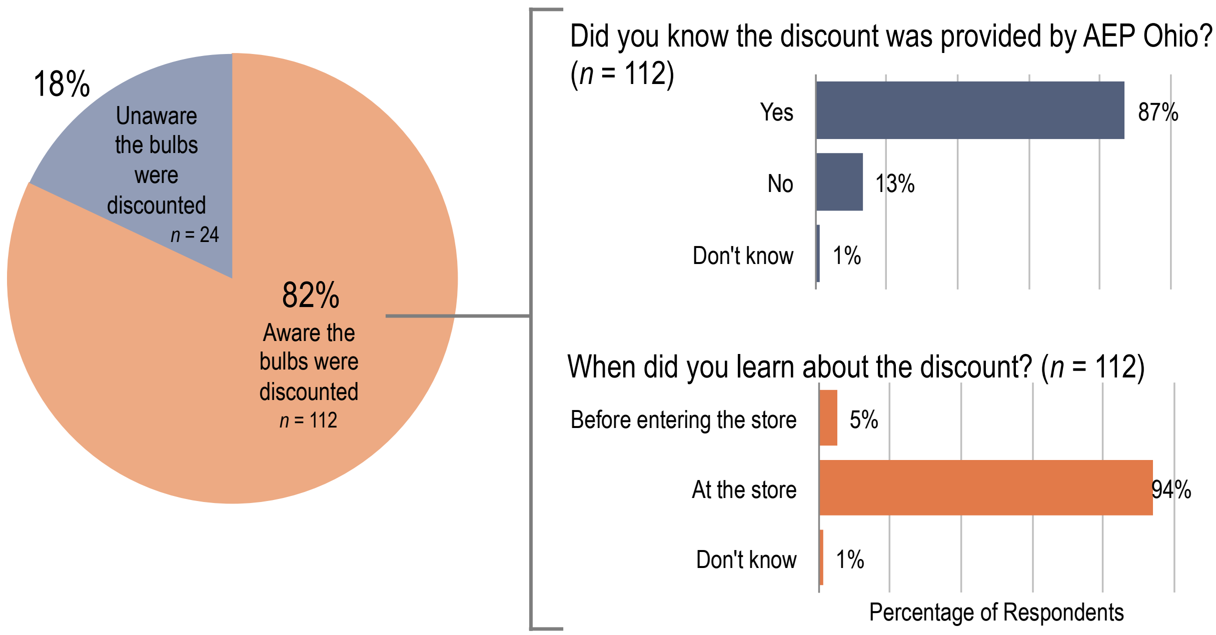
Figure 3-7. Respondents' Knowledge of AEP Ohio's Involvement and When Learned of Discount



Additionally, because of the very limited awareness of AEP Ohio lighting discounts outside of the store aisle there may be opportunities to increase awareness of the discount among the general public. Only four percent (n = 6) of lighting intercept survey respondents were aware of AEP Ohio lighting discounts before entering the store when they purchased the products, compared to 10 percent in 2011.[20] As one member of the program staff stated, "A lot of customers just aren't aware that AEP Ohio is sponsoring the cost reductions… Some may be just going to stores and buying what they've bought for years." The lack of awareness among the general population is supported by findings from the 2012 process evaluation showing that 86 percent of the general population was unaware of lighting discounts offered by AEP Ohio.[21]

The 97 respondents who were aware that the discount was provided by AEP Ohio were asked how they learned of it. The vast majority of discount-aware respondents (87 percent) learned about the discount during in-store demonstrations, which is expected, given that the intercepts themselves were coordinated with APT and completed in conjunction with in-store lighting demonstrations (Table 3-30). Surprisingly, no respondents reported learning of the discounts via AEP Ohio mailings, bill inserts, or website, despite the fact that AEP Ohio has integrated the lighting discounts into their broader energy efficiency advertising to customers and the general public. Despite the fact that six respondents reported knowing of the discounts before entering the store, all attributed their awareness to in-store sources, which suggests that they had previous in-store exposure to the program prior to the day they were interviewed.

[20] This represents a statistically significant decrease in awareness before entering store (x^2 (1)= 4.067, p = 0.032).
[21] Specifically, the question in the general population survey asked "Have you heard of the program AEP Ohio offers that provides discounts for purchasing CFLs at participating retail stores?"

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Table 3-30. Source of Awareness of AEP Ohio Lighting Discounts (n = 97)

Source of Awareness	Number of Respondents	Percentage of Respondents
In-store demonstration	84	86.6%
Signs on the store shelf or in the aisle	12	12.4%
A store employee	3	3.1%
Radio	1	1.0%
Don't know	1	1.0%

Note: The total does not add to 100% because respondents provided multiple responses. Radio was not provided as a response option, but was mentioned by one respondent.

There was a difference in the source of AEP Ohio discount awareness based on the type of light bulb respondents purchased. Of the 97 intercept survey respondents who were aware of the AEP Ohio discount, 79 purchased CFLs and 19 purchased LEDs (one person purchased both CFLs and LEDs). A smaller proportion of CFL-purchasers were aware of the discounts from in-store signs (nine percent, n = 7), compared to LED-purchasers (26 percent, n = 5).[22]. One explanation for this difference is that because LEDs have a higher cost, customers are more likely to pay closer attention to price labels in store aisles. Also, since discounts for LEDs are larger, the cost differential between discounted and non-discounted varieties is more pronounced, making the discount potentially more evident than those provided for CFLs.

3.6.3 Participant Purchasing and Installation Intentions

Lighting intercept survey respondents were asked about their purchasing intentions. Thirty-nine percent (n = 53) reported that they had planned to purchase light bulbs prior to entering the store. Table 3-31 below provides detail on the type of lighting these 53 survey respondents had planned to purchase when they entered the store. As shown in the right-most column, most respondents planned to purchase CFLs (47 percent) or LEDs (30 percent). This represents a difference from the last lighting intercept survey conducted in 2011, as shown in the second column, when of the respondents who had planned to purchase lighting prior to entering the store (n = 81), 75 percent (n = 61) intended to purchase CFLs, 26 percent (n = 21) intended to purchase incandescent lighting, and only two percent (n = 2) intended to purchase LEDs. It is important to note that in the 2011 survey, only CFL-purchasers were asked this question, so the interest in LEDs was likely understated. For comparison, when looking at only the CFL-purchasers in 2013 who had planned to purchase bulbs (n = 40), as shown in the third column, 60 percent (n = 24) intended to purchase CFLs, 13 percent (n = 5) incandescent lighting, and eight percent (n = 3)

[22] It is important to note that the sample size for LED purchasers is small (n = 19), preventing generalizable conclusions. The difference is statistically significant for CFL-purchasers ($x^2(1) = 4.839$, $p = 0.043$), but not for LED-purchasers ($x^2(1) = 4.238$, $p = 0.055$).

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LEDs. Despite the different populations in the two surveys, these results suggest increased customer interest in LEDs.

Table 3-31. Previous Purchasing Intentions by Light Bulb Type Purchased (2011 and 2013)

	2011	2013	
Intended Purchase Bulb Type	Percentages of Respondents (CFL purchasers only)	Percentage of Respondents (CFL purchasers only)	Percentage of Respondents (CFL and LED purchasers)
CFL	75.3%	60.0%	47.2%
LED	2.5%	7.5%	30.2%
Incandescent	25.9%	12.5%	9.4%
Florescent	3.7%	7.5%	5.7%
Halogen	2.5%	2.5%	1.9%
Don't know	1.2%	12.5%	11.3%

Note: The total does not add to 100% because respondents provided multiple responses.

Of those who had intended to buy CFLs ($n = 25$), all but one purchased a discounted CFL; the remaining respondent purchased discounted LEDs. Of those who had intended to buy LEDs ($n = 16$), all but three ultimately purchased discounted LEDs; the remaining respondents purchased discounted CFLs.

Respondents purchasing CFLs ($n = 117$) were asked to report on what they planned on doing with the CFLs they were purchasing.[23] A majority (62 percent) will use the CFLs to replace incandescent light bulbs (Table 3-32), with the remaining either storing the CFLs for later use (20 percent) or replacing existing CFLs (18 percent). No respondents intended to give the discounted CFLs away.

Table 3-32. Intended Use of Discounted CFLs Purchased ($n = 117$)

Light Bulb Type	Number of Respondents	Percentage of CFL Purchasers
Replace older style incandescent	73	62.4%
Store them for later use	23	19.7%
Replace CFLs	21	17.9%
Don't know	1	< 1%

Note: The total does not add to 100% because one respondent provided two responses.

[23] Because of a programming error, those who purchased LED were not asked the question correctly, and their responses are not provided.

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3.6.4 Barriers to Installation of Efficient Lighting

Respondents were asked to report on the primary factor preventing them from installing more CFLs and LEDs in their home. Table 3-33 enumerates the results to those questions, separated by lighting type. The most frequently mentioned reasons for not installing additional CFLs include waiting for incandescent lighting to burn out (32 percent), waiting for a CFL to burn out (18 percent), and CFLs being too expensive (10 percent). For LEDs, the primary reason reported for not installing more LEDs was the expense of purchasing LEDs (40 percent), followed distantly by all other responses.

Table 3-33. Reported Primary Factor Preventing Additional CFL and LED Installations (*n* = 136)

Main Factors Preventing Additional Efficient Lighting Installations	CFLs		LEDs	
	Count	Percent	Count	Percent
Too expensive	13	9.6%	54	39.7%
Waiting for an incandescent to burn out	44	32.4%	11	8.1%
Waiting for a CFL to burn out	25	18.4%	12	8.8%
All fixtures are already full with this lighting type	7	5.1%	2	1.5%
Waiting for an unspecified light bulb type to burn out	8	5.9%	-	-
Waiting for an LED to burn out	2	1.5%	5	3.7%
Takes too long to warm up	2	1.5%	4	2.9%
Don't like the way this lighting type looks in fixtures	2	1.5%	3	2.2%
This lighting type does not have the right light color	2	1.5%	3	2.2%
Not familiar enough with this lighting type	-	-	5	3.7%
Not bright enough	1	0.7%	3	2.2%
There is not a wide enough selection of this lighting type	3	2.2%	1	0.7%
Do not want this lighting type	-	-	4	2.9%
Only want to install CFLs	-	-	3	2.2%
Don't like the way this lighting type fits in fixtures	2	1.5%	-	-
Mercury content	2	1.5%	-	-
Other	10	7.4%	5	3.7%
Don't know	4	2.9%	12	8.8%

Note: No respondents reported issues with either bulb type in terms of compatibility in dimmable or three-way fixtures.

3.6.5 Current Program Challenges and Opportunities for Improvement

The Efficient Products Program was extremely successful; at the time of the evaluation team's interviews with AEP Ohio Program staff in October 2013, the program had already exceeded its savings goals. When asked if there were any challenges for the program, staff from AEP Ohio and APT identified one main challenge. Both AEP Ohio and APT staff (*n* = 2) reported that water heaters are a challenge for the program because they are typically purchased and installed by plumbing contractors who may not be familiar with the latest efficient water-heating technology—including heat pump water heaters and high-efficiency electric heaters—and therefore may be hesitant to recommend it to customers.

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Additionally, program staff identified issues with over 150 customers who applied for rebates for non-qualifying electric water heaters; this number is relatively large compared to the 88 rebates that were submitted and approved for qualifying units. In light of this, APT is considering sponsoring trainings for plumbing contractors focused on high-efficiency and heat pump water heaters in an effort to increase awareness of the technologies and dispel common myths. Contractors would then, in turn, educate customers. Program staff said that there could be potential to coordinate efforts with manufacturers (e.g., GE, Rheem, A.O. Smith) to lead these trainings. By increasing contractor awareness of the technologies and the Efficient Products Program, there is potential to increase sales of program-rebated products.

Additionally, it is possible that the efficient water heater rebates could be promoted to participants of AEP Ohio's In-Home Program. This program conducts energy assessments for residential customers to identify potential energy efficiency upgrades. The hot water heater rebates could be promoted in the detailed report provided to customers. Also, since the reports provide recommendations for contractors, this could be a way to recognize and promote the business of contractors who are involved with the program and who have attended the APT-sponsored trainings.

Besides the opportunity to educate and cultivate relationships with plumbing contractors and cross-promote the rebates with the In-Home Program, program staff offered a few areas for improvement to be considered in the future. First, some program staff spoke to the benefit of having EFI institute electronic rebate processing for the appliance rebates. Switching to an electronic system would help with reporting, give better access to processing data, and indirectly increase participant satisfaction with the appliance rebate component of the program by making the rebate application process paperless and more streamlined, which could potentially lead to shorter wait time for rebates. According to program staff, this change seems likely in the future. Second, there is potential for AEP Ohio or APT staff to encourage retailers to include information about the AEP Ohio-sponsored rebates on their websites. At this point, only two retailers provide any indication on their website regarding which appliances have rebates; these two retailers also provide a link to the rebate application. Having this type of exposure could help to promote awareness and sales of the rebated appliances.

Finally, lighting intercept survey respondents were asked to provide suggestions to improve the lighting discount component of the AEP Ohio Efficient Products Program. In total, 70 percent (n = 95) provided no suggestions. The remaining respondents provided the following responses:

- 15 percent think that the program needs to be advertised more (n = 20).
    - Of these, four said there should be more advertisements in the mail, one said there should be more TV advertisements, and one said that the discount should be more visible in the store aisle. The remaining six respondents simply said the program needs to be advertised more, but did not provide a specific avenue to best achieve increased exposure.
- 7 percent suggested providing larger discounts on lighting products (n = 10).
- 2 percent suggested that APT provide more demonstrations to educate consumers (n = 3).
- 2 percent would like the discounts to cover a wider variety of bulb types (n = 3).

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3.7 Cost Effectiveness Review

This section addresses the cost effectiveness of the Efficient Products Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-34 summarizes the unique inputs used in the TRC test.

Table 3-34. Inputs to Cost-Effectiveness Model for Efficient Products Program

Item	Value
Average Measure Life	11
Units	4,489,676
Annual Energy Savings (kWh)	203,412,000
Coincident Peak Savings (kW)	24,450
Third Party Implementation Costs	$2,090,852
Utility Administration Costs	$1,076,336
Utility Incentive Costs	$8,911,736
Participant Contribution to Incremental Measure Costs	$15,957,057

Based on these inputs, the TRC ratio is 3.3. Therefore, the program passes the TRC test. Table 3-35 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-35. Cost Effectiveness Results for the Efficient Products Program

Test Results for Efficient Products	
Total Resource Cost	3.4
Participant Cost Test	6.9
Ratepayer Impact Measure	0.4
Utility Cost Test	7.8

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

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4 Conclusions and Recommendations

4.1 Conclusions from 2013

The PY 2013 evaluation of the Efficient Products Program resulted in five main conclusions.

1. **Audited savings differed from *ex ante* values from some products, but overall realization rates remained close to 1.** Where the Draft Ohio TRM was used, audited values matched *ex ante* values from program tracking data. For products that were not covered by the Draft TRM, the evaluation team used an independent research-based savings approach, which resulted in different audited values for holiday lights, general purpose LEDs, freezers, televisions, and electric water heaters. However, due to the smaller proportion of savings for these products (compared to CFLs), the realization rates for the overall energy and demand savings were 1.00 and 0.99, respectively.

2. **The LED discounts are becoming more popular over time.** The program discounted about 80,000 general purpose LEDs in 2013, more than twice as many as were discounted in 2012. LEDs are responsible for the second-highest portion of savings, accounting for nearly three percent of both energy and demand savings in 2013. While this is still very small compared to CFLs, it is a large increase from previous years, when LED savings accounted for less than one percent of program savings. AEP Ohio continues to expand the discounted LED offerings as well as the retailers who carry these products. According to research conducted in 2011, AEP Ohio customers are willing to pay a maximum of $8.76 on average for LEDs, about $3 more than for specialty CFLs, which illustrates a willingness to pay a premium for this lamp type, to a certain extent. AEP Ohio is focusing on adjusting incentives to overcome the cost barriers associated with LED purchases in the future.

3. **Overall, intercept survey respondents who purchased program-discounted lighting reported high levels of satisfaction with the program and the discount amount.** Specifically, 98 percent of respondents reported being at least somewhat satisfied with the program, and 95 percent of respondents who were aware of the discount reported being at least somewhat satisfied with the discount amount. Satisfaction with the program did not vary based on the type of lighting purchased (CFL or LED), nor with the intended setting of installation (residential or business).

4. **Customer participation in the water heater rebates presents a challenge to the program.** The number of rebated electric water heaters (n = 88) was especially low, and program staff identified issues with over 150 customers who had applied for rebates for non-qualifying units. A special promotional increase in the rebate amount from $50 to $100 did not have much effect on rebate activity. It is possible that the in-store point-of-purchase marketing approach may not be the best approach to motivate customers to choose energy-efficient water-heaters. AEP Ohio is currently considering how best to reach out to plumbing contractors to market the program to their customers. Considering the large energy savings per unit, there are significant potential

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savings that could be captured by expanding the number of participants who apply for these rebates.

5. **Available information for rebate customers' home heating type does not include the level of granularity required by the Draft Ohio TRM.** In particular, calculations for savings from heat pump water heaters rely on information regarding whether a customer's home is heated by electric resistance heating, heat pump, or a fossil fuel source (e.g., natural gas). Data used by AEP Ohio only contain information regarding whether the heating source is electric or natural gas, and assumes that all customers with electric heating are using electric heat pumps. The evaluation team does not have data to gauge the accuracy of this assumption. Because per-unit savings for heat pump water heaters are relatively large, gaining clarity on this issue seems worthwhile for this measure.

4.2 Recommendations for Program Improvements

The 2013 evaluation of the Efficient Products Program resulted in four recommendations.

1. **Continue to expand the LED component of the program.** Given that cost is the number one barrier for LEDs, continuing to incent this technology will be key to continued adoption. Discounting a variety of LEDs will expand market adoption, and continuing to incorporate LED lighting in memorandums of understanding (MOUs) with a wide variety of retailers (regardless of size) will help ensure partnering retailer satisfaction.

2. **Update the approach used to calculate savings for products not in the Draft Ohio TRM.** In particular, we recommend a model-matching approach to calculate savings for freezers, televisions, and electric water heaters. The model-matching approach based on the efficiency of the units incented is more precise, compared to the current *ex ante* method of applying a single per-unit value for these products.

3. **Continue to investigate ways to increase participation in water heater rebates by engaging plumbing contractors or energy auditors to be reliable advocates for efficient water heater technologies and the Efficient Products rebates.** Plumbing contractors are typically the individuals in the water heater supply chain who recommend specific technologies to the end users. It is unclear whether contractors are aware of the rebates, or if they have sufficient awareness and knowledge of energy efficient water heater technologies. Either AEP Ohio or the evaluation team could conduct reviews of peer programs for best practices in reaching out to contractors, or primary research (i.e., surveys, interviews, focus groups) with this group of market actors to understand how best to educate and motivate them to be active in the program. Additionally, AEP Ohio could explore the possibility of having energy auditors promote the water heater rebates and provide information about qualifying units to customers through the In-Home Program.

4. **Consider ways to determine home heating type for heat pump water heater rebate participants with more granularity.** One simple way to do this would be to add a question to

the rebate form for heat pump water heaters asking customers to indicate whether their home heating is electric resistance (e.g., baseboard heat, electric wall heaters), electric heat pump, or fossil fuel (e.g., natural gas, oil, propane).

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Appendix A Methodology, Findings, and Survey Instruments

This Appendix describes additional details of the methodology and findings for adjusted savings, additional process evaluation results, and survey instruments used for data collection for the 2013 evaluation of the AEP Ohio Efficient Products Program.

Specifically, Appendix A includes the following sections:

- A.1
- Methodology for Adjusted Impact Calculations
- A.2 Adjusted Impact Savings Findings
- A.3 Adjusted Impact Evaluation Conclusions and Recommendations
- A.4 Additional Process Evaluation Results Detail
- A.5 Data Collection Instruments

A.1 Methodology for Adjusted Impact Calculations

In addition to the audited savings presented in the report, the evaluation team estimated adjusted savings using primary data collected through program tracking data, in-store intercepts, and shelf surveys. The objectives of this adjusted impact evaluation were to estimate realized energy savings and assess the accuracy of Draft Ohio TRM deemed savings values. This section summarizes the adjusted savings methodology for the following products:

- A.1.1 Lighting (CFL and General Purpose LEDs)
- A.1.2 LED Holiday Strings
- A.1.3 Clothes Washers
- A.1.4 Dehumidifiers
- A.1.5 Refrigerators
- A.1.6 Freezers
- A.1.7 Electric Water Heaters
- A.1.8 Heat Pump Water Heaters
- A.1.9 Televisions

A.1.1 Lighting (CFL and General Purpose LEDs) Adjusted Savings Methodology

The methodology for calculating adjusted savings for CFLs and general purpose LEDs is described below, including:

- Discounting savings for future lighting installations
- Carryover for unattributed program lighting from 2011 and 2012
- Lighting adjusted energy savings calculation
- Lighting demand reduction savings calculation
- Lighting adjusted savings parameters

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Discounting Savings for Future Lighting Installations

To calculate adjusted savings, the evaluation team used a discounting approach to count savings from lighting products installed in the years following a given program year. The discounting approach seeks to simplify the evaluation of lighting savings by aggregating all program year products into a single evaluation year. This approach combines the number of lighting products installed in the program year (based on first year installation rate of 81.7 percent) with the net present value (NPV) of lighting products installed in future years (based on second and third year installation rates of 8.65 percent), for a combined discounted in-service rate ($ISR_{Y1,2,3}$). $ISR_{Y1,2,3}$ was determined using the utility discount rate (DR) to combine yearly installation rate calculations and future installation discounting approaches from the Uniform Methods Project protocols.[24] Specifically, $ISR_{Y1,2,3}$ was calculated using Equation A-1.

Equation A-1. Total Discounted In-Service Rate

$$\boldsymbol{ISR_{Y1,2,3} = ISR_{Y1} + NPV\,(DR, ISR_{Y2}, ISR_{Y3}) = ISR_{Y1} + \frac{ISR_{Y2}}{(1+DR)^1} + \frac{ISR_{Y3}}{(1+DR)^2}}$$

Important inputs into calculating this combined in-service rate ($ISR_{Y1,2,3}$) are presented in Table A-1.

Table A-1. Overview of Combined Discounting Approach $ISR_{Y1,2,3}$ Calculation

Calculated Value	Variable	Description and Calculation Methodology
Total Discounted In-Service Rate	$ISR_{Y1,2,3}$ = 97.1%	Total discounted in-service rate calculated using the following equation: $ISR_{Y1,2,3} = ISR_{Y1} + \frac{ISR_{Y2}}{(1+DR)^1} + \frac{ISR_{Y3}}{(1+DR)^2}$
In-Service Rate (First Year installation)	ISR_{Y1} = 81.7%	The average percentage of program lighting products that were installed by customers in their homes during the current program year, the same year the products were purchased. The first year in-service rate is equal to the total number of program lighting products installed divided by the total number of program lighting products purchased. This in-service rate was used in the 2012 evaluation for CFLs.
In-Service Rate (Second and Third Year installation)	ISR_{Y2} = ISR_{Y3} = 8.65%	The installation rate of program year purchased bulbs in the second and third years following the program year is determined as follows: $ISR_{Y2} = ISR_{Y3} = (ISR_{MAX} – ISR_{Y1})/2$ Where ISR_{MAX} is 99%, as estimated by the 2006-2008 California Residential Upstream Lighting Programs as the total percentage of program lighting products installed within three years and ISR_{Y1} is the portion of program products installed in the first year. The difference between these two values represents program products that are installed in the second and third year following the program year. We assume that the same number of remaining lighting products are installed in the second and third years, according to the Uniform Methods Protocol for residential lighting installation rate trajectories.
Discount Rate	DR =	We use the AEP Ohio utility discount rate of 8.3% to compute the Net Present Value of

[24] From the Residential Lighting Evaluation Protocol, part of the Uniform Methods Project: "To calculate the installation rate trajectories, the Residential Lighting Evaluation Protocol recommends using the findings from the evaluation of the 2006-2008 California Residential Upstream Lighting Programs, which estimated that 99% of program bulbs get installed within three years, including the program year…Therefore, program administrators should assume the bulbs that will be installed in future years are split equally between one and two years following the program year, calculated as: $ISRPY2$ = (99%−$ISRPY1$)/2 and $ISRPY3$ = (99%−$ISRPY1$)/2 where: ISR = in-service rate." 6-19.

	8.3%	second and third year installations.

Lighting from 2011 and 2012

While the new discounting approach (above) simplifies the Efficient Products Program evaluation, there is a conflict between the introduction of the new approach and the staggered approach used in previous evaluations. This is due to the fact that the remaining lighting products from 2011 and 2012 have not yet been attributed to any program years in an evaluation report, as previous evaluation reports assumed they would be installed in either 2013 or 2014. In order to resolve the issue of the remaining, unattributed lighting products from 2011 and 2012, the evaluation team followed the approach outlined in Table A-2.

Table A-2. Carryover for Lighting from 2011 and 2012 with Unattributed Savings

Program Year (Purchase Year)	Assumed Installation Year	Description of Installation Conditions	Treatment for Calculating Savings	Savings Attribution Year
2011	2013 (third-year savings)	The remaining 2011 lighting products that the 2012 evaluation report assumed to be installed in the 3rd year (first- and second-year savings were counted in 2011 and 2012, respectively)	# of lighting products assumed to be installed in 2013 * per unit savings according to calculations from 2013	2013
2012	2013 (second-year savings)	The 2012 lighting products that the 2012 evaluation report assumed to be installed in the 2nd year (first-year savings were counted in 2012)	# of lighting products assumed to be installed in 2013 * per unit savings according to calculations from 2013	2013
2012	2014 (third-year savings)	The 2012 lighting products that the 2012 evaluation report assumed to be installed in the 3rd year (first-year savings were counted in 2012)	Discounted # of lighting products assumed to be installed in 2014 * per unit savings according to calculations from 2013	2013

Note that the 2012 lighting products that the 2012 evaluation report predicted would be installed in 2014 are attributed to 2013, but these products are discounted using the discounting approach and the utility discount rate of 8.6 percent.

This approach for savings carryover combines the staggered approach to calculate savings from program years where it was applied (2011, 2012) and the future discount savings approach to calculate savings from program years where it now applies (2013, 2014). This consolidated carryover approach simplifies future evaluations by resolving the unattributed savings issue in the current 2013 program year.

Lighting Adjusted Energy Savings Calculation

Equation A-2 provides the general calculation for adjusted lighting energy savings. Per-unit impacts are a function of the differences in wattage between the baseline lamp standard ($Watts_{STD}$) and the program

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lamp installed ($Watt_{PROG}$), the average hours per day that the lamps are used (HOU), the total, discounted in-service rate per lamp ($ISR_{Y1,2,3}$), and a waste heat factor (WHF_E).

Equation A-2. Lighting Energy Savings Impact Calculation

$$\textit{Bulb-Specific Per-Unit Savings (kWh)} = \frac{(Watt_{STD} - Watt_{PROG})}{1,000} * (HOU * 365) * ISR_{Y1,2,3} * WHF_E$$

Total adjusted energy savings for lighting were estimated as the sum of bulb-specific per-unit savings for all lighting products listed in the program tracking database.

Lighting Adjusted Demand Savings Calculation

The equation for the peak demand impact is shown in Equation A-3. Peak demand savings are again a function of the wattage differences between the standard ($Watt_{STD}$) and the installed program product ($Watt_{PROG}$), the discounted in-service rate ($ISR_{Y1,2,3}$), the average summer demand coincidence factor (CF), and a waste heat factor (WHF_D).

Equation A-3. Adjusted Demand Savings Calculation for Lighting Products

$$\textit{Per-Unit Adjusted Demand Savings (kW)} = \frac{(Watt_{STD} - Watt_{PROG})}{1,000} * ISR_{Y1,2,3} * CF * WHF_D$$

Lighting Adjusted Savings Parameters

Lighting adjusted energy and demand savings are calculated based on program bulb wattage and lumen equivalent baseline wattage, adjusted for EISA's impact on wattage availability. The evaluation team calculated mean wattage of program discounted CFLs of 15.27 using weighted averages from the tracking data (based on the quantity of CFLs by wattage) and shown in Table A-3. The weighted average wattage for a standard lighting product was 57.84 Watts.

Table A-3. $Watt_{PROG}$ and $Watt_{STD}$ for Program CFLs

CFLs	Markdown	Coupon	Foodbank/ Fundraiser	Weighted Average
Watt Program	15.37	17.75	13.15	15.27
Watt Standard	58.21	66.14	50.47	57.84
Quantity	4,127,545	3,402	211,037	-

The evaluation team calculated mean wattage of program discounted LEDs of 12.72 watts using weighted averages from the tracking data (based on the quantity of LEDs by wattage) and shown in Table A-4. The weighted average wattage for a standard lighting product was 65.82 Watts.

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Table A-4. Calculation of Watt$_{PROG}$ and Watt$_{STD}$ for Program LEDs

LEDs	Markdown
Watt Program	12.72
Watt Standard	65.82
Quantity	80,846

For lighting adjusted energy and demand savings, the evaluation team calculated standard wattage (Watt$_{STD}$) using a lumen equivalency approach, as was done for the 2012 impact evaluation, according to the values in Table A-5.[25]

Table A-5. Lumen Equivalency Wattages

CFL Wattage	Equivalent Incandescent Wattage
4 to 9	25
9 to 13	40
13 to 15	60
18 to 25	75-Adjusted
23 to 30	100-Adjusted
22 to 40	125
40 to 45	150
LED Wattage	**Equivalent Incandescent Wattage**
4 to 5	40
6 to 8	60
9 to 13	75-Adjusted
16 to 20	100-Adjusted
25 to 28	150

Note. Where there is overlap in wattage categories, "Equivalent Incandescent Wattage" values are averaged. Ex: the 13W CFL Baseline is 50W (average of 40W and 60W).

For EISA impacted light bulbs, the evaluation team calculated Watt$_{STD}$ values using 1) the estimated baseline wattage found in the Uniform Methods Project protocols table (see Table A-6), and 2) observed 75W and 100W bulb counts from the 2013 shelf surveys. Specifically, the evaluation team applied an upward adjustment to the UMP baseline values of 72W and 53W to account for the observed availability

[25] Note 75- and 100-adjusted values were calculated for program lighting products based on month invoiced to reflect the decline in availability *over time* as observed in the shelf-surveys.

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of 100-Watt and 75-Watt lighting products during shelf surveys in the AEP Ohio service territory implemented during 2013.[26]

Table A-6. UMP Lumen Equivalency Values

Lumen Range	2011 Baseline	2012 Baseline	2013 Baseline	2014 Baseline
1490 — 2600	100 W	72 W	72 W	72 W
1050 — 1489	75 W	75 W	53 W	53 W
750 — 1049	60 W	60 W	60 W	43 W
310 — 749	40 W	40 W	40 W	29 W

Chapter 6: Residential Lighting Evaluation Protocol," Table 2, page 10, http://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

Additionally, the evaluation team calculated waste heat factors for energy and demand savings (WHF_E and WHF_D) to account for the cooling energy savings that result from the use of more efficient lighting products. This is the same approach currently used in the Draft Ohio TRM and the Uniform Methods Project protocols for residential lighting also recommend considerations for interactive effects. These waste heat factors to adjust energy and demand savings are calculated using three parameters: [27]

- Percentage of homes with central air conditioning
- Average efficiency (COP) of central air conditioning systems, based on an assumption of Standard SEER = 11
- Decrease in cooling load from more efficient lighting (represented as a percentage of lighting savings), based on a modeled value of 35 percent

For adjusted savings, the evaluation team used the same assumptions for the average efficiency and decrease in cooling load parameters as the Draft Ohio TRM. However, for the percentage of homes with central air conditioning, the evaluation team updated the TRM value (64 percent) with the value from the 2009 RECS survey for Air Conditioning in the Midwest Region for Indiana and Ohio (61.4 percent).[28] The resulting WHF_E value is the same as the TRM value of 1.07 due to rounding; the resulting WHF_D value of 1.20 differs slightly from the TRM value of 1.21.

The sources and definitions of key impact parameters, including descriptions of key parameters for the new discounting approach, are summarized in Table A-7. The average program wattage for LEDs (12.72) is lower than the average program wattage for CFLs (15.27). Additionally, the standard wattage for LEDs (65.82) is *higher* than the average standard wattage for CFLs (57.84).

[26] A full discussion of this baseline calculation is presented in the memo, "2013 Efficient Products Evaluation: Lighting Shelf Survey Wave 2 Findings & Comparison to Wave 1," dated February 14, 2014. Lighting product baseline was calculated for each month invoiced to reflect the declining availability of 75W and 100W bulbs, as noted in the memorandum cited here.

[27] These parameter values are discussed in the Draft Ohio TRM.

[28] See [http://www.eia.gov/consumption/residential/data/2009/], Air Conditioning: in Midwest Region, divisions, and states (HC7.9).

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Table A-7. Key Impact Parameters for Lighting

Parameter Description	Parameter	Source and Calculation Method	CFL Value	LED Value
Program Wattage	$Watt_{PROG}$	The wattage of the purchased lighting product(s). These data come directly from the tracking data for each individual lighting product purchased through the program.	15.27	12.72
Standard Wattage	$Watt_{STD}$	The standard wattage is determined using lumen equivalency, observed shelf-survey data, and information on EISA's anticipated effects on wattage availability.	57.84	65.82
Total Discounted In-Service Rate [a]	$ISR_{Y1,2,3}$	Total discounted in-service rate calculated using the following equation[29]: $ISR_{Y1,2,3} = ISR_{Y1} + \frac{ISR_{Y2}}{(1+DR)^1} + \frac{ISR_{Y3}}{(1+DR)^2}$	97.1%	97.1%
Hours of Use	HOU	The average number of hours installed lighting products are in operation each year. The hours of use for CFLs and LEDs are the same as in the 2011 and 2012 savings calculations.	985.5	985.5
Peak Demand Coincidence Factor	CF	The peak coincidence factor for CFLs and LEDs, determined as part of the 2011 Evaluation.	0.087	0.087
Waste Heat Factor Energy	WHF_E	Takes into account additional energy savings, which are the cooling savings from reduced heat output of more efficient lighting products. Values from the 2010 Draft Ohio TRM were updated with 2009 RECS survey results to determine the percentage of homes with central air conditioning. Due to rounding, the value ended up being the same as that in the Draft Ohio TRM.	1.07	1.07
Waste Heat Factor Demand	WHF_D	Takes into account additional demand savings, which are the cooling savings from reduced heat output of more efficient lighting products. Values from the 2010 Draft Ohio TRM were updated with 2009 RECS survey results for percentage of homes with central air conditioning.	1.20	1.20

a. The installation rate for LEDs is based on the fact that preliminary results of an in-home customer lighting survey conducted by the evaluation team showed some LEDs in storage, suggesting that the ISR is less than 1.0. Specifically, we found LEDs in storage across two customer sites, with more data to be collected later in 2014. Because the specific ISR for LEDs in Ohio is unknown, the evaluation team used the ISR for CFLs, discounted to account for future years' installations, as a conservative estimate.

A.1.2 LED Holiday String Adjusted Savings Methodology

The evaluation team calculated LED holiday string impacts using the same basic equation as other program lighting products (see Equation A-1 and Equation A-2). The values we used for the key impact parameters were specific to LED holiday strings, as shown in Table A-8).

[29] This equation adds the first year installation rate and the Net Present Value (NPV) of the second and third year installations, represented by the two terms on the right. This follows the discounting method discussed in the Uniform Methods Protocol;[29] EMI will use the utility discount rate for Net Present Value calculations. AEP Ohio's discount rate is 8.6%.

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Table A-8. Key Impact Parameters for LED Holiday Strings

Parameter Description	Parameter	Source or Calculation Method
Program Wattage	$Watt_{PROG}$ = 0.069 Watts	Program Tracking Data, variable *MeasSize*
Standard Wattage	$Watt_{STD}$ = 0.400 Watts	The evaluation team will use the same conservative baseline used in the 2011 evaluation, using mini-lights (0.4W) as the standard wattage. [a]
In-Service Rate	ISR = 100%	The evaluation assumes that all LED Holiday Strings purchased through the program are used during the holiday season, so the in-service rate is 100 percent.
Hours of Use	HOU= 480 hours/year	Based on U.S. DOE estimates, the evaluation assumes that LED holiday string lights are used 12 hours per day for 40 days in November and December (480 hours per year), as used in the 2011 Evaluation.
Peak Demand Coincidence Factor	CF = 0	Holiday string lights do not contribute to peak demand savings for AEP Ohio, so the coincidence factor for LED holiday string lights is zero.

a. NSTAR, Holiday Lighting Energy Use Comparison http://www.nstar.com/residential/energy_efficiency/holiday-lights.asp

A. 1.3 Clothes Washer Adjusted Savings Methodology

According to the program logic model, the program incentive motivates customers who are already going to purchase a clothes washer to purchase a more energy-efficient one. Therefore, savings are a function of the incremental energy usage between a clothes washer that meets the minimum federal standard for energy consumption and the AEP Ohio discounted one that meets a more stringent ENERGY STAR or CEE standard.

Clothes Washer Adjusted Energy Savings Calculation

The evaluation team calculated adjusted energy savings (unit energy savings, UES) of the clothes washers using an engineering algorithm that takes into account unit capacity, efficiency, and total annual usage. This algorithm was used in an evaluation of the deemed savings values in the state of Wisconsin and is shown in Equation A-4.[30]

Equation A-4. Potential Unit Energy Savings for Discounted Clothes Washers

$$UES_{potential} = Volume \times \left(\frac{1}{MEF_{STD}} - \frac{1}{MEF_{EE}}\right) \times Cycles$$

This equation uses volume, MEF_{EE}, and MEF_{STD} from the ENERGY STAR qualified model list based on the brand and model. The evaluation team estimated the average number of cycles per unit per year using responses on average number of cycles per week from the 2011 participant survey. The MEF

[30] State of Wisconsin Department of Administration Division of Energy. Focus on Energy Statewide Evaluation. 14 August 2002. Opinion Dynamics Corporation. PA Government Services, Inc.

variable captures the energy savings from efficient clothes washers by incorporating the following components of clothes washer energy usage:

- Energy usage directly from **clothes washer** operation ($S_{operation}$),
- Energy usage from **heating the water** that goes into a clothes washer (S_{water}), and
- The reduction in **dryer** energy usage that results from more efficient moisture removal by the clothes washer (S_{dryer}).

There are only electrical savings associated with these latter two end uses if the customer has an electric hot water heater and an electric dryer, respectively, and used them for a portion of laundry loads. Therefore, the second step in calculating energy savings is adjusting this potential UES based on the breakdown of fuel types and use by AEP Ohio customers. To do this, the evaluation team calculated a fuel adjustment factor (FAF) that incorporated the percentage of the UES from the three end uses (appliance operation, water heating and drying) and the average percentage of AEP Ohio customers who use electricity for each end use, as shown in Equation A-5.

Equation A-5. Fuel Adjustment Factor for Clothes Washers

$$FAF = (S_{operation} * 1.00) + (S_{water} * EWH) + (S_{dryer} * ECD)$$

The evaluation team derived percentages of the UES from the three end-uses, $S_{operation}$, S_{water}, and S_{dryer}, based on characteristics of qualified models in the ENERGY STAR Clothes Washer Savings Calculator Assumptions.[31]

$S_{operation}$ is multiplied by 1.00 because all washing machines operate using electricity. The evaluation team used values from the 2011 participant survey data for the multipliers that account for the percent of loads heated with an electric water heater and percent of loads dried with electric clothes dryers (EWH = 18 percent and ECD = 84 percent, respectively)[32].

To estimate actual per-unit savings, the evaluation team multiplies $UES_{potential}$ by this FAF. The final per-unit energy savings ($UES_{adjusted}$) is shown in Equation A-6.

Equation A-6. Adjusted Unit Energy Savings for Discounted Clothes Washers

$$UES_{adjusted} = UES_{potential} * FAF$$

Total clothes washer adjusted energy savings are the sum of per-unit savings for all clothes washers listed in the program tracking database.

[31] ENERGY STAR Clothes Washer Savings Calculator, http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/appliance_calculator.xlsx
[32] Calculated from the PY 2011 Participant Survey.

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Clothes Washer Adjusted Demand Savings Calculation

The adjusted demand savings for clothes washers is calculated by modeling the unit demand savings (UDS) of the clothes washers discounted through the program. By assuming that the average clothes washer cycle lasts for one hour[33], the average unit demand during operation can be calculated by dividing the annual energy savings (UES_{adjust}) by the number of wash cycles in a year. The UDC is equal to the average operating demand multiplied by the coincidence factor (CF), or percentage of units in use during the peak demand period, as shown in Equation A-7. The CF is the minimum estimate of clothes washers that are in use between 3PM and 6PM, based on the U.S. DOE Building America Benchmark.[34]

Equation A-7. Unit Demand Savings for Discounted Clothes Washers

$$UDS = \left(\frac{UES_{adjust}}{Cycles}\right) \times CF$$

Total clothes washer adjusted demand savings is estimated as the sum of per-unit savings for all clothes washers listed in the program tracking database.

Clothes Washer Adjusted Savings Parameters

The sources and definitions of key impact parameters for the clothes washer calculations are summarized in Table A-9. The average size of program units is 3.96 ft^3, and the average MEF of program units is 2.57 ft^3/kWh/cycle, compared to the standard of 1.26 ft^3/kWh/cycle.

[33] United States. Department of Energy. Electronic Code of Federal Regulations: Title 10: Energy: Part 430: Energy Conservation for Consumer Products. 2011.
[34] Department of Energy, Energy Efficiency and Renewable Energy (EERE). 2011. Building America Analysis Spreadsheet. B10 Analysis - Existing Homes 2011.01.26.xlsm. Retrieved from http://www1.eere.energy.gov/buildings/residential/ba_analysis_spreadsheets.html

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Table A-9. Key Impact Parameters for Clothes Washers

Parameter Description	Parameter	Units	Source	Value
Unit Capacity	Volume	ft^3	ENERGY STAR [(a)]	3.96
Modified Energy Factor – Standard Unit	MEF_{STD}	ft^3 / kWh/cycle	Federal standard [(b)]	1.26
Modified Energy Factor – Energy-Efficient Unit	MEF_{EE}	ft^3 / kWh/cycle	ENERGY STAR [(a)]	2.57
Yearly Washer Loads	Cycles	Number of loads	2011 participant survey data	344
Percent of Loads Heated with Electric Water Heat	EWH	percent	2011 participant survey data	18
Percent of Loads Dried with Electric Clothes Dryers	ECD	percent	2011 participant survey data	84
Fuel Adjustment Factor	FAF	-	Calculated based on other parameters	0.63
Peak Demand Coincidence Factor	CF	-	DOE[(c)]	0.05

a. ENERGY STAR Qualified Clothes Washers list based on tracking data brand and model. http://www.energystar.gov/productfinder/product/certified-clothes-washers/
b. Department of Energy. 2001. DOE Residential Clothes Washer Final Rule (66 FR 3314)
c. Department of Energy Energy Efficiency and Renewable Energy (EERE). 2011. Building America Analysis Spreadsheet. B10 Analysis - Existing Homes 2011.01.26.xlsm. Retrieved from http://www1.eere.energy.gov/buildings/residential/ba_analysis_spreadsheets.html

A.1.4 Dehumidifier Adjusted Savings Methodology

According to the program logic, savings are a function of the incremental energy usage between a dehumidifier that meets the federal standard for energy consumption and the more efficient ENERGY STAR or CEE Tier rated dehumidifier discounted through the program.

Dehumidifiers Adjusted Energy Savings Calculation

The adjusted energy savings are a function of the capacity of the unit (DH_{cap}), the annual usage in hours (HOU), the efficiency of the discounted unit (EF_{EE}), and the minimum federal efficiency standard (EF_{STD}), as shown in Equation A-8. The equation also includes conversion factors to account for different units used for dehumidifier capacity (pints per day) and efficiency factors (liters per hour per watt).

Equation A-8. Unit Energy Savings for Dehumidifiers

$$UES = DH_{cap} \times \text{HOU} \times \left(\frac{1}{EF_{EE}} - \frac{1}{EF_{STD}}\right) \times \frac{0.473\ liters}{pint} \times \frac{day}{24\ hours}$$

The evaluation team determined values for DH_{cap}, EF_{EE}, and EF_{std} by matching brand and model from the program tracking data with ENERGY STAR qualified models. The evaluation team used the same HOU estimate as DOE, which uses the midpoint of Association of Home Appliance Manufacturers (AHAM) estimates for HOU.[35]

[35] Anderson, W. 2010. Notice of Proposed Rulemaking Public Meeting Presentation. December 17. Department of Energy.

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Total dehumidifier adjusted energy savings are the sum of per-unit savings for all dehumidifiers listed in the program tracking database.

Dehumidifier Adjusted Demand Savings Calculation

The adjusted demand savings (UDS) are a function of the capacity of the unit (DH_{cap}), the efficiency of the program discounted unit (EF_{EE}), the minimum federal efficiency standard (EF_{STD}), and the coincidence factor (CF), which captures the percent of units that are in use during the peak period, as shown in Equation A-9.

Equation A-9. Unit Demand Savings for Dehumidifiers

$$UDS = DH_{cap} \times \left(\frac{1}{EF_{EE}} - \frac{1}{EF_{STD}}\right) \times CF \times \frac{0.473\ liters}{pint} \times \frac{day}{24\ hours}$$

This equation uses a coincidence factor (CF) from 2011 participant survey data of 0.843. Participants were asked if they use the dehumidifier during summer weekdays between 3PM and 6PM; the portion that said "yes" make up the coincidence factor.

Dehumidifier Adjusted Savings Parameters

The sources and definitions of key parameters for the dehumidifier calculations are summarized Table A-10. The average capacity of program units is 55.48 pints, and the average efficiency of program units is 1.73 compared to the standard efficient unit of equivalent size of 1.60.

Table A-10. Key Impact Parameters for Dehumidifiers

Parameter Definition	Parameter	Units	Source	Value
Capacity of the Dehumidifier	DH_{cap}	Pints/day	ENERGY STAR [(a)]	55.48
Hours of Use	HOU	Hours/year	DOE [(b)]	1,095
Coincidence Factor	CF	-	2011 participant survey data	0.84
Efficiency – Energy-Efficient Unit	EF_{EE}	L/kwh	ENERGY STAR [(a)]	1.73
Efficiency – Standard Unit	EF_{STD}	L/kwh	DOE Standard [(c)]	1.60

a. U.S. EPA ENERGY STAR qualified product list for dehumidifiers, [http://downloads.energystar.gov/bi/qplist/dehumid_prod_list.xls?3ac5-fe3e], 6/10/13
b. DOE test procedure published in Federal Register on 9/20/2011 http://www.gpo.gov/fdsys/pkg/FR-2011-09-20/html/2011-22812.htm
c. Standards for Residential Dehumidifiers http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/55#standards

It is important to note that the Federal Standard for Dehumidifiers was updated in October 2012.[36] Ex-ante and audited savings values taken from the Draft Ohio TRM are based on a previous standard from October 2006.

http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/dw_dehum_ccp_tp_nopr_presentation.pdf.
[36] http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/55#standards

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A. 1.5 Refrigerator Adjusted Savings Methodology

According to the program logic, energy savings are a function of the incremental energy usage between a refrigerator that meets the federal standard for energy consumption and the more efficient ENERGY STAR or CEE Tier rated refrigerator discounted through the program.

Refrigerator Adjusted Energy Savings Calculation

For program refrigerators, full-year unit energy savings (UES) are a function of the rated annual energy usage of the standard unit (UEC_{STD}) minus the rated energy usage of the efficient unit (UEC_{EE}), as shown in Equation A-10.

Equation A-10. Unit Energy Savings for Refrigerators

$$UES = UEC_{STD} - UEC_{EE}$$

This approach assumes that refrigerators are in constant use throughout the year, as was indicated in the 2011 participant surveys.

Refrigerator Adjusted Demand Savings Calculation

The evaluation team estimated adjusted demand savings by modeling the unit demand savings (UDS) as the unit energy savings (UES) divided by 8,760 and adjusted with a peak adjustment demand factor (DF_{REF}). This demand factor, representing the ratio of average peak hourly demand to average overall hourly demand, was determined through the Appliance Recycling Metering Study. This calculation for unit demand savings is shown in Equation A-11.

Equation A-11. Unit Demand Savings for Refrigerators

$$UDS = DF_{REF} \times \frac{UES}{8,760}$$

The evaluation team determined the peak adjustment demand factor from the results of the 2013Appliance Recycling Metering Study. The evaluation team determined the value of DF for Efficient Products using a subset of the metering sample that reflected appliance operation during on-peak versus off-peak operation.[37]

Refrigerators Adjusted Savings Parameters

Definitions and sources of key refrigerator adjusted savings parameters are summarized in Table A-11. The evaluation team calculated annual consumption of program units by matching model numbers in the ENERGY STAR database on a unit-by-unit basis. The average consumption of program units is 476.97 kWh/year, compared to the average standard efficiency of 616.65 kWh/year.

[37] This subset was selected to include only appliances 20 years or younger. This subset was used to approximate Efficient Products demand impacts because appliances of this vintage were manufactured after the Federal Standard that came into effect, initially, in 1993.

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Table A-11. Key Impact Parameters for Refrigerators

Parameter Description	Parameter	Value	Units
Energy Consumption-Standard Unit	UEC_{STD}	616.65	kWh/year
Energy Consumption-Energy-Efficient Unit	UEC_{EE}	476.97	kWh/year
Peak Adjustment Demand Factor	DF_{REF}	1.05	-

A.1.6 Freezer Adjusted Savings Methodology

According to the program logic, energy savings are a function of the incremental energy usage between a freezer that meets the federal standard for energy consumption and the more efficient ENERGY STAR or CEE Tier rated freezer discounted through the program.

Freezer Adjusted Energy Savings Calculation

For these units, full-year unit energy savings (UES) are a function of the rated annual energy usage of a standard unit (UEC_{STD}) minus the rated energy usage of the efficient unit (UEC_{EE}), as shown in Equation A-12.

Equation A-12. Unit Energy Savings for Freezers

$$UES = PUF \times (UEC_{STD} - UEC_{EE})$$

The Part-Use Factor (PUF) is applied because stand-alone freezers may be used to supplement an existing refrigerator-freezer unit, and may not be used all year long. The PUF is calculated as shown in Equation A-13. Participant surveys conducted in 2012 found that all respondents indicated that the freezer was in use all year long; therefore the evaluation team used a PUF of 1.0.

Equation A-13. Part-Use Factor

$$PUF = \frac{\#\ months\ used}{12\ months}$$

Freezer Adjusted Demand Savings Calculation

The evaluation team estimated adjusted demand savings by modeling the unit demand savings (UDS) as the unit energy savings (UES) divided by 8,760[38] and adjusted with a peak adjustment demand factor (DF_{FRZ}). The evaluation team calculated this demand factor, representing the ratio of average peak hourly demand to average overall hourly demand, through the Appliance Recycling Metering Study. This calculation for unit demand savings is shown in Equation A-14.

[38] This is the same method that the evaluation team is using to calculate demand savings for refrigerators and freezers recycled through the Appliance Recycling Program.

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Equation A-14. Unit Demand Savings for Freezers

$$UDS = DF_{FRZ} \times \frac{UES}{8,760}$$

This evaluation team determined the peak adjustment demand factor from the results of the 2013 Appliance Recycling Metering Study. The evaluation team determined the value of DF for Efficient Products using a subset of the metering sample that reflected appliance operation during on-peak versus off-peak operation.[39] This approach assumes that freezers are in constant use during the coincident peak period, which was indicated in the 2012 participant surveys.

Freezer Adjusted Savings Parameters

Definitions and sources of key refrigerator adjusted savings parameters used by the evaluation team are summarized in Table A-12. The annual consumption of program units was determined by matching model numbers in the ENERGY STAR database on a unit-by-unit basis. The average consumption of program units is 549.49 kWh/year, compared to the average consumption for standard units of 614.41 kWh/year.

Table A-12. Key Impact Parameters for Freezers

Parameter Description	Parameter	Value	Units
Energy Consumption- Standard Unit	UEC_{STD}	614.41	kWh/year
Energy Consumption- Energy-Efficient Unit	UEC_{EE}	549.49	kWh/year
Peak Adjustment Demand Factor	DF_{FRZ}	1.28	-
Part Use Factor	PUF	1	-

A.1.7 Electric Water Heater Adjusted Savings Methodology

According to the program logic, savings from electric water heaters are a function of the incremental energy usage between a water heater that meets the federal standard for energy consumption and the more efficient program qualifying water heater (with minimum EF of 0.95) discounted through the program.

[39] This subset was selected to include only appliances 20 years or younger. This subset was used to approximate Efficient Products demand impacts because appliances of this vintage were manufactured after the Federal Standard that came into effect, initially, in 1993.

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Electric Water Heater Adjusted Energy Savings Calculation

The evaluation team calculated adjusted energy savings for electric water heaters as a function of the baseline or standard annual water heater electric consumption, the efficiency of the discounted unit (EF_{EE}), and the minimum federal efficiency standard (EF_{STD}), as shown in Equation A-15.

Equation A-15. Unit Energy Savings for Electric Water Heaters

$$UES = kWh_{STD} \times \left(\frac{EF_{EE} - EF_{STD}}{EF_{EE}}\right)$$

For this equation, the evaluation team used EF_{EE} values from the program tracking database, and EF_{STD} values were calculated based on the volume of the program unit. The evaluation team calculated minimum energy factor (EF_{STD}) for electric water heaters manufactured after January 20, 2004 based on volume, as 0.97 - (0.00132 × Rated Storage Volume in gallons).[40] Total electric water heater adjusted energy savings are the sum of per-unit savings for all units listed in the program tracking database.

Electric Water Heater Adjusted Demand Savings Calculation

The evaluation team calculated adjusted demand savings based on the Unit Energy Savings and the percent of average daily load (based on EPRI load curve models for Hot Water Demand and 2012 participant survey responses) that coincides with peak hours for the AEP Ohio service territory.[41] The evaluation team determined unit demand savings using average unit energy savings, adjusted by the coincidence factor (CF) and the load shape factor (PF), according to Equation A-16.

Equation A-16. Unit Demand Savings for Efficient Electric Water Heaters

$$UDS = CF \times PF \times \frac{\mathbf{UES}}{8,760}$$

In this equation, UES/8,760 represents average hourly hot water heating demand savings for the program water heaters. *CF* is the fraction of the discounted water heaters that are in use coincident with the AEP Ohio summer peak (based on participant survey results). *PF* represents a potential adjustment for summer hourly demand; this factor is based on the assumption that average hourly water heater load, for water heaters in use, varies with both time of day and season. As in 2012, the evaluation team used a PF value of 1.0.

Total demand savings for the electric water heaters purchased through the program were calculated by the evaluation team by multiplying the Unit Demand Savings by the number of units in the program.

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[40] Per 10-CFR-430.32, http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/27

[41] As defined in Lutz et al.1996. Modeling Patterns of Hot Water Use in Households. (EERE/DOE) Retrieved from: http://efficiency.lbl.gov/drupal.files/ees/Modeling%20Patterns%20of%20Hot%20Water%20use%20in%20Households_LBL-37805_Rev.pdf

Electric Water Heater Adjusted Savings Parameters

The sources and definitions of key parameters for electric water heater calculations used by the evaluation team are summarized in Table A-13. The average volume of program units is 41.48 gallons. The evaluation team determined the efficiency of program units by matching model numbers available from secondary sources. The average efficiency of the program units is 0.95, compared to the efficiency of 0.92 for standard electric water heaters of equivalent volume.

Table A-13. Key Impact Parameters for Electric Water Heaters

Parameter Definition	Parameter	Units	Source	Value
Consumption Typical Water Heater	kWh_{STD}	kWh	DOE [(a)]	3,460
Efficiency – Energy-Efficient Unit	EF_{EE}	-	Program tracking data	0.95
Efficiency – Standard Unit	EF_{STD}	-	DOE [(b)]	0.92
Unit Volume	Vol	gal	Program tracking data	41.48
Coincidence Factor	CF	-	2012 Participant surveys	0.28
Seasonal Load Shape Factor	PF	-	Secondary source, if available	1

a. Assumption of 3460 kWh taken from; Residential Water Heaters Technical Support Document for the January 17, 2001, Final Rule Table 9.3.9, p9-34, http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/09.pdf

b. DOE Buildings Energy Data Book Table 7.5.3 Efficiency Standards for Residential Water Heaters

A.1.8 Heat Pump Water Heater Adjusted Savings Methodology

According to the program logic, savings from heat pump water heaters are a function of the incremental energy usage between an electric water heater that meets the federal standard for energy consumption and the more efficient heat pump water heater discounted through the program.

Heat Pump Water Heater Adjusted Energy Savings Calculation

The evaluation team calculated adjusted energy savings for heat pump water heaters as a function of the baseline or standard annual electric water heater electric consumption, the efficiency of the discounted unit (EF_{EE}), the minimum federal efficiency standard (EF_{STD}), as well as cooling and heating energy use impacts (kWh_{cool} and kWh_{heat}), adjusted by the conditioned space factor (CSF) as shown in Equation A-17.

Equation A-17. Unit Energy Savings for Heat Pump Water Heaters

$$\boldsymbol{UES = kWh_{std} \times \left(\frac{EF_{EE} - EF_{STD}}{EF_{EE}}\right) + (kWh_{cool} - kWh_{heat}) * CSF}$$

For this equation, EF_{EE} values are from the program tracking database, and EF_{STD} values were calculated by the evaluation team based on the volume of the program unit. The minimum energy factor (EF_{STD}) for electric water heaters manufactured after January 20, 2004 was calculated based on volume as 0.97 - (0.00132 × Rated Storage Volume in gallons).[42] The other values were derived as noted in Table A-14.

[42] Per 10-CFR-430.32, available at http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/27

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Total heat pump water heater adjusted energy savings are the sum of per-unit savings for all heat pump water heaters listed in the program tracking database.

Heat Pump Water Heater Adjusted Demand Savings Calculation

The evaluation team based adjusted demand savings on the percent of units that were described by 2012 survey participants as being kept in heat pump mode and a per-unit demand savings constant. As shown in Equation A-18, unit demand savings in heat pump mode at peak are assumed to be 0.17 kW, estimated from a FEMP report that presented results from field-testing various heat pump water heater model prototypes.[43] The Heat Pump Factor (HPF) is the portion of participants who stated that their heat pump water heater is in heat pump mode. The evaluation team used the average value for HPF determined from the 2012 participant survey, 0.67.

Equation A-18. Unit Demand Savings for Heat Pump Water Heaters

$$\boldsymbol{UDS = HPF \times (0.17\text{kW})}$$

Heat Pump Water Heater Adjusted Savings Parameters

The sources and definitions of key parameters for the heat pump water heater calculations are summarized in Table A-14. The average volume of program units was 50.39 gallons. The evaluation team determined the efficiency of program units by matching model numbers in the ENERGY STAR database. The average efficiency of the program units was 2.48, compared to the efficiency of 0.90 for standard electric water heaters of equivalent volume.

[43] Based on a chart showing summer weekday average electrical demand on page 10 of FEMP Study "Field Testing of Pre-Production Prototype Residential Heat Pump Water Heaters" (http://www1.eere.energy.gov/femp/pdfs/tir_heatpump.pdf). Using data points from the chart, the average delta kW in heat pump mode during the peak hours compared to resistance mode is 0.17kW.

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Table A-14. Key Impact Parameters for Heat Pump Water Heaters

Parameter Definition	Parameter	Units	Source	Value
Consumption Typical Water Heater	kWh_{STD}	kWh	DOE [(a)]	3,460
Space heating loss from conversion of heat in home to water heat	kWh_{heat}	kWh	DOE and Energy Center of Wisconsin [(b)]	346.4
Cooling savings from conversion of heat in home to water heat	kWh_{cool}	kWh	DOE and Energy Center of Wisconsin [(c)]	180
Efficiency – Energy-Efficient Unit	EF_{EE}	-	Program tracking data	2.48
Efficiency – Standard Unit	EF_{std}	-	DOE [(d)]	0.9
Unit Volume	Vol	gal	Program tracking data	50.39
Heat Pump Factor	HPF	-	2012 Participant Surveys	0.67
Conditioned Space Factor	CSF	-	2012 Participant Surveys	0.65

a. Assumption of 3,460 kWh taken from: Residential Water Heaters Technical Support Document for the January 17, 2001, Final Rule Table 9.3.9, p9-34, http://www1.eere.energy.gov/buildings/appliance_standards/residential/pdfs/09.pdf

b. Assumption of 1,577 kWh for electric home heating and 779 kWh for heat pump heating determined by calculating the MMBtu removed from the air, applying the REMRate determined percentage (35%) of lighting savings that result in reduced cooling loads (lighting is used as a proxy for hot water heating since load shapes suggest their seasonal usage patterns are similar), assuming a SEER 11 central AC unit, multiplying by 64% to adjust for the percentage of OH homes having cooling (East North Central census division from Energy Information Administration, 2005 Residential Energy Consumption Survey; http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/hc6airconditioningchar/pdf/tablehc12.6.pdf), and applying the Discretionary Usage Adjustment of 0.75% (Based on Energy Center of Wisconsin, May 2008 metering study; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research", p. 31.)

c. Assumption of 180 kWh determined by calculating the MMBtu removed from the air, as above, applying the REMRate determined percentage (45%) of lighting savings that result in increased heating loads, converting to kWh and dividing by efficiency of heating system (1.0 for electric resistance, 2.0 for heat pump).

d. DOE Buildings Energy Data Book Table 7.5.3 Efficiency Standards for Residential Water Heaters

A.1.9 Television Adjusted Savings Methodology

The television measure program theory incentivizes participants to buy energy efficient televisions that exceed the ENERGY STAR specification for televisions. Therefore, the television adjusted energy savings are a function of the difference in unit energy consumption (UEC) of ENERGY STAR televisions that qualify for the program and a baseline available television. However, determination of a "baseline available television" is complicated by the lack of a Federal Television Standard and the high market penetration of ENERGY STAR qualified units.

The Efficient Products television rebate came into effect on the same date as the ENERGY STAR Version 6.0 standard, on June 1, 2013. Therefore, the evaluation team initially planned to use the energy consumption of a television that meets the previous version 5.3 of ENERGY STAR levels as a baseline. However, the availability of ENERGY STAR label products is typically very high (for example, 84 percent of television shipments in 2012 qualified as Version 5.3 ENERGY STAR, which was the current standard then) and the energy consumption of televisions is continually decreasing.[44] Therefore, the evaluation team used the version baseline corresponding to individual units, which is a data field in ENERGY STAR tracking called "Maximum On Mode Power for Qualification (Watts)." The evaluation team calculated adjusted savings based on this baseline wattage from ENERGY STAR tracking data,

[44] "ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2012 Summary," http://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2012_USD_Summary_Report.pdf

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which presents the baseline energy use for each individual model at time of manufacture.[45] Where program televisions exceed the current ENERGY STAR Version 6.0 efficiency, the savings will be larger.

Television Adjusted Energy Savings Calculation

The evaluation team calculated savings from units incentivized through the program as the difference in annual unit energy consumption (UEC) of program televisions and a baseline unit, given current and previous ENERGY STAR standards. This savings calculation for the difference between the unit energy consumption of standard and program televisions is shown in Equation A-19.

Equation A-19. Unit Energy Savings for Televisions

$$UES = UEC_{STD} - UEC_{PROG}$$

The annual unit energy consumption of the baseline television (UEC_{STD}) and the program television (UEC_{PROG}) were calculated by the evaluation team using the following Equation A-20 and Equation A-21. The division by 1,000 converts from watt- to kilowatt-hours.

Equation A-20. Unit Energy Consumption for Standard Televisions

$$UEC_{STD} = 365 * \frac{(HOU_{standby} * Watt_{standby,STD}) + (HOU_{active} * Watt_{active,STD})}{1000}$$

Equation A-21. Unit Energy Consumption for Program Televisions

$$UEC_{PROG} = 365 * \frac{(HOU_{standby} * Watt_{standby,PROG}) + (HOU_{active} * Watt_{active,PROG})}{1000}$$

The total television adjusted energy savings are the sum of per-unit annual savings for all televisions listed in the program tracking database.

Television Adjusted Demand Savings Calculation

The evaluation team calculated adjusted demand savings based on the unit energy savings and the coincidence factor (CF), which represents the percentage of each television's operating hours that coincide with the AEP Ohio summer peak, as shown in Equation A-22.

Equation A-22. Unit Demand Savings for Televisions

$$UDS = (Watt_{active,STD} - Watt_{active,PROG}) * CF + (Watt_{standby,STD} - Watt_{standby,PROG}) * (1 - CF)$$

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[45] *Maximum On Mode Power for Qualification (Watts)* is the maximum energy consumption for an ENERGY STAR qualified unit, defined as "the maximum On Mode power requirement for a model with the given Screen Area to qualify for ENERGY STAR. The Power Consumption in On Mode cannot exceed this value" (https://data.energystar.gov/Government/ENERGY-STAR-Certified-Televisions/n6gj-5es2). This value was used as a baseline for each product in the ENERGY STAR database to reflect the high penetration of ENERGY STAR qualified units in the television market. Savings are realized when televisions exceed the ENERGY STAR version in place at time of manufacture.

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The evaluation team calculated total television demand savings as the sum of the per-unit demand savings for all televisions listed in the program tracking database.

Television Adjusted Savings Parameters

Key adjusted impact parameters for televisions are summarized in Table A-15.

Table A-15. Key Impact Parameters for Televisions

Parameter Definition	Parameter	Units/ Value	Source	Value
Wattage consumption in "standby" mode for standard television	$Watt_{standby,STD}$	Watts	ENERGY STAR Qualification; value of 1 Watt is used because 1 Watt is the maximum standby energy consumption threshold	1
Wattage consumption in "active" mode for standard television	$Watt_{active,STD}$	Watts	ENERGY STAR tracking data "Maximum On Mode Power for Qualification" [(a),]	62.21
Wattage consumption in "standby" mode for program television	$Watt_{standby,PROG}$	Watts	Program Tracking data match to ENERGY STAR Qualifying Version 6.0 (or 5.3) Television List	0.19
Wattage consumption in "active" mode for program television	$Watt_{active,PROG}$	Watts	Program Tracking data match to ENERGY STAR Qualifying Version 6.0 (or 5.3) Television List	43.49
Hours of Use in "standby"	$HOU_{standby}$	19	ENERGY STAR uses 19 hours as the assumed hours of standby operation	19
Hours of Use in "active" mode	HOU_{active}	5	ENERGY STAR uses 5 hours as the assumed hours of active mode	5
Coincidence Factor	CF	0.169	Adapted from Pacific Gas and Electric television Workpaper [(a)]	0.169

a. PG&E Work Paper PGECOAPP104 Energy Efficient Televisions Revision # 5. August 24. 2012. [46]

Using these values, the evaluation team calculated the average consumption of program units at 301.92 kWh/year, while the equivalent size baseline unit consumption was 433.28 kWh/year.

A.2 Adjusted Impact Savings Findings

This section presents the adjusted impact energy and demand findings, determined by the evaluation team using the approaches and parameter values discussed in the previous section.

[46] Pacific Gas and Electric's television work paper uses Nielsen data for television viewing periods to calculate the percentage of television operation hours that are likely to overlap with PG&E's summer peak demand period of 2-5pm. The evaluation team made the assumption that usage patterns in the AEP Ohio service territory are similar to those in the PG&E service territory. This enabled the evaluation team to use the same Nielsen data as PG&E and modify the summer peak demand period assumptions to match the AEP Ohio peak period of 3-6pm. The evaluation team also used ENERGY STAR estimate of 5 hours per day instead of the 5.15 hours used by PG&E. Although the 5 hours per day assumption used by the evaluation team is slightly less than the PG&E assumption of 5.15 hours, the later peak period for AEP Ohio (3-6 pm) compared to the PG&E peak period (2-5 pm) results in a coincidence factor of 0.169 for AEP Ohio, somewhat higher than the coincidence factor of 0.153 found in the PG&E work paper.

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A.2.1 Overall Adjusted Savings Results

The overall adjusted energy and demand savings for the program, calculated by the evaluation team using the adjusted calculation methods presented in the previous sections, are summarized in Table A-16. Lighting products accounted for 95 percent and 94 percent of adjusted energy and demand savings, respectively.

Table A-16. Overall Adjusted Energy and Demand Savings

Product	Number of Units	Total Adjusted Energy Savings (MWh)	Total Adjusted Demand Savings (MW)	Percent of Adjusted Energy Savings	Percent of Adjusted Demand Savings
Lighting	4,447,576	193,955	19.18	95.2%	93.6%
Appliances	42,100	9,722	1.31	4.8%	6.4%
Program Total	**4,489,676**	**203,677**	**20.49**	**100.0%**	**100.0%**

Lighting Adjusted Savings Results

The adjusted energy savings for the 2013 program lighting products are summarized in Table A-17. Like *ex ante* and audited savings, almost all of the program's adjusted energy savings for lighting came from program CFLs. Carryover savings are not shown, but are instead reported separately in Table A-19 below, to show the separate contribution of lighting products purchased in previous years that the evaluation team assumes are installed in 2013 and 2014.

Table A-17. Lighting Adjusted Energy Savings

Lighting Product	Number of Units	Total Adjusted Energy Savings (MWh)	Average Per-Unit Energy Savings (kWh)	Percent of Savings
CFLs	4,341,984	189,227	43.55	97.6%
LEDs	80,846	4,395	54.36	2.3%
LED Holiday	24,746	282	11.41	0.1%
Total	**4,447,576**	**193,955**	**43.56**	**100.0%**

The adjusted demand savings for the 2013 program lighting products are summarized in Table A-18. Like *ex ante* and audited savings, almost all of the program's adjusted demand savings for lighting came from program CFLs. Because of the pattern of operation, there are no demand savings from LED holiday lights.

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Table A-18. Lighting Adjusted Demand Savings

Lighting Product	Number of Units	Total Adjusted Demand Savings (MW)	Average Per-Unit Demand Savings (kW)	Percent of Savings
CFLs	4,341,984	18.74	0.0043	97.7%
LEDs	80,846	0.44	0.0054	2.3%
LED Holiday Lights	24,746	-	-	0.0%
Total	**4,447,576**	**19.18**	**0.0043**	**100.0%**

Carryover Savings Results for Unattributed Program Lighting from 2011 and 2012

Lighting products from 2011 and 2012 that were assumed to be installed in future years were all counted by the evaluation team in 2013, as explained in the section above, "Lighting from 2011 and 2012." Using the approach outlined in Table A-2, the evaluation team applied the watt difference ($Watts_{STD} – Watt_{PROG}$) from 2013 to the bulbs from 2011 and 2012 that are being counted in 2013. We counted more than 1 million light bulbs as "carryover," with resulting savings values presented in Table A-19.

Table A-19. Carryover from 2011 and 2012 Lighting Products for Adjusted Savings

	PY 2011, installed 2013		PY 2012, installed 2013		PY 2012, installed 2014		Total Carryover
Lighting Type	CFL	LED	CFL	LED	CFL	LED	-
Total Units	3,522,858	7,221	4,293,125	27,172	4,293,125	27,172	12,170,673
Proportion Installed	0.087	0.087	0.087	0.087	0.08	0.08	0.084
Number Installed	304,727	625	371,355	2,350	342,895	2,170	1,024,122
Watt Difference	46.28	53.12	46.28	53.12	46.28	53.12	-
HOU	985.5	985.5	985.5	985.5	985.5	985.5	-
CF	0.087	0.087	0.087	0.087	0.087	0.087	-
WHF_E	1.07	1.07	1.07	1.07	1.07	1.07	1.07
WHF_D	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Per-Unit Energy Savings for 2013 (kWh)	48.80	56.01	48.80	56.01	48.80	56.01	48.84
Per-Unit Demand Savings for 2013 (kW)	0.005	0.006	0.005	0.006	0.005	0.006	0.005
Total Energy Savings (MWh)	**14,871**	**35**	**18,123**	**132**	**16,734**	**122**	**50,016**
Total Demand Savings (MW)	**1.472**	**0.003**	**1.794**	**0.013**	**1.657**	**0.012**	**4.95**

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Appliance Adjusted Savings Results

The adjusted energy savings for the 2013 program appliances are summarized in Table A-20. The majority of savings for appliances (63.8 percent) came from clothes washers. Clothes washers have both the highest number of rebated units as well as the second highest calculated per-unit savings.

Table A-20. Appliance Adjusted Energy Savings

Appliance Type	Number of Qualified Units	Total Adjusted Energy Savings (MWh)	Percent of Savings	Per-Unit Energy Savings
Clothes Washers	18,151	6,199	63.8%	342
Refrigerators	17,905	2,501	25.7%	140
Heat Pump Water Heaters	256	536	5.5%	2,094
Televisions	1,820	239	2.5%	131
Freezers	2,299	149	1.5%	65
Dehumidifiers	1,581	87	0.9%	55
Electric Water Heaters	88	11	0.1%	125
Total	**42,100**	**9,722**	**100.0%**	**-**

The adjusted demand savings for the 2013 program appliances are summarized in Table A-21. As is the case for energy savings, the majority of demand savings for appliances (67.2 percent) came from clothes washers. Clothes washers have both the highest number of rebated units as well as the second highest calculated per-unit savings.

Table A-21. Appliance Adjusted Demand Savings

Appliance Type	Number of Qualified Units	Total Adjusted Demand Savings (MW)	Percent of Savings	Per-Unit Demand Savings (kW)
Clothes Washers	18,151	0.88	67.2%	0.05
Refrigerators	17,905	0.30	22.9%	0.02
Dehumidifiers	1,581	0.07	5.3%	0.04
Heat Pump Water Heaters	256	0.03	2.3%	0.12
Freezers	2,299	0.02	1.5%	0.01
Televisions	1,820	0.01	0.8%	0.01
Electric Water Heaters	88	< 0.01	< 0.1%	0.01
Total	**42,100**	**1.31**	**100.0%**	**-**

Relative appliance overall adjusted energy and demand savings are represented in Figure A-1, which reflects the large contribution of clothes washers to appliance savings.

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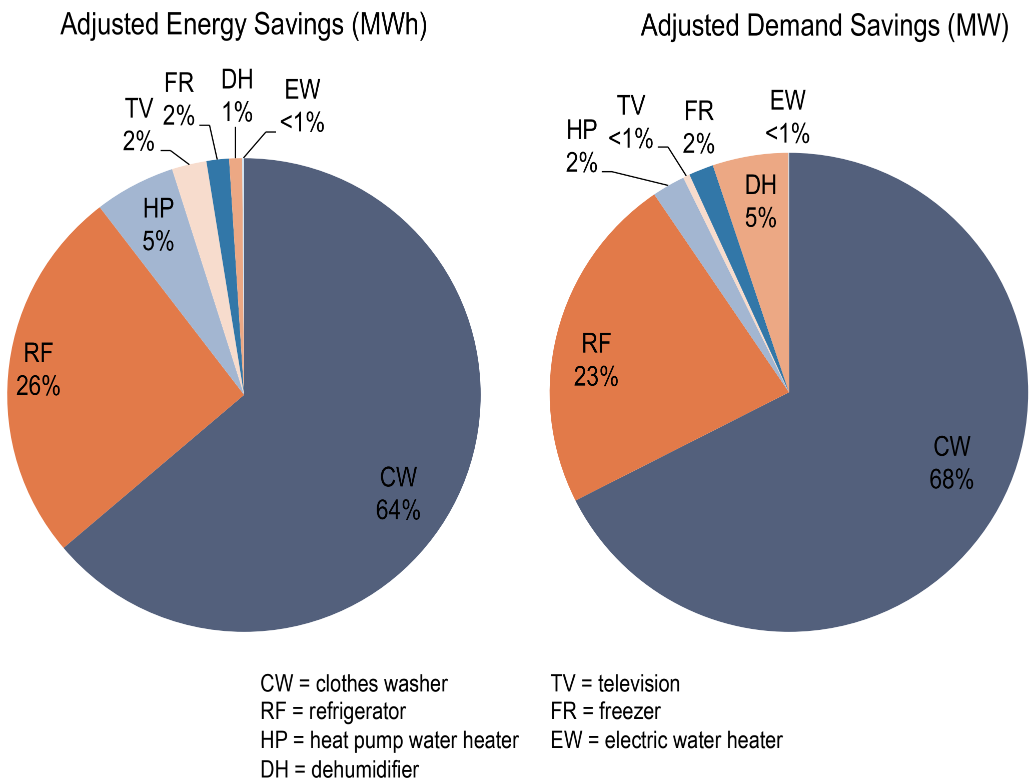
Figure A-1. Relative Adjusted Savings, Appliances



A.2.2 Adjusted Savings Realizations Rates

Realization rates for the adjusted energy and demand savings are presented in Table A-22. Overall, the realization rate for energy was 1.00, while the realization rate for demand was 0.83. The energy and demand realization rates for lighting products were 0.99 and 0.82, respectively. The overall realization rates for appliances were both greater than 1.0. For lighting, the reasons for these differences are due the different approaches, discussed in more detail below. For appliances, the differences are primarily due to the more exact model-matching approach used by the evaluation team and the use of different parameters, particularly for clothes washers. These differences are explained in more detail below.

Table A-22. Adjusted Savings Realization Rates

	Ex Ante Claimed Savings		Adjusted Savings		Realization Rates	
Product Category	MWh	MW	MWh	MW	Energy	Demand
Lighting Products	196,602	23.48	193,955	19.18	0.99	0.82
Appliances	7,521	1.19	9,722	1.31	1.29	1.10
Total	**204,123**	**24.67**	**203,677**	**20.49**	**1.00**	**0.83**

The evaluation team calculated adjusted savings realization rates for lighting and products separately. Table A-23 presents lighting realization rates. Differences in *ex ante* and adjusted savings are due to differences in savings methodology and parameter values. Where the *ex ante* savings calculations use the TRM delta watts multiplier for CFLs, adjusted savings use a watt difference calculation. This watt difference approach is based on lumen equivalency, discussed in the lighting adjusted savings parameters section. For LEDs, the adjusted savings approach uses a discounted installation rate of 97.1%, rather than the 100% used in *ex ante* savings. Additionally, for both CFLs and LEDs, there are differences in hours of use and coincidence factor parameter values, with the adjusted values being slightly lower than the TRM values. The evaluation team also accounted for the diminishing availability of 75W incandescents over the course of the year.[47]

Table A-23. Adjusted Savings Realization Rates by Lighting Product

Lighting Product	Ex- Ante Claimed Savings		Adjusted Savings		Realization Rates	
	MW	MWh	MWh	MW	Energy	Demand
CFLs	191,173	22.86	189,277	18.74	0.99	0.82
LEDs	5,218	0.62	4,395	0.44	0.84	0.71
Holiday Lights	211	-	282	-	1.34	-
Total	**196,602**	**23.48**	**193,955**	**19.18**	**0.99**	**0.82**

Table A-24 presents the adjusted savings realization rates for different appliances. A brief explanation of each of these appliance realization rates is provided below the table.

Table A-24. Adjusted Savings Realization Rates by Appliance Type

Appliance	*Ex Ante* Claimed Savings		Adjusted Savings		Realization Rates	
	MWh	MW	MWh	MW	Energy	Demand
Clothes Washers	4,103	0.58	6,199	0.88	1.51	1.52
Refrigerators	2,302	0.41	2,501	0.30	1.09	0.73
Heat Pump Water Heaters	433	0.06	536	0.02	1.24	0.33
Dehumidifiers	327	0.07	87	0.01	0.27	0.14
Televisions	186	0.05	239	0.07	1.28	1.40
Freezers	154	0.02	149	0.03	0.97	1.50
Electric Water Heaters	16	< 0.01	11	< 0.01	0.69	0.28
Total Appliances	**7,521**	**1.19**	**9,722**	**1.31**	**1.29**	**1.10**

[47] Note that a currently ongoing metering study in the AEP Ohio service territory will provide more information on lighting hours of use and coincidence factors for future evaluation years.

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The adjusted energy and demand savings vary by appliance based on the specific evaluation calculations for each:

- **Clothes washers-** the difference between *ex ante* and adjusted values is due to the use of model number matching in adjusted savings. This model-matching approach resulted in larger capacity and higher efficiency (MEF) for efficient products compared to the parameters in the Draft Ohio TRM approach. Additionally, the adjusted savings cycles/year parameter was slightly higher than the value used in the TRM.
- **Refrigerators and freezers-** the difference is due to the evaluation's use of model number matching in adjusted savings calculations. Additionally, differences in demand savings are due to the evaluation team's use of peak demand factors.
- **Heat pump water heaters-** the difference is also due in part to the evaluation's use of model number matching, which resulted in higher program unit efficiency than that in the TRM. Additionally the evaluation team used impact parameters (CF, HPF) from the 2011 Efficient Products participant survey, which differ from the values used in the Draft Ohio TRM.
- **Dehumidifiers-** the difference is due to both the evaluation's use of model number matching as well as the use of the newer standard for dehumidifiers in adjusted savings, compared to the Draft Ohio TRM. Additionally, the adjusted savings hours of use parameter for dehumidifiers was different than the value used in the TRM approach.
- **Televisions-** the difference, again, is mostly due to the evaluation's use of model number matching as well as the use of baseline from this ENERGY STAR model list. AEP Ohio applied *ex ante* values from the 2012-2014 EE/PDR Plan.
- **Electric water heaters** – the difference is also due to the evaluation's use of program model number matching. Like televisions, AEP Ohio applied *ex ante* values from the 2012-2014 EE/PDR Plan.

A.3 Adjusted Impact Evaluation Conclusions and Recommendations

The Draft Ohio TRM should be updated. Some federal standards have been updated since the TRM was drafted in 2010. Additionally, the TRM does not include savings for some products included in the Efficient Products Program. The evaluation team recommends that an updated version of the Ohio TRM include the following changes.

- **Correct the clothes washer coincidence factor error.** The TRM currently has an inconsistency in the coincidence factor declared for clothes washers. Two separate values, of 0.033 and 0.045, are cited for the coincidence factor (CF) parameter. The evaluation team determined that the intended value was 0.045 and used this in calculating audited savings. AEP Ohio used the same value in calculating *ex ante* savings. To avoid ambiguity, this issue should be resolved with a revision to the text of the TRM.
- **Update dehumidifier values to current Federal Standard and ENERGY STAR qualifying efficiencies.** The current TRM values rely on 2006 Federal Standards and ENERGY STAR qualifying values for unit capacity (pints/day). These values should be updated to reflect the

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current version of both the Federal Standard and ENERGY STAR qualification from 2012.[48] The update could include the current tables or remain current by referencing the most current version.

- **Consider including point-of sale freezers and use separate peak demand factors for refrigerators and freezers.** The Draft Ohio TRM does not currently include savings values for point-of-sale freezers. For refrigerators, the TRM includes a Temperature Adjustment Factor of 1.30. This value is applied to determine *ex ante* values for both refrigerators and freezers. Based on the results of the Appliance Recycling Metering study, separate adjustment factors should be considered for refrigerators and freezers. These were found to be 1.05 and 1.28, respectively. The adjustment factors are different because of both location and temperature differential. Freezers are more frequently placed in unconditioned spaces, while many refrigerators will be placed in conditioned spaces. The temperature differential between the inside and outside of the unit is higher for a freezer than for a refrigerator because the average cabinet temperature of freezers is lower.
- **Adopt lumen equivalency savings calculation approach for CFLs.** The current TRM savings approach for CFLs is based on a delta-watts multiplier approach. This multiplier is applied to program wattage in energy and demand savings equations. However, this method is not readily transparent and is based on program-specific data that may not be universally applicable to different program years and lighting product distributions. Additionally, this savings calculation approach for CFLs does not follow the same savings logic as for other products in the TRM that rely on a direct comparison of the energy consumption and demand of a standard unit and an energy-efficient unit with equivalent performance. Furthermore, the Uniform Methods Project recommends the use of a lumen equivalency approach, for its consistency with EISA and use of lumen categories in manufacturer considerations.[49] The evaluation team used this lumen equivalency approach in calculating adjusted savings. This approach is more transparent when accounting for impacts of EISA, is in keeping with the savings theory for other efficient products (comparison of standard to efficient unit based on performance characteristics) and will be useful as lumens increasingly become adopted as the basis for lighting purchasing decisions.
- **Include LED deemed savings values or standardized calculation approach.** The evaluation team recommends the inclusion of LEDs in the TRM. This would help standardize savings approaches and encourage exploration of the differentiation between savings parameters for LEDs compared to other lighting products. A LED specific approach in the TRM could provide information on installation rate, hours of use, and coincidence factor that are specific to LEDs.
- **Consider television deemed savings values or a recommended approach.** Television savings

[48] Federal Standard, available at: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/55; Energy Star Criteria, available at: http://www.energystar.gov/index.cfm?c=dehumid.pr_crit_dehumidifiers

[49] "[T]he Residential Lighting Evaluation Protocol recommends using a lumen equivalency approach to estimate delta watts for conditions where the baseline wattage cannot be collected by the program implementation contractor at the time of measure installation. This approach is recommended because (1) it provides consistency with the EISA requirements and (2) most manufacturers' rated baseline wattage is already based on similar lumen categories," Chapter 6 *Chapter 6: Residential Lighting Evaluation Protocol*, Section 4.4 *Recommended Approach*

calculations are complicated by the lack of a Federal Standard, which serves as the baseline product efficiency for other appliances such as clothes washers and dehumidifiers. The inclusion of a recommended savings value or savings calculation approach in the TRM could help provide consistency in how television savings are calculated for the Efficient Products and similar programs.

It is not clear if the interactive effects used in the Draft Ohio TRM are accurate for AEP Ohio customers. While interactive effects are important to consider for lighting energy savings, the current values in the TRM may overstate savings because heating effects were not considered. Heating effects decrease savings because more space heating is required when efficient lighting is used. In addition, the TRM does not show how values for average cooling system efficiency and decrease in cooling load are related to the stock of Ohio homes and lighting. Furthermore, the TRM values do not consider how interactive effects values may be different for CFLs and LEDs, based on the cooling savings value. LEDs have higher lumen efficacy than CFLs, thus even lower heat gain. Because these interactive effects factors have a large influence on savings estimates, it may be worthwhile to determine interactive effects specific to AEP Ohio customers for different lighting types.

- **The evaluation team recommends conducting primary research with AEP Ohio customers to verify the interactive effects for lighting.** These values should be verified and updated, as appropriate, based on research on central air conditioning use and cooling savings specific to AEP Ohio customers. Updated modeling of interactive savings effects can help determine the most appropriate adjustment to lighting savings values. A modeling study could help determine if the savings value of 35 percent is appropriate for cooling savings and what value, if any, should be used for a heating loss value. Alternatively, the sources used to inform these factors could be updated with secondary data, when available (such as updating regularly with new versions of the RECS).

A.4 Additional Process Evaluation Results Detail

This section contains additional results from the process evaluation, including survey respondents' reported satisfaction with AEP Ohio, as well as their awareness of and response to EISA.

A.4.1 Satisfaction with AEP Ohio

Satisfaction with AEP Ohio as a service provider was high among survey respondents, with 90 percent reporting being at least somewhat satisfied. Table A-25 below outlines all responses to this question.

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Table A-25. Satisfaction with AEP Ohio as Service Provider

Satisfaction	Number of Respondents	Percent of Respondents
Very satisfied	91	66.9%
Somewhat satisfied	32	23.5%
Neither satisfied nor dissatisfied	8	5.9%
Somewhat dissatisfied	2	1.5%
Very dissatisfied	3	2.2%
Total	**136**	**100.0%**

All survey respondents were invited to provide reasons for their satisfaction rating of AEP Ohio. The respondents with positive attitudes toward AEP Ohio provided the following responses:

- 29 percent said that AEP Ohio electric service is dependable and reliable (n = 40).
- 20 percent were satisfied because they never encountered any issues with the company or its service and had no reason to be less than satisfied (n = 27).
- 15 percent mentioned positive experiences with customer service representatives (n = 21).
- 10 percent mentioned that AEP Ohio deals with issues such as outages quickly (n = 13).
- 9 percent mentioned that the electricity is reasonably priced (n = 12).

Reasons provided for dissatisfaction with AEP Ohio included: service is too expensive and rates are too high (10 percent, n = 14), issues with service interruptions (less than 1 percent, n = 1), and unpleasant experiences with customer service representatives (less than 1 percent, n = 1).

Despite the fact that some respondents provided critical feedback on AEP Ohio's service, opinions were positive overall, and many respondents reported feeling more favorable of AEP Ohio as a result of the program. In fact, 74 percent of respondents reported that they felt more positively of AEP Ohio because of the lighting discount. The remaining 26 percent reported feeling no different toward AEP Ohio; no participants reported feeling less favorable toward AEP Ohio, which suggests an overall net positive effect of the program on customers' opinions of AEP Ohio.

A.4.2 EISA Awareness and Resulting Purchasing Intentions

The intercept survey captured customer awareness of EISA regulations, as well as their reported past and future purchasing decisions in light of the decreasing availability of standard incandescent light bulbs.

Even though a majority of the respondents surveyed (60 percent) reported being aware of the EISA standards for light bulbs, only 52 percent reported being at least somewhat familiar with the standards. Figure A-2 provides a breakdown of reported level of familiarity with the lighting standards among respondents.

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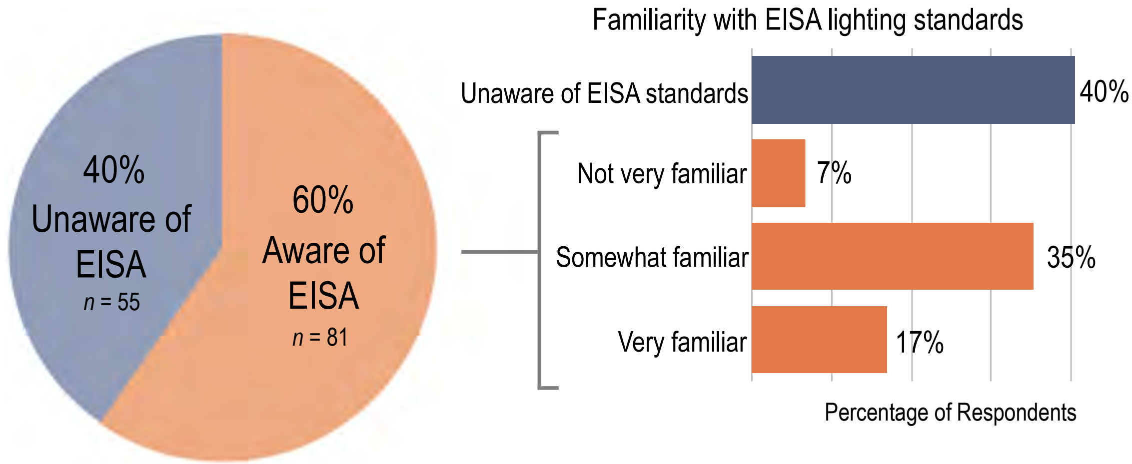
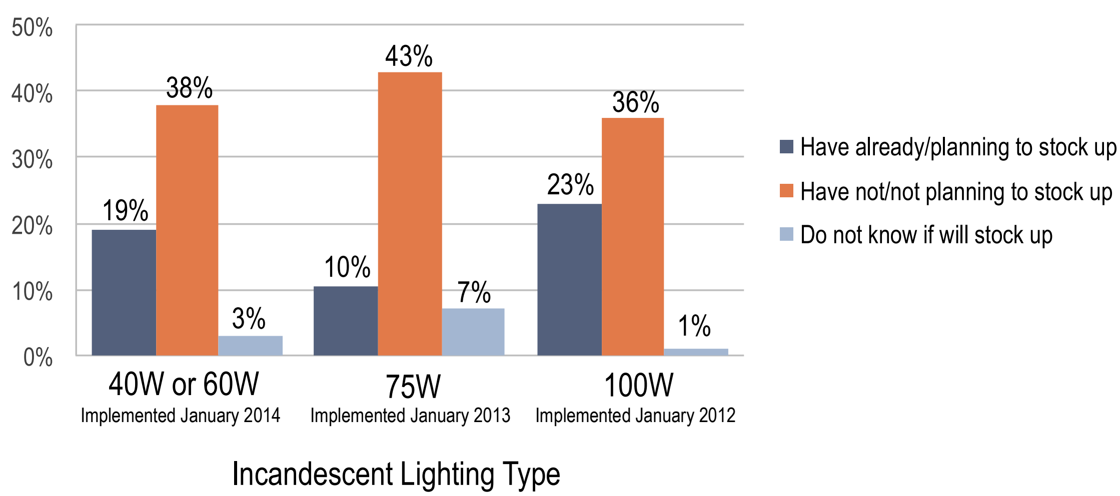
Figure A-2. Customer Awareness and Familiarity with EISA Standards for Light Bulbs (n = 136)



Note: The 4 respondents who reported "Don't know" to awareness of EISA lighting standards are included in the "unaware" group; the one respondent who reported "Don't know" to level of familiarity is not included in the bar chart.

Respondents were also asked to report on their purchasing decisions related to incandescent lighting impacted by EISA. Figure A-3 below provides lighting participants' responses related to 100W, 75W and 40W/60W incandescent light bulbs. Nearly a quarter (23 percent) of respondents aware of EISA standards have already stocked up on 100W incandescent light bulbs, while one fifth (19 percent) are planning to stock up on 40W or 60W light bulbs; only 10 percent of EISA-aware respondents reported intentions to stock up on 75W light bulbs. In total, 28 percent (n = 38) of all respondents reported having already or planning to stock up on incandescent varieties that are being phased out as a result of EISA.

Figure A-3. EISA-Aware Respondents' Intentions to Purchase EISA-Impacted Incandescents (n = 81)



Note. The 55 respondents who did not report being aware of EISA (51 "unaware" and 4 "don't know" if aware) were not asked this question. For the question regarding 100W incandescent lighting, respondents were asked only if they had already stocked up, not if they planned to in the future.

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Finally, respondents reported what type of lighting they will likely purchase the next time they need to buy a 100W or 75W incandescent light bulb, now that availability is increasingly limited. As shown in Table A-26, three out of four respondents reported that they plan to purchase CFLs with equivalent light in the future, in lieu of 75W or 100W incandescent light bulbs. Only four percent of respondents reported that they will purchase either lower wattage standard incandescent or equivalent light halogen lighting, which points to a decided preference among participants to purchase energy efficient lighting.

Table A-26. Purchasing Preference Instead of 75W or 100W Lighting

Alternative Light Bulb Type	Number of Respondents	Percentage of Respondents
Equivalent light CFL	101	74.3%
Equivalent light LED	21	15.4%
Lower wattage standard incandescent	3	2.2%
Equivalent light halogen light bulb	2	1.5%
Don't know	9	6.6%
Total	**136**	**100%**

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A.5 Data Collection Instruments

A.5.1 AEP Ohio Efficient Products In-store Intercept Survey

PRIOR TO THE START OF A SURVEY PLEASE FILL OUT:
QA1. Field Staff Name: ____
QA2. Date: ____
QA3. Time: ____
QA3. Store Name: ____
QA4. Store City: ____

INTRO1. Hi, my name is <INTERVIEWER>. On behalf of AEP Ohio, I am conducting a survey about lighting purchases today. Do you have a few minutes to answer some questions?

SECTION A: BULB INVENTORY

A1. Do you mind if I take a look at your lighting selections?

[SURVEYOR: RECORD CUSTOMER LIGHTING PURCHASES]
[COLLECT UP TO 5 DIFFERENT BULB TYPES (i.e., ENTIRELY DIFFERENT PACKAGES)]
[MULTIPLE PACKAGES OF THE SAME BULB TYPE SHOULD BE ENTERED AS A SINGLE LINE WITH "# OF PACKS" ENTERED APPROPRIATELY.]
[IF MORE THAN 5 DIFFERENT BULB TYPES (i.e., ENTIRELY DIFFERENT PACKAGES) ARE PRESENT IN CUSTOMER CART, ENTER PROGRAM CFLs AND LEDs FIRST]

Pkg#	Bulb Type	# of Packs	Bulbs per pack	Watts	Lumens	AEP Discount?	Base Type	Shape	Dimmable CFL? [SHOW ONLY IF A1B=CFL]	3-way CFL? [SHOW ONLY IF A1B=CFL]
A1a	*A1b*	*A1c*	*A1d*	*A1e*	*A1f*	*A1g*	*A1h*	*A1i*	*A1j*	*A1k*
#	*CFL or LED*	*#*	*#*	*#*	*> 2600 1490 - 2600 1050 - 1489 750 - 1049 310 - 749 < 310*	*Yes No*	*Standard / GU24 / candelabra base*	*A-lamp / Flood (Reflector) / Regular Spiral / Globe / Candelabra / Torpedo*	*Yes No*	*Yes No*
Ex.	CFL	2	4	13 w	750 - 1049	Yes	Standard	Regular Spiral	No	No
1										
2										
3										
4										
5	…	…	…	…		…		…		

CREATE VARS TO CLASSIFY BULB PURCHASES:
If A1A(i) = CFL then BULBTYPE1(i) = CFL
If A1A(i) = LED then BULBTYPE1(i) = LED

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If BULBTYPE(i) = CFL and A1H(i) = "Standard" and A1i = "Regular Spiral" and A1j ≠ 1 and A1k ≠ 1 then CFLREG(i) = 1.

If BULBTYPE(i) = CFL and A1H(i) ≠ "Standard" or A1i ≠ "Regular Spiral" or A1j = 1 or A1k = 1 then CFLSPEC(i) = 1.

If A1G(i) = Yes then PGMBULB(i) = 1

IF CFLREG(i) = 1 AND PGMBULB(i) = YES, PROGCFLREG(i) = 1
IF CFLSPEC(i) = 1 AND PGMBULB(i) = YES, PROGCFLSPEC(i) = 1
IF BULBTYPE(i) = LED AND PGMBULB(i) = YES, PROGLED(i) = 1

A2. Are you planning on installing the bulbs you are purchasing today at your home or in a business location?

1. Home
2. Business
3. Both
8. Don't know **[TERMINATE]**
9. Refused **[TERMINATE]**

[ASK IF A2 = 1 or 3]
A3.Home Who is your electricity provider for your home?

1. AEP Ohio (includes Ohio Power and Columbus Southern Power)
2. Another company in Ohio (Specify)______
3. Another company outside of Ohio (Specify)______
8. Don't know
9. Refused

[ASK IF A2 = 2 or 3]
A3.Bus Who is your electricity provider for the business where these bulbs will be installed?

1. AEP Ohio (includes Ohio Power and Columbus Southern Power)
2. Another company in Ohio (Specify)______
3. Another company outside of Ohio (Specify)______
8. Don't know
9. Refused

[IF A3.Home = 2, 3, 8, or 9 **AND A3.Bus** = 2, 3, 8, or 9**, TERMINATE]**

Qual. I have some additional questions. For your time, we are providing a $25 gift card. May I continue?

1. Yes
2. No **[TERMINATE]**

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<u>SECTION B: BULB INSTALLATION AND USAGE</u>

[ASK IF ANY CFLREG(i) = 1 AND A2 = 1 or 3]

B1.CFLReg.H **For the rest of this survey, the term "regular CFL" will refer to the traditional corkscrew shaped CFLs you are purchasing.**

How many of the <u>regular CFLs</u> you are purchasing today do you think you will install in your <u>home</u> <u>over the next year</u>?
[ENTER RESPONSE]
8. Don't know
9. Refused

[ASK IF ANY CFLSPEC(i) =1 AND A2 = 1 or 3]

B1.CFLSpec.H **For the rest of this survey, the term "specialty CFL" will refer to any CFL bulbs that are <u>*not*</u> the traditional corkscrew shaped bulbs**
[IF NEEDED: These include any 3-way, flood or reflector, dimmable, globe, candelabra, torpedo bulbs, or any with a non-standard base].

How many of the <u>specialty CFLs</u> you are purchasing today do you think you will install in your <u>home</u> <u>over the next year</u>?
[ENTER RESPONSE]
8. Don't know
9. Refused

[ASK IF ANY BULBTYPE(i)=LED AND A2 = 1 or 3]

B1.LED.H.1 **How many of the <u>LEDs</u> you are purchasing today do you think you will install in your <u>home</u> <u>over the next year</u>?**
[ENTER RESPONSE]
8. Don't know
9. Refused

B1.LED.H.3 **In which rooms of your home do you plan on installing these LED bulbs? Approximately how many bulbs per room? (Your best guess is fine.)**
1. List of [Rooms, Fill-in for approximate number in each room]
8. Don't know
9. Refused

[ASK IF ANY CFLREG(i) =1 AND A2=2 or 3]

B1.CFLReg.B **How many of the <u>regular CFLs</u> you are purchasing today do you think you will install in your <u>business</u> <u>over the next year</u>?**
[ENTER RESPONSE]
8. Don't know
9. Refused

[ASK IF ANY CFLSPEC(i) =1 AND A2=2 or 3]

NAVIGANT

B1.CFLSpec.B **How many of the <u>specialty CFLs</u> you are purchasing today do you think you will install in your <u>business</u> <u>over the next year</u>?**
[ENTER RESPONSE]
8. Don't know
9. Refused

[ASK IF ANY BULBTYPE(i) =1 AND A2=2 or 3]
B1.LED.B **How many of the <u>LEDs</u> you are purchasing today do you think you will install in your <u>business</u> <u>over the next year</u>?**
[ENTER RESPONSE]
8. Don't know
9. Refused

<u>SECTION C: INTENTIONS</u>

C1. Were you originally planning to buy bulbs when you came into the store today?
1. Yes
2. No **[SKIP TO C3]**
8. Don't know **[SKIP TO C3]**
9. Refused **[SKIP TO C3]**

C2. What types of bulbs were you planning to buy when you came into the store today?
1. CFLs
2. Incandescents
3. LEDs
4. Halogens
5. Fluorescent tubes
6. Other (specify)________________
8. Don't know
9. Refused

[ASK IF ANY PROGCFL(i) =1]

C3. For the most part, what do you plan on doing with the CFLs you are purchasing today? [READ RESPONSES 1 THROUGH 4] [RANDOMIZE RESPONSES 1-4]
1. Replace older style incandescent bulbs
2. Replace CFLs
3. Store them for later use
4. Give them away
5. Other (specify)___________
8. Don't know
9. Refused

[ASK IF ANY PROGLED(i) =1]

C4. For the most part, what do you plan on doing with the LED(s) you are purchasing today? [READ RESPONSES 1 THROUGH 4]

NAVIGANT

[RANDOMIZE RESPONSES 1-4]

1. Replace older style incandescent bulbs
2. Replace CFLs
3. Store them for later use
4. Give them away
5. Other (specify)___________
8. Don't know
9. Refused

SECTION D: AWARENESS

D1. Are you aware some of the bulbs you are purchasing today are discounted?

1. Yes
2. No **[SKIP TO E1.CFL]**
8. Don't know **[SKIP TO E1.CFL]**
9. Refused **[SKIP TO E1.CFL]**

D2. Did you know the discount was provided by AEP Ohio?

1. Yes
2. No
8. Don't know
9. Refused

D3. Did you know about the discount before you entered the store today, or did you learn about it while you were in the store?

1. Before
2. Learned about it here
8. Don't know
9. Refused

[ASK ONLY IF D2=1; ELSE SKIP TO D5]

D4. I am going to read a list of ways that you might have heard of the AEP Ohio CFL discounts. Please tell me if you learned about the CFL/LED discounts from any of the following sources. [READ LIST; ACCEPT MULTIPLE RESPONSES]
[RANDOMIZE RESPONSES 1-5]

1. Utility mailing/bill insert
2. The AEP Ohio website
3. Signs on store shelf with bulbs or in store aisle
4. A store employee
5. In-store demonstration or lighting booth
6. Or any other way? (SPECIFY_____________________________)
8. Don't know
9. Refused

D5. How satisfied are you with the discount amount? Would you say you were: [READ FROM LIST]

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1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither Satisfied nor dissatisfied
4. Somewhat satisfied
5. Very satisfied
6. The discount amount is unknown
8. Don't Know
9. Refused

SECTION E: BARRIERS AND SATISFACTION

E1.CFL **What is the main factor preventing you from installing more CFLs in your home? [DO NOT READ; ACCEPT SINGLE RESPONSE ONLY]**

1. Waiting for incandescent bulb to burn out
2. Waiting for a CFL to burn out before replacing it
3. Waiting for an LED to burn out before replacing it
4. Waiting for a halogen/"efficient incandescent" to burn out before replacing it
5. Waiting until a bulb (no type specified) burns out before replacing it **[PROBE : WHAT TYPE OF BULB – CFL, LED, OR INCANDESCENT – AND RECORD AS 1, 2, OR 3 ABOVE IF RESPONDENT CAN SPECIFY TYPE]**
6. Storing incandescent bulbs
7. CFLS are too expensive/cost too much
8. Need dimmable bulbs / can't get dimmable CFLs / can't use CFLs with dimmer switches
9. Need 3-wat bulbs / can't get 3-way CFLs / can't use CFLs in my 3-way fixtures / when I use regular CFLs in my 3-way fixtures, they do not work
10. Don't like the way CFLs look in fixtures
11. Don't like the way CFLs fit in fixtures
12. CFLs aren't bright enough
13. CFL light color isn't what I want / isn't right
14. CFLs take too long to light up
15. Concerned about mercury content
16. All fixtures already have CFLs
17. Nothing (SPECIFY "WHY": ______________)
18. Other (specify)________________
98. Don't know
99. Refused

E1.LED **What is the main factor preventing you from installing more LEDs in your home? [DO NOT READ; ACCEPT SINGLE RESPONSE ONLY]**

1. Waiting for incandescent bulb to burn out
2. Waiting for a CFL to burn out before replacing it
3. Waiting for an LED to burn out before replacing it
4. Waiting for a halogen/"efficient incandescent" to burn out before replacing it

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5. Waiting until a bulb (no type specified) burns out before replacing it **[PROBE : WHAT TYPE OF BULB – CFL, LED, OR INCANDESCENT – AND RECORD AS 1, 2, OR 3 ABOVE IF RESPONDENT CAN SPECIFY TYPE]**
6. Storing incandescent bulbs
7. LEDs are too expensive/cost too much
8. Need dimmable bulbs / can't get dimmable LEDs / can't use LEDs with dimmer switches
9. Need 3-way bulbs / can't get 3-way LEDs / can't use LEDs in my 3-way fixtures / when I use regular LEDs in my 3-way fixtures, they do not work
10. Don't like the way LEDs look in fixtures
11. Don't like the way LEDs fit in fixtures
12. LEDs aren't bright enough
13. LED light color isn't what I want / isn't right
14. LEDs take too long to light up
15. All fixtures already have LEDs
16. Nothing (SPECIFY "WHY": ____________)
17. Other (specify)______________
98. Don't know
99. Refused

E2. If you were rating your overall satisfaction with the AEP Ohio Discount Lighting Program, would you say you were:
[READ FROM LIST]
1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither Satisfied nor dissatisfied
4. Somewhat satisfied
5. Very satisfied
8. Don't Know **[SKIP TO E5]**
9. Refused **[SKIP TO E5]**

E2a. Why do you give it that rating?
1. [RECORD VERBATIM]
88. DON'T KNOW
99. REFUSED

E3. Do you have any suggestions to improve the AEP Ohio Discount Lighting Program?
1. Yes, [RECORD VERBATIM]
2. No
8. Don't Know
9. Refused

E4. Based on your overall experience with AEP Ohio's service, how satisfied are you with having them as your electric company? Would you say you are:
[READ LIST]

NAVIGANT

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither Satisfied nor dissatisfied
4. Somewhat satisfied
5. Very satisfied
8. Don't Know
9. Refused

E4a. Why did you rate it that way?
[PROBE FOR CLARITY AND SPECIFICITY IF NEEDED: Was there something in particular you had in mind when you chose a rating of [RATING]?]

[OPEN END]
98. Don't know
99. Refused

E5. Would you say participating in this program has made you feel more favorable, less favorable, or no different about AEP Ohio?

1. Less favorable about AEP Ohio
2. More favorable about AEP Ohio
3. No different about AEP Ohio
8. Don't know
9. Refused

SECTION F: EISA QUESTIONS

F1. In 2007, Congress passed a law to set higher energy standards for light bulbs. The law phases out 40 to 100 watt standard incandescent light bulbs from 2012 through 2014. Have you heard of these new light bulb standards before today?

1. Yes
2. No **[SKIP TO F4]**
8. Don't know **[SKIP TO F4]**
9. Refused **[SKIP TO F4]**

F2. How familiar are you with the new light bulb standards? Would you say you are… [READ LIST]

1. Not very familiar
2. Somewhat familiar
3. Very familiar
8. Don't Know
9. Refused

F3a. In 2012, the law affected 100-watt incandescent light bulbs. Did you stock up on 100-watt bulbs while they were still being sold?

1. Yes
2. No
8. Don't know

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9. Refused

F3b. **In 2013, the law affected 75-watt bulbs. Once stores sell through their existing inventory of standard 75-watt incandescent bulbs this year, you will no longer be able to purchase them. Have you been or do you plan on stocking up on extra 75-watt bulbs in anticipation of this change?**

1. Yes
2. No
8. Don't know
9. Refused

F3c. **In 2014, the law will affect both 40 and 60-watt bulbs. Once stores sell through their existing inventories of standard 60 and 40-watt incandescent bulbs next year, you will no longer be able to purchase them. Do you plan on stocking up on extra 40 or 60-watt bulbs in anticipation of this change?**

1. Yes
2. No
8. Don't know
9. Refused

F4. **The next time you need to buy a 100 or 75-watt light bulb, will you buy an equivalent light CFL, an equivalent light halogen bulb, an equivalent light LED, an equivalent wattage 3-way incandescent, or buy a lower wattage traditional incandescent that is still available? [SHOW CUSTOMER EXAMPLE PHOTOS]**

1. Lower wattage standard incandescent
2. Equivalent light CFL
3. Equivalent light halogen bulb
4. Equivalent Light LED
5. Equivalent wattage 3-way Incandescent
6. Some other bulb type (specify) __________
8. Don't know
9. Refused

Okay, thank you very much for your time today. **[Provide customer with gift card.]**

[AFTER CUSTOMER HAS LEFT, PLEASE FILL OUT INFORMATION]
QA5. Survey Ending Time:____
QA6. Where in store interview was completed:

1. Main lighting aisle / display
2. End-cap display (end of aisle)
3. Stand alone / Pallet display
4. Next to APT lighting demonstration
5. Other ____________________

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A.5.2 AEP Ohio Efficient Products Program Lighting Shelf Survey

The Lighting Shelf Survey data were collected using online survey software. The data fields that were collected, along with examples of how the data were organized, is shown below.

Observation #	Store ID	Brand	Brand (Other)	3-Way	Wattages (3-way)	Wattage (Fixed)	Lumens	Model #	# of Bulbs in Pack	Notes
1	Retailer Name/ Location 1	GE		No		75	900	GE0123	1	
2	Retailer Name/ Location 2	Feit		Yes	50,100,150		600,1200,1500	FE0123	2	
etc …										

APPENDIX C

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APPLIANCE RECYCLING PROGRAM

2013 Evaluation Report

Prepared for:
AEP Ohio

AEP OHIO®
A unit of American Electric Power

May 8, 2014

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Executive Summary

This report presents the results of an evaluation of the 2013 AEP Ohio Appliance Recycling Program. The Executive Summary provides a high-level description of the program summary, key impact findings, key process findings, and recommendations stemming from these findings. Detailed methodology and findings are contained in the body of the report following this Executive Summary.

Program Summary

The objective of the AEP Ohio Appliance Recycling Program is to remove old, inefficient refrigerators and freezers from operation as secondary units in homes and therefore reduce energy use and peak demand. The program also prevents existing primary appliances from being retained and used as secondary units after customers purchase new units. In 2013, the AEP Ohio Appliance Recycling Program collected a total of 19,392 appliances, which is a 25 percent increase from 2012.

Compared to the 2012 Appliance Recycling Program, there were no significant changes to the 2013 program. As in 2012, the customer incentive was $50 per appliance for the first nine months of 2013. In 2013 the incentive amount was increased to $60 from October 1 to December 24 in an attempt to increase program participation, compared to 2012, when the same incentive increase occurred November 1st through December 31st. Another minor change in the program compared to 2012 was a $15 to $20 "SPIF" (Sales Promotion Incentive Fund) incentive that was paid to retailer sales associates at Sears from September 28 to December 31 as a trial to determine whether monetary incentives are an effective motivator for partner retailer sales staff.

Key Impact Findings

Table ES-1 shows the *ex ante* savings claimed by the program, the audited savings, and the 2013 realization rates. The realization rate for 2013 was 1.00 for both energy and demand. Refrigerators accounted for 82% of the program savings in 2013 and freezers accounted for 18%. To estimate the audited savings, the evaluation team independently applied the methods and assumptions outlined in the State of Ohio Draft Energy Efficiency Technical Reference Manual (Draft Ohio TRM) [1].

[1] State of Ohio Energy Efficiency Technical Reference Manual 2010, accessed at: http://amppartners.org/pdf/TRM_Appendix_E_2011.pdf

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Table ES-1. Program Savings and Realization Rate for Program Year 2013

	Ex Ante Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)
Energy Savings (MWh)	26,180	26,180	1.00
Demand Savings (MW)	4.19	4.19	1.00

Conclusions from Program Year 2013

The 2013 evaluation resulted in three main conclusions.

1. **Audited savings matched program *ex ante* values based on the Draft Ohio TRM.** There were no issues in the review of audited savings which resulted in a realization rate of 1.0 for both energy and demand savings.

2. **Overall, the Appliance Recycling Program is running very smoothly.** The program has not undertaken any significant changes since 2012 and continues to provide significant savings and high satisfaction from customers.

3. **The retailer partnership component of the program continues to be challenging, but there are opportunities to increase promotion of the program in a variety of retailer settings.** Despite attempts to increase in-store enrollment at retail partners, this component continues to account for a small portion of appliance pickups. However, retailers remain an important source of program awareness and opportunities exist to continue to message the program in retailer settings.

Recommendations for Program Improvements

The 2013 evaluation resulted in two main recommendations.

1. **Continue allocating funds toward marketing channels similar to those employed at the end of 2013, as they appear to have led to a notable increase in monthly appliance pickups in the last quarter of the year**. While appliance pickups in previous years have peaked in the summer (June–August), in 2013 these grew during the year and peaked in October through December. The large increase in pickups at the end of 2013 differed from previous years, which the program staff attributed to the increase in marketing for the program to advertise the increased incentive; in past years, marketing of the program has nearly ceased at the end of the year.

2. **Conduct concerted outreach to non-partnering retailers to ensure that the program is being messaged properly and promotional materials are provided as needed.** A formal outreach initiative could ensure that sales associates are educated on the program and have all appropriate messaging materials.

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1 Introduction

This section provides a description of the AEP Ohio Appliance Recycling Program, as well as a brief discussion of the underlying program theory and logic. In addition, this section describes minor differences in how the 2013 program was implemented compared to the 2012 program. The reader is directed to the 2011 evaluation report[2] for a thorough review of the program processes and theory. The last part of this section describes the objectives of this evaluation.

1.1 Program Description

The objective of the AEP Ohio Appliance Recycling Program is to remove old, inefficient refrigerators and freezers from operation as secondary units in homes and therefore reduce energy use and peak demand. The program also prevents existing primary appliances from being retained and used as secondary units after customers purchase new units or sold into the secondary market.

AEP Ohio offers free removal and recycling of refrigerators and freezers and provides a cash incentive to customers who retire these appliances. The incentives include $50 per appliance (increased to a $60 payment October 1st through December 24th) and free pickup of the old appliances. For a customer to qualify, the refrigerator and/or freezer must be between 10 and 30 cubic feet in size, empty, and operational at the time of pickup. In 2013, the program collected a total of 19,392 appliances (15,549 refrigerators and 3,843 freezers).

The implementation contractor, JACO Environmental, provides complete implementation services, including verifying customer eligibility, scheduling appliance pickups, collecting appliances from customers' homes, transferring the appliances to a recycling facility (performed by subcontractor Appliance Distribution), and processing incentive payments. The implementation contractor also handles the development of marketing materials, media placement, and promotion of the program, as well as data tracking and reporting for the appliance scheduling and collection.

In addition to direct pickup by a program contractor, the Appliance Recycling Program also recycles some units through a partnership with two retail chains in the AEP Ohio service territory, because working appliances picked up by these stores may otherwise find their way back into the secondary market. In the retailer partnership component of the program, the retailer promotes the program and enrolls customers who are purchasing new appliances from the retailer. The retailer then collects the old appliance(s) when they deliver the new appliance(s) to the customer and then delivers the appliance to JACO for recycling.

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[2] Ohio Public Utilities Commission Docket 12-1537-EL-EEC, May 15, 2012, *In the Matter of the Annual Portfolio Status Report Under Rule 4901:1-39-05(C), Ohio Administrative Code, by Ohio Power Company, Appendix C.*

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In 2013, the program aimed to reduce energy usage by 22.0 GWh and peak demand by 4.3 MW. These goals account for 10 percent of AEP Ohio's 2013 consumer portfolio energy goal and 16 percent of the consumer portfolio demand goal.

1.1.1 2013 Program Differences Compared to 2012

Although the core program processes and basic program theory of the 2013 program were identical to 2012, there were a number of small changes related to program implementation and marketing for 2013.

Program Implementation
While the incentive amount for customers remained at $50 for the first nine months of the year, it was increased to $60 from October 1 to December 24 in an attempt to increase enrollment over the last quarter of the year. In 2012, the $60 incentive only was offered in November and December.

As part of a trial to determine whether a Sales Performance Incentive Fund (SPIF) paid to retail partner sales associates is an effective way to drive program enrollment through the retail channel, retail sales associates received a $15 to $20 incentive for every customer they enrolled in the program between September 28 and December 31. According to JACO staff, sales associates received $20 if they enrolled customers in-store using the Quick Links system and $15 if customers enrolled over the phone. One AEP Ohio program manager stated that this incentive did not have much impact on enrollment during that time period.

Marketing
In 2013, the program engaged in four marketing efforts that were new. The first was an "Oldest Fridge" competition that was coordinated among Ohio utilities between May and July, which provided a $1,250 prize to the customer who recycled the oldest refrigerator. Second, the program ran the "Recycle and Win" contest, in which all customers who enrolled during a 60-day period in March and April were entered into a raffle for one of four $250 gift cards. Third, AEP Ohio tested a direct mail targeted marketing approach in 2013. For this effort, AEP Ohio looked at the demographic characteristics of customers most likely to participate in the program (e.g., living in highest performing zip codes, having lived in their home for 10 years or longer, participating in other energy efficiency programs) and sent out targeted mailers advertising the program to approximately 10,000 customers who matched this profile. Finally, the program ran two raffle promotions directed specifically at AEP Ohio employees to encourage appliance recycling. The first raffle ran in September and had a prize of tickets to an OSU sport event, followed closely in November by a second raffle with a prize of a $100 gift card.

1.1.2 Program Theory

The basic program theory of the 2013 program is unchanged compared to the 2012 program theory. As part of the 2011 evaluation, the evaluation team constructed a detailed logic model to thoroughly capture the program theory of the Appliance Recycling Program. Because the program theory for the 2013 program is unchanged from that in the 2011 program, a detailed program theory description and logic

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model are not contained in this current report. The reader is instead referred to the 2011 evaluation report.[3]

1.2 Evaluation Objectives

This report presents the findings from the impact and process evaluations of the AEP Ohio Appliance Recycling Program for 2013. The objectives of the evaluation were to: (1) quantify energy and peak demand savings impacts in 2013 for these products, (2) determine key process-related program strengths and weaknesses, and (3) provide recommendations to improve the program. Specific research questions are summarized below.

The evaluation sought to answer the following key research questions.

Impact Questions

1. How many appliances were collected through the program, by type (refrigerator or freezer), status (primary vs. secondary use), configuration (e.g., upright vs. chest), and pickup mechanism (i.e., JACO home pickup vs. retail partnership)?
2. What is the annual energy (kWh) and summer peak demand (kW) savings per-unit? How are savings affected by adjusting for customer part-use or summer-use factors?
3. What are the annual energy (kWh) and summer peak demand (kW) impacts resulting from the program? Did the program meet its energy and demand goals? If not, why not?
4. What were the realization rates? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
5. What is the cost effectiveness of this program?

Process Questions

1. How do participants become aware of the program?
2. In what ways is the Appliance Recycling Program cross-promoted with other programs offered by AEP Ohio?
3. Are participants satisfied with various aspects of the program (i.e., enrollment, appliance pickup, incentive payment)? If not, why not?
4. What would participating customers do with secondary units in the absence of the program?
5. How many participants enroll through a retailer vs. other channels?
6. How many customers enroll in the program but then cancel? How many of these never re-enroll in the program?
7. Is the new partnering retailer satisfied with the program? What has been their experience with the program thus far?
8. Has the program as implemented changed from 2012? If so, how, why, and was this an advantageous change?
9. What are the current program challenges and how are these being addressed?
10. What are the opportunities for program improvement?

[3] *Ibid*.

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2 Methodology

This section describes the methodology used to conduct the impact and process evaluations. For the impact evaluation, the evaluation team estimated two types of savings, audited savings and adjusted savings. To estimate the audited (*ex post*) energy and demand savings, the evaluation team independently applied the methods and assumptions outlined in the Draft Ohio TRM. These savings values, referred to as the audited impact evaluation results, are presented in the body of this report. The evaluation team also calculated adjusted energy and demand savings, which were based on primary data collected. The methods and results of the adjusted savings analysis, referred to as the adjusted impact evaluation, are presented in the Appendix and are meant to serve as a comparison to, and test of the appropriateness of assumptions specified in the Draft Ohio TRM.

Table 2-1 summarizes the various activities undertaken for the audited impact and process evaluation. The evaluation team analyzed new program documentation for 2013 (the 2013 marketing materials) and reviewed program tracking data, which contain information on all of the refrigerators and freezers recycled through the Appliance Recycling Program. The evaluation team also conducted a brief secondary literature review to assess any new studies relevant to the calculation of adjusted savings, as detailed in the appendix.

Primary data collection efforts included in-depth telephone interviews with program staff at AEP Ohio and the program implementer (JACO). In order to understand customers' experience with the program, the evaluation team conducted a telephone survey with customers who had a refrigerator or freezer recycled through the program in 2013.

Table 2-1. Summary of Data Review and Data Collection Activities

Data Collection Type	Targeted Population	Supported Evaluation Activities
Tracking Data Review	All program participants	Impact Evaluation
Program Documentation Review	Any new program documentation	Process Evaluation
Secondary Literature Review	Any new published studies relevant to the evaluation of appliance recycling	Impact Evaluation (adjusted savings)
Metering Study	Program participants	Impact Evaluation (adjusted savings)
In-depth Telephone Interviews	Program staff, Partnering retailer	Process Evaluation
Telephone survey	Program participants	Impact Evaluation (adjusted savings) and Process Evaluation

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2.1 Tracking Data Review

The program tracking data is critical for determining the impacts of the Appliance Recycling Program, as it describes the number and types of appliances collected through the program. Thus, reviewing the tracking system is important for calculating program impacts and for assessing the effectiveness of program processes.

The tracking data collected by JACO was provided by AEP Ohio for the evaluation team to review. First, the evaluation team determined key data fields essential for consideration in the impact and process evaluations. Next, the team examined frequency distributions for each of the key fields, identifying missing, incomplete, or inconsistent data. Finally, the team formulated assumptions that are used in subsequent analyses to account for missing, incomplete, or inconsistent data. The result was a more complete and accurate evaluation and assessment of the impacts of the Appliance Recycling Program. The tracking review also included additional assessments of the data, including:

- Analysis of the key characteristics (e.g., age, size, model) of appliances recycled through the program.
- Assessment of how refrigerator and freezer configuration is tracked.
- Analysis of duplicate account numbers to determine how many customers recycled more than one appliance through the program.

The assessment of the tracking data is discussed in the Appendix Section A.1, where program activity is discussed along with the necessary adjustments that were made to account for missing or erroneous data. In addition to records on completed projects, the evaluation team also reviewed appointment cancellation data, which contains all of the customers who signed up for the Appliance Recycling Program and then cancelled or changed their pickup appointment at least once. The evaluation team reviewed these data with the following objectives:

- Determine how many customers enroll in the program but then cancel.
- Determine how many of those who cancel re-enroll and participate in the program at a later date.
- Determine how many customers cancel and never re-enroll in the program.

To determine how many cancellations represent true dropouts and how many go on to eventually participate in the program, the evaluation team compared the cancellation data with the program tracking data, using the same approach as in 2011. A detailed explanation of the method for analyzing the cancellation data can be found in Section 4.3.7 of the 2011 Appliance Program evaluation report.

2.2 Program Documentation Review

The evaluation team focused the program documentation review on aspects of the 2013 program that were new, including:

- Revised pages of the AEP Ohio Appliance Recycling Program website.
- The 2012-2014 Energy Efficiency/Peak Demand Reduction Action Plan.

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These documents were reviewed to understand the details of the 2013 program and to inform customer surveys.

2.3 *Secondary Literature Review*

The evaluation team reviewed published reports and technical reference manuals regarding calculations of impact savings for Appliance Recycling. In particular, this included review of the Draft Ohio TRM for refrigerator and freezer early retirement (recycling).

2.4 *Metering Study*

The evaluation team implemented an appliance metering study in AEP Ohio's service territory; this is discussed in detail in the Appendix.

2.5 *In-depth Interviews*

In order to answer the key process evaluation research questions, the evaluation team conducted a series of in-depth interviews, as summarized in Table 2-2. The purpose of these interviews was to understand changes in program implementation, collect feedback on research priorities, and understand stakeholders' experiences with the program.

Table 2-2. Summary of In-depth Interviews

Data Collection Type	Targeted Population	Sample Frame	Sample Target	Sample Size	Timing
In-depth Telephone Interviews	AEP Ohio Program Staff	Contacts from AEP Ohio	Program Manager Consumer Programs and Marketing Manager	2	September 2013
	JACO Program Staff	Contacts from AEP Ohio	Program Development Manager Retail Program Manager	2	September and October 2013
	ABC Warehouse Program Coordinator	Contacts from APT	Program Coordinator	1	October 2013

2.6 *Participant Survey*

The evaluation team also conducted a telephone survey with program participants. The data from this survey was used to address process evaluation research questions and to provide data for the adjusted impact evaluation presented in the Appendix.

To ensure that surveys were conducted with a representative sample of participants, the survey sample was stratified by appliance type: refrigerator or freezer. Within each stratum, surveys were completed

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with a random sample of participants. The evaluation team constructed the sample design before the final end-of-year program data were available. The evaluation team estimated target sample sizes needed to estimate results at a 95 percent level of confidence +/- 5 percent relative precision (95/5) at the program level, while simultaneously attaining a minimum of 90/10 for both customers recycling refrigerators and customers recycling freezers.

In order to derive target sample sizes, the evaluation team started by assuming an estimated total of 20,000 recycled units for the year, which was based on the yearly unit goals for the implementer. Based on this information, to attain 95/5 at the program level the evaluation team computed a minimum sample size of 377 completed participant surveys. In order to attain a minimum of 90/10 at the appliance level, the evaluation team allocated 70 target completes to freezers; 307 target completes to refrigerators.

Table 2-3 shows the actual population of appliances collected in 2013 through the program, the number of participant surveys completed, and the resulting sampling error. Overall, at the program level, sampling efforts resulted in +/- 4.98 percent precision at a 95 percent level of confidence. For refrigerators, +/- 5.52 percent precision was attained and for freezers +/- 11.61 percent precision was attained at the 95 percent level of confidence. Note that the sample sizes for both customers recycling refrigerators and customers recycling freezers exceeded the 90/10 confidence/precision threshold.

Table 2-3. 2013 Participant Survey Completes and Population-Level Sampling Error

Appliances Collected	2013 Population Size (N)	Survey Target Completes	Survey Completes (n)	Sampling Error (95% CI)
Refrigerators	15,549	307	309	5.52%[a]
Freezers	3,843	70	70	11.61%[b]
Total	19,392	377	379	4.98%

a. At 90% confidence, sampling error = 4.63%.
b. At 90% confidence, sampling error = 9.74%.

In order to secure the 379 survey completes, the evaluation team attempted to contact 2,640 AEP Ohio customers who participated in the program. Table 2-4 below highlights the call disposition from those attempted contacts. In total, 14 percent of all customers contacted ultimately participated in the survey.

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Table 2-4. Participant Survey Sample Disposition

Contact Disposition	Customers	Percent
Unable to reach (e.g., no answer, busy, answering machine)	1,753	66%
Completes	379	14%
Refusal	224	8%
Non-specific callback/Appointment scheduled	112	4%
Telephone number issue	59	2%
Respondent disqualified from survey because not familiar with JACO [a]	29	1%
Quota met	20	1%
Appliance not picked up from primary residence/Respondent not primary user	15	1%
Electric company not AEP Ohio	12	<1%
Respondent disqualified due to coding error [b]	4	<1%
Language barrier	4	<1%
Unknown	29	1%
Total Participants Attempted to Contact	2,640	100%

Note. Total sums to less than 100 percent due to rounding.

a. Specifically, these 29 respondents were disqualified from the survey when they responded "Don't know" to the question "Our records show that you had an appliance picked up by AEP Ohio's subcontractor JACO. Is this correct?"

b. These respondents were improperly disqualified from the survey based on their responses to the question "Our records show that you had an appliance picked up by AEP Ohio's subcontractor JACO. Is this correct?"

2.7 *Audited Savings Evaluation Methods*

Program savings were audited using the AEP Ohio program tracking data, the participant survey and the Draft Ohio TRM. The program tracking data was used to verify appliance counts by type and evaluation team verified appliance pickups through the participant survey. The evaluation team determined audited savings values by applying the deemed values for refrigerator and freezer "Early Retirement" (recycling) from the Draft Ohio TRM to these appliance counts. Deemed values for refrigerator and freezer early retirement are summarized in Table 2-5.

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Table 2-5. Deemed Per-Unit Savings Values from Draft Ohio TRM

Appliance Type	Deemed Per-Unit Energy Savings (kWh)	Deemed Per-Unit Demand Savings (kW)
Refrigerator	1,376.15	0.22
Freezer	1,244.40	0.20

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3 Detailed Evaluation Findings

This section presents the detailed findings from the 2013 Appliance Recycling Program evaluation related to (1) program activity, (2) audited impact findings, and (3) process evaluation findings. Additional details are in the appendix.

3.1 *Program Activity*

In 2013, the AEP Ohio Appliance Recycling Program collected a total of 19,392 appliances. This included 15,549 refrigerators and 3,843 freezers as shown in Table 3-1, which resulted in an *audited* energy savings of 26,180 MWh and *audited* demand savings of 4.19 MW. In 2013, the program achieved 119% of the 22 GWh energy savings goal and achieved 97% of the peak demand goal of 4.3 MW.

Table 3-1. Appliance Recycling Program Year 2013 Activity

Appliance Type	Number of Units	Percent of Total Appliances
Refrigerators	15,549	80.2%
Freezers	3,843	19.8%
Total Appliances	19,392	100.0%

Key program activity findings for 2013 are summarized below:

- **Appliance age is younger than previous years.** The average age of program refrigerators in 2013 was 20 years, compared to 23 years in 2012 and 29 years in 2011. Likewise, the average age of freezers was 24 years, compared to 30 years in 2012 and 32 years in 2011. This decrease in appliance age over time may be a reflection of the program having already targeted older appliances. Importantly, the average refrigerator age has declined to 20 years, which dates back to the 1993 major change in refrigerator Federal Standards. If this trend continues it may represent a significant "tipping point" in refrigerator age, which may impact unit savings.
- **There was an increase in units recycled per month through the end of the year**. Appliance pickups peaked in December, with 642 freezers and 2,196 refrigerators. This was unique to 2013, as pickups usually peak in the summer and are very low at the end of the year.
- **Most participants (94 percent) recycled only one unit.** The evaluation team determined that 6% of participants recycled two units through the program.
- **Four units recycled through the program were found to be smaller than the 10 cubic feet qualifying size.** These units were picked up by the program as part of the "Oldest Fridge" contest, because very old refrigerators are smaller than more modern appliances. Therefore these units were counted towards both overall program savings by the program and this evaluation.

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3.2 *Impact Findings*

This section provides a detailed description of audited impact findings for the 2013 Appliance Recycling Program. Findings from the adjusted impact evaluation are included in the Appendix.

The deemed savings values from the State of Ohio Draft Energy Efficiency Technical Reference Manual from August 2010 for the early retirement (recycling) of a refrigerator are: 1,376.15 kWh and 0.22 kW.[4] The evaluation team verified appliance pickups through the participant survey and applied the deemed TRM per-unit savings values to calculate audited program savings for refrigerators in the tracking data, as shown in Table 3-2.

Table 3-2. Recycled Refrigerator *Ex Ante* and Audited Savings and Realization Rate

	Per-Unit Savings (TRM)	Count [(a)]	Total *Ex Ante* Savings	Total Audited Savings	Realization Rate
Energy (kWh)	1,376.15	15,549	21,397,756	21,397,756	1.00
Demand (kW)	0.22	15,549	3,421	3,421	1.00

a. There is an inconsistency in appliance count between tracking files from AEP. The AppRecUnits file contains 15,570 refrigerators, while the AppRecSavings file contains 15,569. The value of 15,569 was used here. In addition, 20 of these 15,569 units were determined to have been recycled prior to the program year and so were removed from the appliance counts and savings calculations.

The deemed savings values from the Draft Ohio TRM for the early retirement (recycling) of a **freezer** are as follows: 1,244.40 kWh and 0.20 kW.[5] The evaluation team verified appliance pickups through the participant survey and applied the deemed Draft Ohio TRM per unit savings values to calculate audited program savings for program freezers in the tracking data, as shown in Table 3-3.

Table 3-3. Recycled Freezer *Ex Ante* and Audited Savings and Realization Rate

	Per-Unit Savings (TRM)	Count	Total *Ex Ante* Savings	Total Audited Savings	Realization Rate
Energy (kWh)	1,244.40	3,843	4,782,229	4,782,229	1.00
Demand (kW)	0.20	3,843	769	769	1.00

In summary, the total audited savings for refrigerators and freezers in 2013 are 26,180 MWh and 4.19 MW. Eighty-two percent of energy and demand savings come from refrigerators, as shown in Table 3-4,

[4] The Draft Ohio TRM lists the energy savings value as 1,376 **or** as 1,619 kWh times a 0.85 in situ factor. AEP Ohio uses the latter calculated value of 1,619 * 0.85, which comes out to 1376.15 kWh. Using either value, audited savings achieve a realization rate of 1.00.

[5] The Draft Ohio TRM lists the energy savings value as 1,244 **or** as 1,464 kWh times a 0.85 in situ factor. AEP Ohio uses the latter calculated value of 1,464 * 0.85 value, which comes out to 1244.4 kWh. Using either value, audited savings achieve a realization rate of 1.00.

which account for 80% of program units. The energy and demand realization rates are both 1.00, for refrigerators, freezers, and the program overall.

Table 3-4. Total Audited Energy (MWh) and Demand (MW) Savings Realization Rate

Appliance	Count	Energy Savings (MWh)	Demand Savings (MW)	Energy Realization Rate	Demand Realization Rate	% of Energy Savings	% of Demand Savings
Refrigerators	15,549	21,398	3.42	1.00	1.00	82%	82%
Freezers	3,843	4,782	0.77	1.00	1.00	18%	18%
Total	19,392	26,180	4.19	1.00	1.00	-	-

3.3 Process Findings

This section provides a detailed description of process findings for the 2013 Appliance Recycling Program. Overall, process evaluation data collection efforts indicate that the Appliance Recycling Program is running smoothly. On the whole, the overall program structure and program processes have remained relatively unchanged from 2012.

Participants continue to be very satisfied with the program and all of its underlying elements (e.g., enrollment experience, rebate amount, collection team, time to receive rebate). Participants also report high levels of satisfaction with AEP Ohio as a service provider, with 82 percent reporting to be at least "somewhat satisfied." The participant survey suggests that fewer respondents feel more favorable toward AEP Ohio as a result of program participation in 2013 (43 percent) as compared to 2012 (54 percent). Regardless of this change in responses, the program is well received by participants and has a net positive impact on their favorability toward AEP Ohio.

Participant awareness comes mostly from bill inserts, word of mouth, appliance retailers, and TV advertisements. There has been a consistent increase in awareness from retailer sources—including sales associates and store postings—since 2011. Although 36 percent of survey respondents reported learning about the program from an in-store source, only 9 percent learned from either of the two partnering retailers, suggesting that the program is being promoted in retail locations that do not partner with the program. Additionally, in 2013, there was an increase in overall awareness from TV advertisements compared to 2012.

Of all the customers who signed up for the program, 21 percent canceled an appointment at some point, but 89 percent ultimately participated. In other words, 11 percent of customers who signed up for the program dropped out at some point. The dropout rate is relatively low compared to past years, suggesting that program processes related to cancellations and dropouts is improving. This increased participant retention rate could suggest that participants are more able to schedule collection times that are convenient for their schedules and that the program is potentially more successful at enrolling customers who intend to participate. The incentive amount and convenience of the pickup are the main drivers to participation reported by survey respondents.

The central challenge from a process perspective continues to be the low enrollment rate achieved through the retailer partnership. The retailer partner interviewed for this evaluation is very satisfied with the program because it integrates well into their existing system for appliance drop-off and they maintain a good working relationship with JACO. Despite this, there are opportunities to increase in-store retailer enrollment since rates remain very low. Additional challenges include successfully cross-promoting the program and effectively marketing to encourage additional participation.

Key findings from the process evaluation of the 2013 Appliance Recycling Program are discussed below, and include the following topics:

- Participant satisfaction
- Marketing and program awareness
- Participant experiences, including: motivations for appliance disposal; motivations for program participation; enrollment experience; appliance collection process; communication with AEP Ohio and program staff; rebate timing and amount; perceived energy savings; and actions absent the program
- Cancelled appointments
- Current program challenges and opportunities for improvement

3.3.1 Participant Satisfaction

Participant survey respondents reported high levels of satisfaction with each program component and the program overall, as shown in Table 3-5. Specifically, on a scale of one to five where one is "very dissatisfied" and five is "very satisfied" the average reported satisfaction score with the Appliance Recycling Program was 4.78. Among the various program elements, satisfaction was highest for the collection team, sign-up experience, and payment amount.

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Table 3-5. Satisfaction with Appliance Recycling Program and its Elements

Program Element	Mean	n [a]	Standard Deviation
Collection team	4.90	376	0.43
Sign-up experience	4.86	337	0.47
Program overall	4.78	378	0.56
Payment amount	4.71	371	0.65
Time between enrollment and pickup	4.61	375	0.82
Realized savings [b]	4.50	141	0.69
Time between pickup and payment [c]	4.46	285	0.84
Program communications [d]	4.33	39	1.01

Note. The mean values are based on a 1 (“very dissatisfied”) to 5 (“very satisfied”) satisfaction scale.
a. The number of respondents excludes those who responded “Don’t know” or refused to answer the question.
b. Only the respondents who reported noticing energy savings (38% of all respondents) were asked to report their satisfaction with the savings.
c. Only the respondents who reported that they knew how long it took to receive their check (76% of all respondents) were asked about their satisfaction with the time it took.
d. Only the respondents who reported that they spoke with program staff (10% of all respondents) were asked to report their satisfaction with communication.

These satisfaction scores remain consistent with past evaluations, with the exception of satisfaction with communication with AEP Ohio program staff, for which there was a statistically significant decrease in satisfaction. [6] Despite this change, satisfaction with program communications is still very high, with 71 percent of individuals who contacted AEP Ohio or program staff (n = 39) reporting to be at least “somewhat satisfied” with their communication. Additionally, there were no differences in participant satisfaction based on the type of appliance recycled, the sign-up method, or what the participant would have done with the appliance without the program.

Survey respondent satisfaction with AEP Ohio as their service provider was very high, as shown in Table 3-6. In total, 82 percent (n = 312) reported being at least “somewhat satisfied” with AEP Ohio, while only 7 percent of the respondents reported being very dissatisfied with AEP Ohio. The 27 participants who reported being less than satisfied with AEP Ohio were asked for reasons for dissatisfaction with AEP Ohio. Responses included: electricity prices are increasing / my rate is too high (n = 14); power outages are occurring more frequently (n = 6); slow responses to outages (n = 4); issues

[6] Despite the fact that there was a significant decrease in average satisfaction with program communications from 2012 (2012 mean = 4.78, $t(144) = 2.938$; $p = 0.004$), it is important to note that only two respondents indicated any dissatisfaction in the 2013 survey; in 2012, three respondents provided this response. Since only 39 respondents were asked the question compared to 107 in 2012, this represents a larger proportion compared to those who followed up with AEP Ohio staff, but similar proportion to overall sampled population.

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with billing ($n = 4$); and experiences with poor customer service ($n = 3$). These results are consistent with the 2012 evaluation.

Table 3-6. Satisfaction with AEP Ohio

Satisfaction Rating	Frequency	Percent
Very satisfied	213	56.2%
Somewhat satisfied	99	26.1%
Neither satisfied nor dissatisfied	37	9.8%
Somewhat dissatisfied	20	5.3%
Very dissatisfied	7	1.8%
Total	376	100.0%

Note. Results are not shown for the three respondents who reported "Don't know" to this question.

Additionally, survey respondents were asked to report on the effect that the Appliance Recycling Program has had on their attitude toward AEP Ohio. As the responses in Table 3-7 illustrate, program participation has a positive impact on customers' perception of AEP Ohio for a sizable portion (43 percent) of the participant population. Despite this, the program had no effect on a majority (55 percent) of the respondents' attitudes.

Table 3-7. Effect of Program Participation on Favorability Toward AEP Ohio

Response	Frequency	Percent
More favorable toward AEP Ohio	163	43.0%
Less favorable toward AEP Ohio	2	0.5%
No different about AEP Ohio	207	54.6%
Don't know	5	1.3%
Refused	2	0.5%
Total	379	100%

A smaller portion of respondents were more favorable toward AEP Ohio as a result of the program (43 percent), compared to the 2012 when 54 percent of respondents provided that response. This statistically significant change suggests that the program had less of a positive impact on participants' attitude toward AEP Ohio in 2013, as compared to 2012.[7] Regardless of this change, satisfaction with and favorability toward AEP Ohio was very high among surveyed participants in 2013.

[7] x^2 (2) = 9.066, $p = 0.011$

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3.3.2 Marketing and Program Awareness

The program engaged in four marketing efforts that were new for 2013. The first was an “Oldest Fridge” competition that was coordinated among Ohio utilities between May and July. Under the terms of the competition, the customer who turned in the oldest fridge won a $1,000 gift card good toward ENERGY STAR products at any Ohio retailer. This competition gave AEP Ohio the opportunity to reach out to the media to announce the contest and the winner in September. One AEP Ohio program manager reported that the effort might have had the unintended effect of encouraging people only with very old units to participate; however, there was no statistically significant difference between ages of appliances during and not during this contest window.

Second, the program ran the “Recycle and Win” contest in 2013. In this contest, customers who enrolled in the program over the course of the contest’s 60-day period in March and April were entered into a drawing for a $250 gift card. There is no clear indication of a significant impact on enrollment numbers during this time period that could be attributed to the raffle.

Third, AEP Ohio also tested a direct mail targeted marketing approach in 2013. For this effort, AEP Ohio looked at the demographic characteristics of customers most likely to participate in the program (e.g., living in highest performing zip codes, having lived in their home for 10 years or longer, and participating in other energy efficiency programs) and sent out targeted mailers advertising the program to approximately 10,000 customers who matched this profile. According to the AEP Ohio program manager, the response rate for this effort did not reach the target of 2 percent, and thus was not considered successful.

Finally, the program aimed to recruit AEP Ohio employees to participate in the Appliance Recycling Program, which was a new marketing approach for the program. In the fall of 2013, the program ran two raffle promotions directed specifically at AEP Ohio employees. The first raffle ran in September and had a prize of tickets to an OSU sport event, followed closely in November by a second raffle with a prize of a $100 gift card. According to AEP Ohio staff, between 50 and 60 employees recycled appliances and were entered into the raffles.

Despite these new marketing campaigns, the ways in which participants learned about the program remained relatively consistent from 2012. Specifically, both program data and participant survey data confirm that the most frequent sources of awareness for the program were utility bill inserts, word of mouth, appliance retailers, and television advertisements. Based on the data collected for all participants at the time of enrollment, the most frequently mentioned sources of awareness were utility bill inserts, word of mouth, and appliance retailers. Table 3-8 below provides the responses provided by all program participants at the time of enrollment. Responses remained consistent from 2012, expect for a notable jump in awareness from appliance retailers, which increased from 8 percent to 13 percent.

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Table 3-8. Program Awareness Reported at Enrollment

Source of Awareness	Frequency	Percent
Utility bill insert	6,584	36%
Friend/neighbor	2,736	15%
Appliance retailer	2,331	13%
Television	2,260	12%
Newspaper	788	4%
Radio	693	4%
AEP Ohio Email	643	4%
AEP Ohio Home Energy Report	475	3%
AEP Ohio Postcard	412	2%
Web Advertisement/Search	385	2%
Utility company web site	379	2%
Utility newsletter	133	1%
AEP Ohio Employee Referral	103	1%
Other [a]	407	2%
Total	18,329	100%

Note. Total sums to more than 100 percent due to rounding.
a. Other responses with less than 1 percent of total responses include: repeat customer (n=80), AEP Now/news/employee raffle (n=71), community event (n=67), truck sign (n=63), magnet mailer (n=60), Pandora radio (n=57), ValPak (n=5), and Room AC Program (n=4).

In the participant survey, respondents were asked to report on how they first became aware of the program, and if they ever heard from other sources. Results to these questions are presented in Figure 3-1 below by awareness source.

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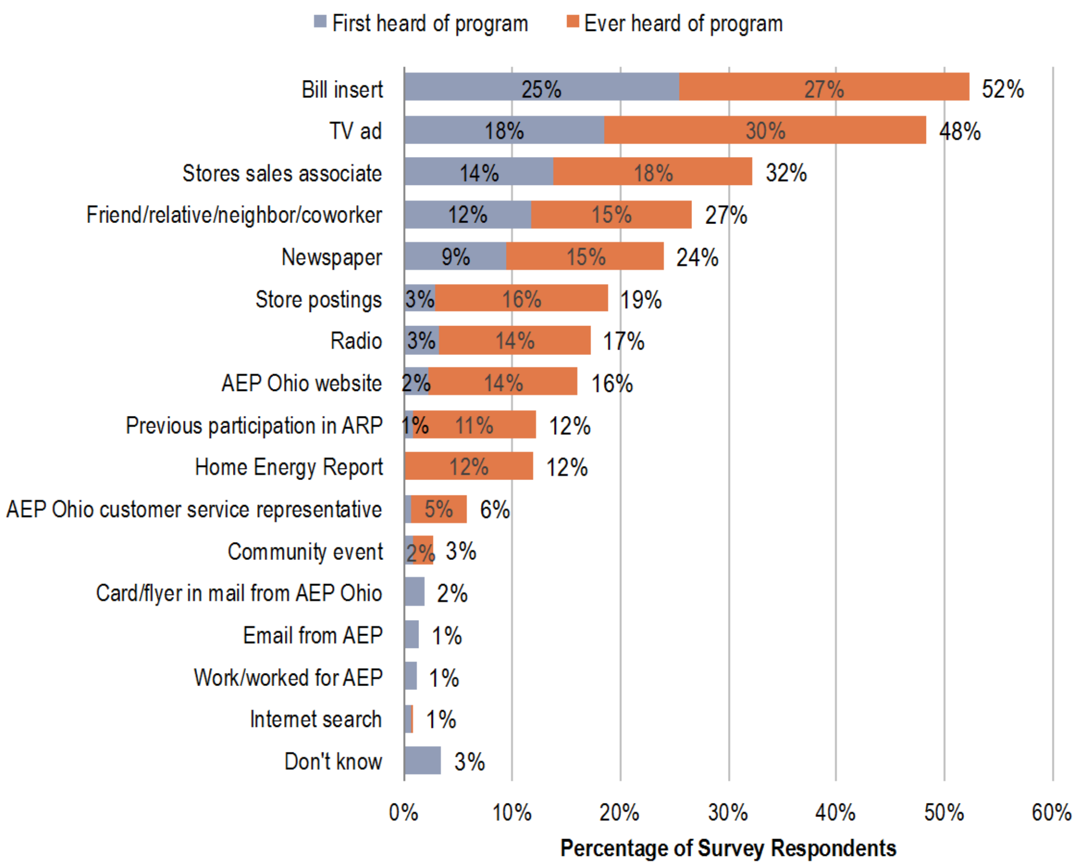
Figure 3-1. Where Survey Respondents Heard of the Appliance Recycling Program



Compared to 2012, there was a statistically significant increase among survey respondents in overall awareness from TV advertising (up to 48 percent from 38 percent), sales associates (up to 32 percent from 22 percent), and store postings (up to 19 percent from 12 percent).[8] These results point to an overall trend of increased program awareness from retailers, with 36 percent of survey respondents learning about the program at some point from a sales associate and/or a store posting.[9] This response has steadily and significantly increased in prevalence since 2011 and 2010, when awareness from either retailer source was 25 percent and 10 percent, respectively. Interestingly, the retailers from which participants are learning of the program are not all participating retailers. Of the 136 survey respondents who learned from a retailer source of some sort, only 33 (24 percent) learned from one of the two participating retailers; the remaining respondents reported learning about the program from a total of 19

[8] Awareness increased among participants in the following sources: TV advertisement s(x^2 (1) = 7.592; p = 0.004); sales associate (x^2 (1) = 9.493; p = 0.001); and store postings (x^2 (1) = 6.241; p = 0.008).

[9] The 36 percent of respondents who heard about the program from a sales associate and/or store posting is smaller than the sum of respondents who heard from these two sources because respondents could indicate hearing about the program from *both* the sales associate and store posting.

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different retailers—from large retail chains to small, independent stores. In total, only 9 percent of all surveyed respondents learned through a participating retailer.

3.3.3 Program Participation

The following section provides key findings related to program participation. Topics to be discussed include motivations for appliance disposal, motivations for program participation, enrollment experience, communication with AEP Ohio and program staff, rebate timing and amount, perceived energy savings, and actions absent the program.

3.3.3.1 Motivations for Appliance Disposal

Survey respondents were asked to provide their reasons for disposing of their appliance. Table 3-9 presents reasons for appliance disposal, with the most frequently mentioned responses including the appliance was not working properly (36 percent), the appliance was not energy efficient (28 percent), there was no need for the appliance (24 percent), and the appliance was old (21 percent). It is worth noting that 7 percent of the respondents said that the opportunity to take advantage of the program was one of the key reasons for disposing of their appliance.

Table 3-9. Participants Reasons for Disposing of Appliance

Reasons for Disposing of Appliance	Refrigerator (n=309)		Freezer (n=70)		Total (n=379)	
	Count	%	Count	%	Count	%
The appliance was not working properly	117	38%	19	27%	136	36%
The appliance was not energy efficient	77	25%	28	40%	105	28%
The appliance was a spare that I did not use / I did not want it anymore or no longer needed it	68	22%	22	31%	90	24%
The appliance was old	64	21%	14	20%	78	21%
I wanted an appliance with more modern features	42	14%	7	10%	49	13%
I wanted to take advantage of AEP Ohio's offer to remove it for free	24	8%	2	3%	26	7%
The appliance was expensive to run	22	7%	5	7%	27	7%
I wanted to take advantage of the rebate	16	5%	5	7%	21	6%
I wanted a smaller appliance	7	2%	8	11%	15	4%
I wanted a bigger appliance	17	6%	0	0%	17	4%
I got a new primary appliance, so wanted to replace the secondary appliance with the old primary	8	3%	0	0%	8	2%

Note. Responses do not sum to 100% because multiple responses were accepted.

Beyond their motivation to dispose of their appliance, survey respondents were asked to report on reasons for participating in the Appliance Recycling Program over other disposal options. The most frequently mentioned motivations included the cash incentive (74 percent), the convenience of the at-

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home pickup (46 percent), and that the program disposed of the appliance in an environmentally sound fashion (17 percent). Over half of the surveyed participants (53 percent, n = 199) reported that their *primary* reason for participating in the program was the cash incentive. In fact, 57 percent of the survey respondents said that the rebate "very much" influenced them to participate in the program, while only 4 percent of the respondents said the rebate had no influence at all on their decision to participate in the program.

3.3.3.2 Motivations for Program Participation

Overall, respondents reported that the cash incentive was the largest influence on their decision to participation in the program. On a scale of 1 (meaning "not at all") to 5 (meaning "very much"), the mean score for the level of influence the incentive had on program participation was 4.11, indicating strong influence. In fact, 74 percent of all survey respondents reported that the incentive was a key motivator to participation, when considering other disposal options. Table 3-10 below provides the variety of survey respondents' reported motivations for participating in the Appliance Recycling Program, in addition to the cash incentive. Other common reasons included the convenience of an at-home pickup and the benefit of having the appliance recycled in a way that is good for the environment.

Table 3-10. Motivations for Participating in AEP Ohio Appliance Recycling Program Over Alternative Disposal Options

Reason for Participation	Frequency	Percent
The cash incentive	279	74%
The convenience of at-home pickup	174	46%
To dispose of appliance in a way that is good for the environment	64	17%
The pickup was free	19	5%
Did not know of any other option	12	3%
Retailer recommended it	4	1%
Wanted to get rid of it quickly	3	1%
Wanted to participate in contest for oldest refrigerator	3	1%
Friend/family recommended it	2	1%

Note. The total does not add to 100% because respondents were allowed to provide multiple responses.

3.3.3.3 Enrollment Experience

Enrollment through the call center was the most popular method (71 percent), followed by website (28 percent), and in-store sign up (1 percent). Table 3-11 below provides the details related to the number of customers who signed up for the program via each possible enrollment method. Although there were

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relatively few business customers (2 percent, $n = 364$), they were more likely to enroll via the call center, when compared to residential customers.[10]

Table 3-11. Source of Participant Application

Application Processing Source	Frequency	Percent
Call Center	12,557	71.2%
Website	4,994	28.3%
Retailer QuickLink Application	91	0.5%
Total	17,642	100.0%

One of the key findings from the 2012 evaluation was that enrollment through retailer partners was low, and that there was room for growing in-store enrollment. As a result, program staff ran a trial to determine whether a "SPIF" paid to retail partner sales associates could be an effective way to drive enrollment in the program through the retail channel. Retail sales associates received a $15 to $20 incentive for every customer they enrolled in the program between September 28 and December 31. According to JACO staff, sales associates received $20 if they enrolled customers in-store using the Quick Links system and $15 if customers enrolled over the phone.

Despite the SPIFs, in-store enrollment rates through the Quick Links system did not change significantly in 2013. The vast majority of participants (71 percent) enrolled over the phone through the call center; a smaller, but sizable, portion of participants (28 percent) signed up through web enrollment. The remaining participants ($n = 91$, 0.5 percent) enrolled through the retailer Quick Links system, at a similar rate to the in-store enrollment numbers reported in 2012 ($n = 84$, 0.6 percent). Although this represents a very small number of participants, a total of 540 (3 percent) customers used the retailer partnership in some capacity (i.e., by enrolling through a different channel than Quick Links). Figure 3-2 below highlights the proportion of customers who signed up via each enrollment method by month. The 1 percent enrollment rate for October suggests that the SPIF incentive had no impact on enrollment coordinated through retail partners.

[10] Specifically, 76 percent of business customers enrolled via call center, compared to 70 percent of residential customers (x^2 (2) = 6.093, $p = 0.048$).

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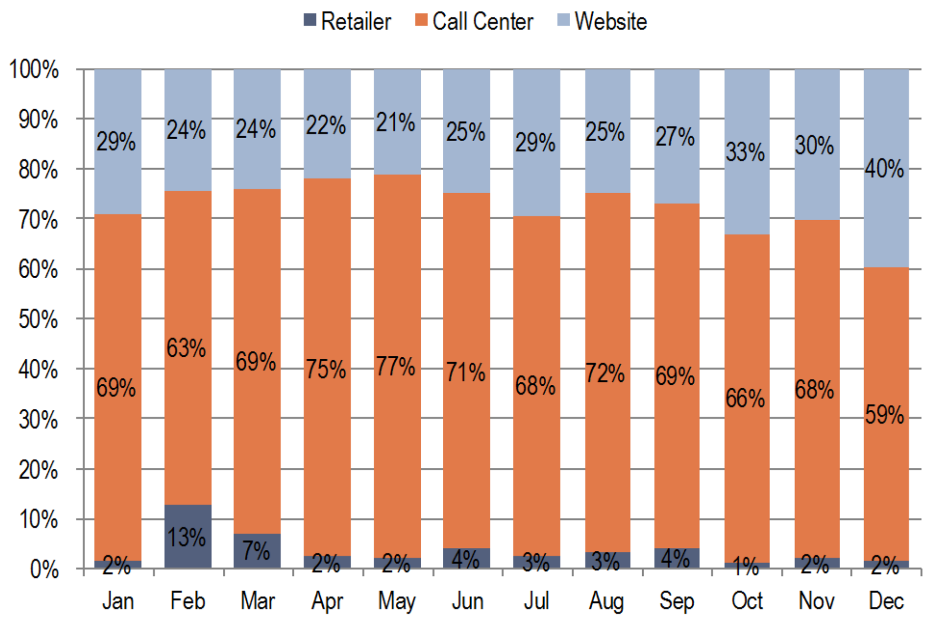
Figure 3-2. Percentage of Participants in Each Enrollment Channel by Month



Note. "Retailer" accounts for all participants whose participation in the program was coordinated with a retailer pickup/drop off service.

Of the 540 participants who coordinated the pickup of their recycled appliance with the drop-off of a new appliance through the retailer partner, 449 participants ultimately enrolled in the program via phone or website. In other words, of those that used the retailer partnership in some capacity, only 17 percent enrolled in the program while in the store. Additionally, only 20 percent (n = 461) of respondents who reported becoming aware of the program through a retailer ultimately enrolled through a participating retailer.

Overall, survey respondents reported high satisfaction with the enrollment experience, with 90 percent saying they were "very satisfied" and less than one percent dissatisfied with the sign-up experience, as shown in Table 3-12.

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Table 3-12. Reported Satisfaction with Sign-Up Experience

Satisfaction Rating	Frequency	Percent
5 - Very satisfied	303	89.9%
4	22	6.5%
3	11	3.3%
2	0	0.0%
1 - Very dissatisfied	1	0.3%
Total	337	100.0%

Note. Results are not shown for the 40 respondents who were not asked the question because they were not the one in the household to sign up and the two respondents who reported "Don't know" to this question

Most respondents (96 percent) who enrolled over the phone (n = 306) reported that the customer representative was polite and that all of their questions about the program were answered during the sign-up process. The respondents who enrolled on the website (n = 73) were equally satisfied with the sign-up experience. In fact, 98 percent reported that it was easy to find the sign up screen, and 90 percent said that they received confirmation that their sign up had been successful. Three individuals reported that the website did not answer all of their questions about the program, including:

- One said that they had issues with getting the correct name associated with the billing address.
- One said they got more information from the flyer they received than from the website.
- One said that they had issues with timeliness because the scheduling a pickup online was difficult in their geographic area.

3.3.3.4 Appliance Collection Process

A total of 373 respondents (98 percent) reported that they were able to schedule a pickup date and time that was convenient. Of the participants that knew when they scheduled the pickup, 99 percent said that they were able to schedule it within 6 weeks of sign up. In fact, 86 percent reported scheduling their pickup within two weeks of enrollment. Overall, satisfaction with the time it took for appliance collection after sign up was high, as shown in Table 3-13.

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Table 3-13. Satisfaction with Time it Took Between Scheduling and Pickup

Satisfaction Rating	Frequency	Percent
5 - Very satisfied	290	77.3%
4	40	10.7%
3	32	8.5%
2	10	2.7%
1 - Very dissatisfied	3	0.8%
Total	375	100.0%

Note. Results are not shown for the four respondents who reported "Don't know" to this question.

In fact, 87 percent of respondents said they received a call in advance of the pickup to confirm the appointment; an additional 11 percent (n = 42) did not know or remember a call, while only 2 percent (n = 7) were certain that they did not receive a call. The vast majority (97 percent) reported that the collection team arrived during the scheduled appointment time; an additional 1 percent (n = 5) did not know if the team arrived during this timeframe, and 1 percent (n = 5) reported that they arrived outside of the scheduled time. Because of the collection team's ability to deliver service in the allotted timeframe and provide a reminder of the appliance collection, satisfaction with the appliance collection team was very high, as shown in Table 3-14.

Table 3-14. Satisfaction with Appliance Collection Team

Satisfaction Rating	Frequency	Percent
5 - Very satisfied	351	93.4%
4	17	4.5%
3	6	1.6%
2	0	0.0%
1 - Very dissatisfied	2	0.5%
Total	376	100.0%

Note. Results are not shown for the three respondents who reported "Don't know" to this question.

Of the two respondents who were "very dissatisfied" with the collection team, one reported that the collection team scratched the floor where the appliance was picked up, while the other respondent reported that the collection team picked up the wrong appliance.

3.3.3.5 Communication with AEP Ohio and Program Staff

Following enrollment, only 39 respondents (11 percent) contacted AEP Ohio or program staff with questions. Of these, 29 contacted them only once, with the remaining 10 contacting them multiple times. Satisfaction with these interactions was very high, as shown by Table 3-15.

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Table 3-15. Satisfaction with Communication with AEP Ohio and Program Staff

Satisfaction Rating	Frequency	Percent
Very satisfied	24	61.5%
Somewhat satisfied	7	17.9%
Neither satisfied nor dissatisfied	6	15.4%
Somewhat dissatisfied	1	2.6%
Very dissatisfied	1	2.6%
Total	**39**	**100.0%**

Note. This question was not asked of the 340 respondents who did not contact program staff following sign up.

The two respondents who reported being less than satisfied with communication with AEP Ohio and program staff provided reasons for their dissatisfaction. One said that there was miscommunication between AEP Ohio and JACO, leaving the respondent to contact AEP Ohio about when the pickup would happen instead of hearing directly from JACO. One said that they have not yet received their check, despite contacting program staff multiple times; this respondent has given up on trying to contact AEP Ohio staff out of frustration with the communication.

3.3.3.6 Rebate Timing and Amount

While the incentive amount for customers was $50 for the first nine months of the year, it was increased to $60 from October 1 to December 24 in an attempt to increase enrollment over the last quarter of the year. As stated above, the incentive was a main driver to participation for survey respondents. Overall, respondents reported high satisfaction with both the rebate amount (mean score of 4.71) and the time it took to receive the rebate (mean score of 4.46) on the 1 to 5 scale, with 1 meaning “very dissatisfied” and 5 meaning “very satisfied.”

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Table 3-16 illustrates that satisfaction with the rebate amount was very high among survey respondents.

Table 3-16. Satisfaction with the Payment Amount

Satisfaction Rating	Frequency	Percent
Very satisfied	291	78.4%
Somewhat satisfied	60	15.8%
Neither satisfied nor dissatisfied	13	3.4%
Somewhat dissatisfied	5	1.3%
Very dissatisfied	2	0.5%
Total	371	100.0%

Note. Results are not shown for the eight respondents who reported "Don't know" to this question.

The seven dissatisfied respondents were given the opportunity to provide a rebate amount that they would have preferred. Responses included: \$50 ($n = 2$), \$75 ($n = 2$), and \$100 ($n = 2$). The remaining participant reported wanting reimbursement to pay for the floor that was ruined in the course of participation. It is important to note that two of these respondents reported wanting \$50—the actual amount of the rebate.

Table 3-17 below highlights how satisfaction was high among the survey respondents for the time it took to receive the rebate, as 91 percent of those who provided an estimate reported receiving the check within six week of appliance pickup. In total, 91 respondents reported to not knowing how long it took to receive the rebate, and only two respondents reported that they had not yet received their checks, waiting 8 and 50 weeks.

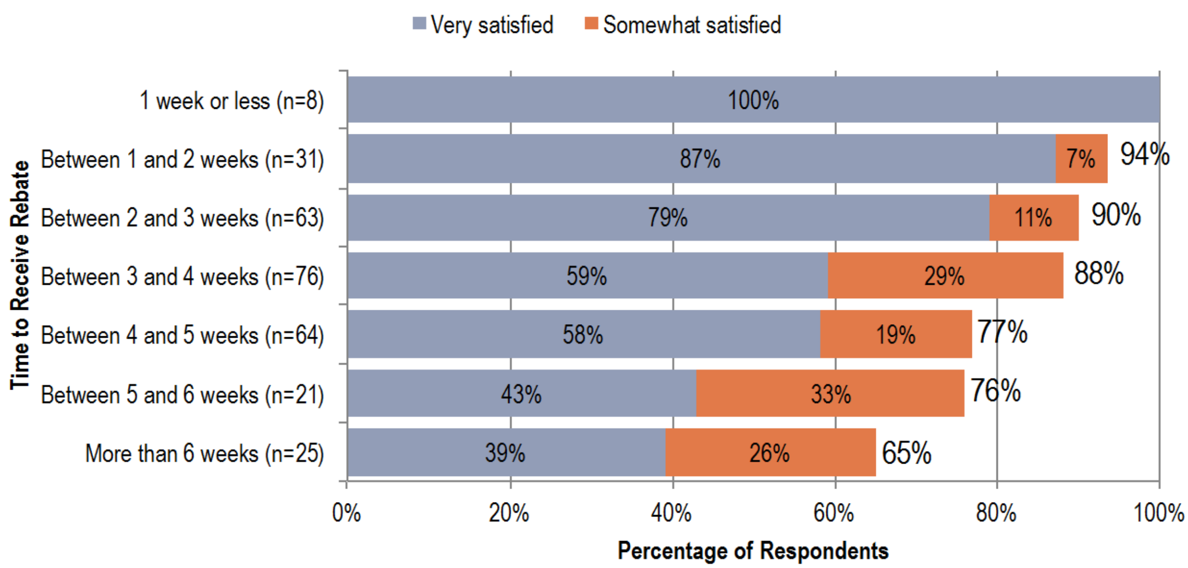
Table 3-17. Satisfaction with the Time to Receive Rebate

Satisfaction Rating	Frequency	Percent
Very satisfied	184	64.6%
Somewhat satisfied	56	19.6%
Neither satisfied nor dissatisfied	37	13.0%
Somewhat dissatisfied	7	2.5%
Very dissatisfied	1	0.4%
Total	285	100.0%

Note. Results are not shown for the one respondent who reported "Don't know" to this question and for the 93 respondents who were not asked the question.

As might be expected, satisfaction with the time it took to receive the rebate was closely related to how long each respondent reported waiting for their rebate, as shown in Figure 3-3. As time between pickup and rebate receipt increased, the proportion of very satisfied respondents decreased. Respondents who received their rebate checks within 2 weeks had average satisfaction mean of 4.85, while those who received it between 2 and 6 weeks had a mean score of 4.44, and those who waited for more than 6 weeks reported a mean score of 3.91, on a scale of 1 being "very dissatisfied" and 5 being "very satisfied."

Figure 3-3. Percentage of Respondents at Least Somewhat Satisfied with Time to Receive Rebate



Note. The 91 respondents who responded "don't know" to the length of time to receive rebate are not included here.

3.3.3.7 *Perceived Energy Savings*

Nearly half of the survey respondents (46 percent, $n = 142$) reported noticing energy savings on their electric bills after recycling their appliance. There were a larger proportion of respondents who recycled a freezer who reported energy savings (64 percent) compared to those who recycled a refrigerator (43 percent).[11] Figure 3-4 breaks the difference in if the respondent realized savings by if the appliance was replaced after their appliance was recycled.

[11] This represented a statistically significant difference based on appliance type recycled (x^2 (1) = 8.117, $p = 0.003$).

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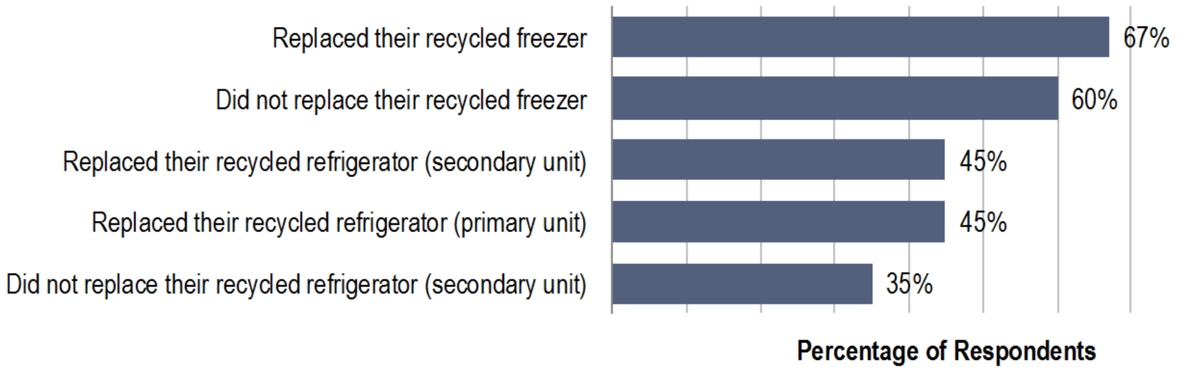
Figure 3-4. Percentage of Respondents Who Noticed Energy Savings by Appliance Type and Replacement Status



Of those who noticed energy savings (n = 141), 92 percent of the respondents reported being at least somewhat satisfied with these energy savings, as shown in Table 3-18. Satisfaction did not vary based on the type of appliance recycled or if the respondent replaced the appliance.

Table 3-18. Satisfaction with Energy Savings

Satisfaction Rating	Frequency	Percent
Very satisfied	85	60.3%
Somewhat satisfied	44	31.2%
Neither satisfied nor dissatisfied	10	7.1%
Somewhat dissatisfied	2	1.4%
Very dissatisfied	0	0.0%
Total	141	100.0%

Note. The 237 respondents that did not notice energy savings were not asked this question; one respondent reported “Don’t know” to this question and is not included in this table.

3.3.3.8 Actions Absent the Program

The participant survey results provide evidence that the program is effective in influencing customers to remove appliances from service that may have otherwise continued to contribute to residential electrical consumption and demand. As shown in Table 3-19, respondents reported that, without the program, 68 percent of the appliances would have either been kept in service at some level (e.g., used at least some of the time) or disposed of in such a way that the appliance may have remained in service elsewhere (e.g., sold, given away for free). The most common methods of disposal absent the program included taking the appliance to the dump or recycling center (28 percent), having the appliance removed by the dealer where they purchased a new appliance (23 percent), and giving it away for free (22 percent).

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Table 3-19. What Participants Would Have Done with the Appliance Without the Program

Status	Action Absent the Program	Refrigerator Count	Refrigerator %	Freezer Count	Freezer %	Total Count	Total %
Off Grid	Dump/Recycling Center	85	28.9%	15	21.7%	100	27.5%
	Stored unplugged	10	3.4%	6	8.7%	16	4.4%
Total Off Grid		95	32.3%	21	30.4%	116	32.0%
Potentially On Grid	Sold it	20	6.8%	5	7.2%	25	6.9%
	Gave it away for free	58	19.7%	22	31.9%	80	22.0%
	Removed by dealer	73	24.8%	11	15.9%	84	23.1%
	Used at least some of the time	48	16.3%	10	14.5%	58	16.0%
Total Potentially On Grid		199	67.7%	48	69.6%	247	68.0%
Total		294	100.0%	69	100.0%	363	100.0%

Note. The 16 respondents who replied "Don't know" to this question are not included in the table.

These findings are very similar to those identified during the 2012 program evaluation (72 percent of appliances would have potentially been on-grid) and suggest that the program is continuing to influence the removal of less-efficient appliances.

3.3.4 Cancelled Appointments

As shown in Table 3-20, the overall dropout rate for the 2013 program year was 11 percent, which is a slight decrease from 2012 (12 percent dropout rate) and 2011 (14 percent dropout rate). Of all the customers who enrolled in the program at some point, 89 percent eventually participated in the program.

Table 3-20. Participation and Dropout After Initial Enrollment in the Program

Behavior After Initial Enrollment	Number of Customers	Percent of Customers
Kept Original Appointment and Never Cancelled	15,750	79.4%
Cancelled At Least Once And Eventually Participated	1,892	9.5%
Cancelled At Least Once And Never Participated (e.g., "Near-Participants" or "Dropouts")	2,202	11.1%
Total Number of Customers Who Initially Enrolled in the Program	19,844	100.0%

Note. Customers that had valid data populated in the "ClientPremiseID" field were included in this analysis.

This table shows that there were 4,094 customers who cancelled an appointment with the Appliance Recycling Program at some point. Of these, 46 percent (n = 1,892) eventually participated in the program, while the remaining 54 percent (n = 2,202) ultimately did not participate in the program. Out of all of these cancellations, 89 percent (n = 3,651) cancelled their appointment only once, 9 percent (n = 385) cancelled twice, and 2 percent (n = 58) cancelled at least three times.

3.3.5 Current Program Challenges and Opportunities for Improvement

Interviews with a partnering retailer and program staff identified two key challenges facing the program: 1) low rates of enrollment at partnering retailers, and 2) difficulties of cross-promoting the program.

As in previous years, the primary improvement opportunity for the Appliance Recycling Program is the retail partnership. According to one program staff member, the biggest challenge facing the program is recruiting retailers to partner in the program. Beyond the issue of convincing unaffiliated retailers, there is the issue that the two current retailers are not great sources of program enrollment. Despite a full year with two retail partners, enrollment through this channel remains relatively low. Interestingly, there is also a trend of increased awareness of the program through sales associates and in-store advertisements since previous evaluations. Although there is increased awareness through these sources, it has not lead to an increased in-store enrollment, which points to a significant challenge the program has in getting retailers to actively enroll participants. Program staff have attempted to address this issue by creating incentives for retailer associates for signing up customers; unfortunately, analysis of the program tracking data does not show that this effort increased enrollment.

The retailer interviewed was unable to explain the low levels of in-store enrollment from their stores. Despite the low rate of enrollment, the retailer reported to be satisfied with how the program is currently enrolling participants. The retailer uses the program as a sales tool and believes it to be a differentiating service provided to customers. By streamlining the replacement of an appliance to only one visit and one delivery fee for their customers, as well as the added benefit of providing rebates, this retailer says there is no downside to the partnering arrangement. This individual made the following suggestions to make the program more useful: (1) make the program literature and marketing materials clearer regarding the size requirements of the recycled appliances; (2) publicize the program and the rebate more widely to the general population through TV commercials, postcards, and bill inserts; and (3) provide incentives to sales people to encourage them to get customers to participate.

The second major challenge is cross-promotion of the Appliance Recycling Program with other energy efficiency initiatives. Currently, AEP Ohio has cross-promotion efforts for the program and the Efficient Products Program and the In Home program. The purpose of these cross-promotion initiatives is to raise awareness across a wide base of customers who are engaged in different energy efficiency programs. One staff member said that there is potential in expanding the promotion to the in-home audit program to identify program-eligible units and enroll customers on the spot. Additionally, there is opportunity to expand the program's exposure to multi-family buildings by targeting marketing materials to property managers and working with participants in the Multifamily Direct Install Program. There may be some challenges in cross-promoting the program in the future, as programs are run by a variety of sub-contractors, each with their own processes and customer markets. For this reason, AEP Ohio may need to help coordinate messaging opportunities on a high level. In 2013, there was one pickup from a multifamily building that resulted in 20 refrigerators being picked up on one account number.

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In the participant survey, respondents were given the opportunity to provide suggestions for improving the program. Of the 98 respondents who provided feedback, responses included:

- Offer a larger rebate (*n* = 20)
- Send rebate checks sooner following pickup (*n* = 14)
- Improve communication and messaging for the program (*n* = 14)
    - Specifically, participants had the following suggestions: communicate that the appliance does not need to be cleaned prior to pickup (*n* = 3); communicate more clearly that the appliance is not going to the needy (*n* = 2); offer more information on how and where to purchase an energy efficient replacement (*n* = 2); communicate the winner of the promotional contests (e.g., the oldest refrigerator) to those who participated in the contest (*n* = 2).
- Publicize the program more (*n* = 3)
- Make the timeframe between scheduling and pickup shorter (*n* = 12)
- Include other appliances in the program (*n* = 8)
- Offer more convenient and flexible hours for appliance pickup (*n* = 7)
- Make the rebate check look less like junk mail (*n* = 2)
- Increase the program's capacity to allow for more than two pickups per year (*n* = 2)

Additionally, in an effort to understand the best methods of reaching AEP Ohio customers who might be interested in the Appliance Recycling Program, survey respondents were asked to provide suggestions as to the best way to get the word out about the program and its offerings. The most frequently mentioned methods of increasing awareness included including more information in bill inserts and TV advertisements. The full list of suggestions from the 130 respondents who provided insight is included in Table 3-21.

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Table 3-21. Participant Preferred Sources of Program Promotion

Advertising Avenue	Frequency	Percent
More information within the billing communication (e.g., flyers, inserts, information on e-bills)	56	15%
TV advertisements	54	15%
Local newspapers	22	6%
Radio advertisements	19	5%
Signs in appliance retailers	14	4%
Encourage sales associates to promote the program	10	3%
Improve billing statement advertisements (e.g., user bolder fonts, emphasize the program more)	8	2%
Flyers or pamphlets attached to appliances at retailers	5	1%
Social media advertising	3	1%
Web advertising	3	1%
Billboards	2	1%
Magazines	2	1%
Local news TV programs	2	1%
Advertising on appliance retailer websites	2	1%

Note. This represents the responses from 130 participants who provided suggestions. In total, 236 reported that they had "no suggestions", while three reported "Don't know"; the remaining 10 respondents were not asked the question because it was added to the survey instrument after pre-testing had completed.

3.4 *Cost Effectiveness Review*

This section addresses the cost effectiveness of the Appliance Recycling Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-22 summarizes the unique inputs used in the TRC test.

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Table 3-22. Inputs to Cost-Effectiveness Model for Appliance Recycling Program

Item	Value
Average Measure Life	8
Units	19,392
Annual Energy Savings (kWh)	26,179,986
Coincident Peak Savings (kW)	4,189
Third Party Implementation Costs	$948,311
Utility Administration Costs	$357,969
Utility Incentive Costs	$2,308,964
Participant Contribution to Incremental Measure Costs	$0

Based on these inputs, the TRC ratio is 2.7. Therefore, the program passes the TRC test. Table 3-23 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-23. Cost Effectiveness Results for the Appliance Recycling Program

Test Results for Appliance Recycling	
Total Resource Cost	2.7
Participant Cost Test	11.5
Ratepayer Impact Measure	0.5
Utility Cost Test	2.7

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

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4 Conclusions and Recommendations

4.1 *Conclusions from Program Year 2013*

Detailed conclusions for the 2013 Appliance Recycling Program evaluation follow.

1. **Audited savings matched program e*x ante* values based on the Draft Ohio TRM.** There were no issues in the review of audited savings which resulted in a realization rate of 1.0 for both energy and demand savings.

2. **Overall, the Appliance Recycling Program is running very smoothly.** The program has not undertaken any significant changes since 2012 and continues to provide significant savings and high satisfaction from customers.

3. **The retailer partnership component of the program continues to be challenging, but there are opportunities to increase promotion of the program in a variety of retailer settings.** Despite attempts to increase in-store enrollment at retail partners, this component continues to account for a small portion of appliance pickups. However, retailers remain an important source of program awareness and opportunities exist to continue to message the program in retailer settings.

4.2 *Recommendations for Program Improvements*

The 2013 evaluation resulted in two main recommendations.

1. **Continue allocating funds toward marketing channels similar to those employed at the end of 2013, as they appear to have led to a notable increase in monthly appliance pickups in the last quarter of the year**. While appliance pickups in previous years have peaked in the summer (June–August), in 2013 these grew during the year and peaked in October through December. The large increase in pickups at the end of 2013 differed from previous years, which the program staff attributed to the increase in marketing for the program to advertise the increased incentive; in past years, marketing of the program has nearly ceased at the end of the year.

2. **Conduct concerted outreach to non-partnering retailers to ensure that the program is being messaged properly and promotional materials are provided as needed.** A formal outreach initiative could ensure that sales associates are educated on the program and have all appropriate messaging materials.

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Appendix A Methodology, Findings, and Survey Instruments

Appendix A describes additional details of the methodology and findings, as well as survey instruments used for data collection for the 2013 evaluation of the AEP Ohio Appliance Recycling Program. Specifically, Appendix A includes the following sections:

- Detailed tracking data review and program activity
- PJM Methodology for adjusted impact evaluation
- Adjusted impact evaluation results
- Data collection instruments
- Appliance Metering Memorandum

A.1 Tracking Data Review and Program Activity

The evaluation team reviewed the AEP Ohio tracking data to inform both the audited and adjusted impact evaluation. This tracking data consisted of three main data files, all of which were reviewed for completeness. The evaluation team used the full file "AppRecUnits2013-FullYear" to calculate the audited savings detailed in the body of this report, as well as to conduct the adjusted impact evaluation, as discussed in the next section of this Appendix.

There was a slight inconsistency in appliance count between the first and second files listed here:

- AppRecUnits2013-FullYear_unencrypted.sav, contained 15,570 refrigerators.
- AppRecSavings2013-FullYear_unencrypted.sav, contained 15,569 refrigerators.
- AppRecCustomers2013-FullYear_unencrypted.sav, contained participant data, and was not used in the impact calculations.

Twenty of the refrigerators in the program tracking data were determined to have been recycled prior to the program year and so were removed from the appliance counts and savings calculations.

The field "MeasVintage," which provides the year of appliance manufacture and is used to calculate appliance age in ex post savings equations, was assigned values of "0" for 13 units (9 refrigerators and 4 freezers) in the tracking data. As this field was used to estimate the adjusted savings, the evaluation team assumed an average age (20.06 and 24.19 for refrigerators and freezers, respectively) for these 13 appliances.

A.1.1 Appliance Characteristics

This section provides a summary of program activity, as well as a detailed description of the appliances collected through the 2013 AEP Ohio Appliance Recycling Program. This information about program appliances was used to develop adjusted savings, as detailed below. Alongside the discussion of appliance characteristics is a description of any invalid information discovered in the program tracking data and how these data were treated in order to carry out the subsequent impact analyses.

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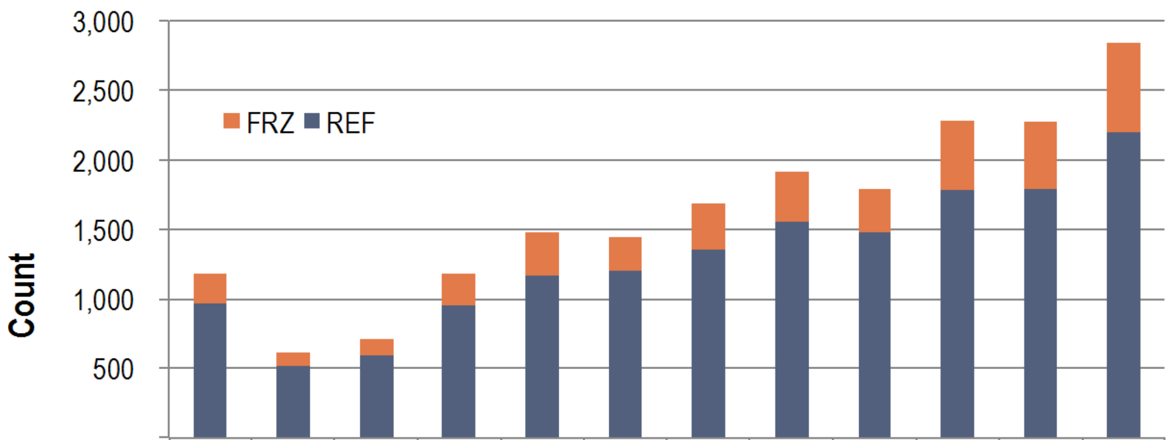
Appliances Recycled by Month

Figure A-1 shows refrigerators and freezers recycled by month. The most appliances were recycled in December 2013, with 642 freezers and 2,196 refrigerators picked up that month.

Figure A-1. Appliance Recycled by Month



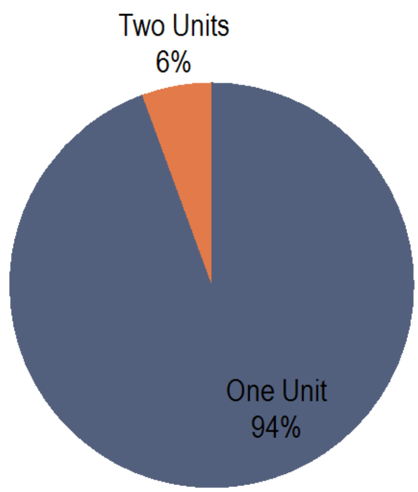
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
FRZ	222	95	120	227	307	245	324	360	324	496	481	642
REF	959	515	595	954	1,170	1,202	1,358	1,554	1,469	1,784	1,793	2,196

Month

Appliances Recycled per Participant

As shown in Figure A-2 the majority of participants recycled a single unit. Six percent of participants recycled 2 appliances through the program.

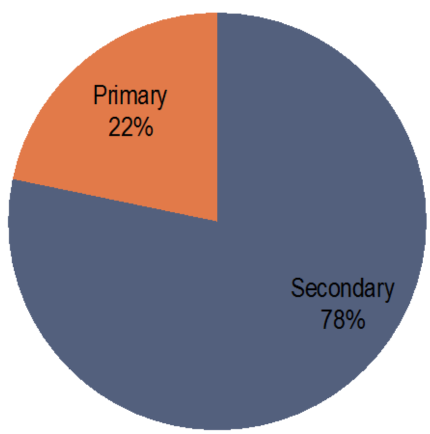
Figure A-2. Appliances Recycled per Participant



Appliances Recycled by Primary or Secondary Use

All freezers recycled through the program were assumed to be secondary units, used in addition to a main refrigerator. Figure A-3 shows the breakdown of primary versus secondary refrigerators recycled through the program, as recorded in program tracking data. The majority of recycled refrigerators were secondary units.

Figure A-3. Appliances Recycled by Primary or Secondary Use (Refrigerators; n = 15,549)



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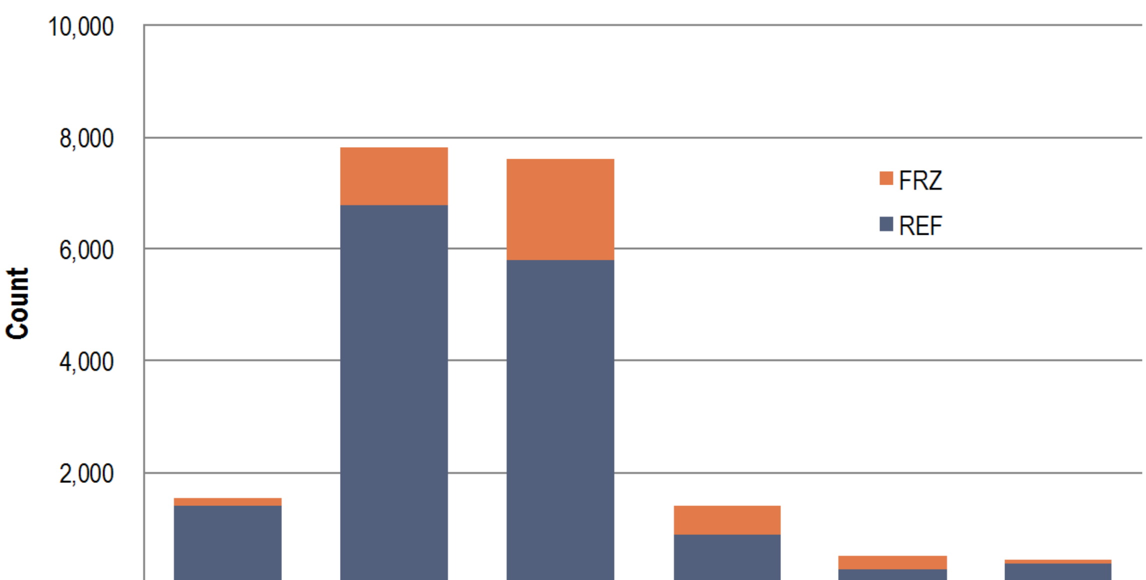
Appliances Recycled by Age

The average age of refrigerators recycled through the program was 20.1 years. The average age of freezers was greater, at 24.2 years. Most of the appliances were between 10 and 29 years old, but there were a number of significantly older appliances (see "50 or more" years in Figure A-4). Note that age was missing for 9 refrigerators and 4 freezers in the tracking data; for these appliances, the evaluation team assumed an average age (20.06 and 24.19 for refrigerators and freezers, respectively).

Figure A-4. Appliances Recycled by Age (Years)



	less than 10	10 to 19	20 to 29	30 to 39	40 to 49	50 or more
FRZ	159	1,056	1,808	510	219	87
REF	1,396	6,776	5,807	888	296	378

Appliances Recycled by Size

The average size of refrigerators recycled through the program was 18.8 ft^3, with a minimum of 6 and maximum of 32 ft^3. The average size of freezers was slightly smaller, at 16.3 ft^3, with ranging from 10 to 32 ft^3. There were four refrigerators less than 10 ft^3. Even though these units would not ordinarily qualify for the program, these four refrigerators were recycled as part of the "Oldest Fridge" contest and so contributed to 2013 savings. Appliance size is presented in Figure A-5.

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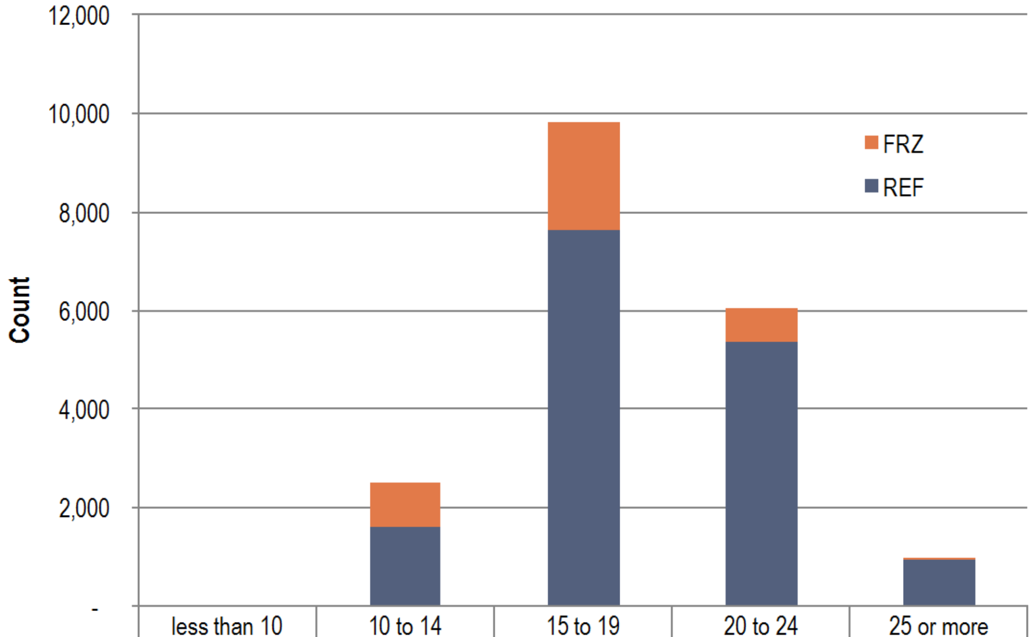
Figure A-5. Appliances Recycled by Size (ft³)



	less than 10	10 to 14	15 to 19	20 to 24	25 or more
FRZ	-	919	2,173	703	48
REF	4	1,601	7,649	5,355	941

A.2 PJM Methodology for Adjusted Impact Evaluation

The evaluation team collected primary metered data for a sample of program appliances with the intention of bidding these savings into PJM. The results of this metering study were used to inform adjusted savings estimates for this evaluation. The evaluation team metered in situ electricity demand data from refrigerators and freezers recycled in the AEP Ohio territory and used this data to model the energy consumption and demand of appliances as a function of key appliance characteristics such as size and age. The evaluation team presented a full description of this metering study as a memorandum to AEP Ohio, which is also included as an attachment to this report, in Section A.5.

The final equations for estimating energy consumption from the metering study are presented below for refrigerators and freezers.

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Equation A-1. Annual UEC for Refrigerators (kWh)

$$
\begin{aligned}
\boldsymbol{UEC_{Ref}} \cong\ & 184.30 \\
& + 287.20 \times \boldsymbol{PrimaryUseDummy} \\
& + 29.27 \times \boldsymbol{SizeInCuFt} \\
& + 309.22 \times \boldsymbol{SidebySideDummy} \\
& + 286.17 \times \boldsymbol{Pre1993Dummy}
\end{aligned}
$$

Equation A-2. Annual UEC for Freezers (kWh)

$$
\begin{aligned}
\boldsymbol{UEC_{Frz}} \cong\ & + 409.38 \\
& + 0.71\, \boldsymbol{SizeInCuFt} \times \boldsymbol{AgeInYears} \\
& + 372.30 \times \boldsymbol{Pre1993Dummy}
\end{aligned}
$$

The final equations for estimating peak demand from this metering study are presented for refrigerators and freezers.

Equation A-3. Peak Demand for Refrigerators (kW)

$$
\begin{aligned}
\boldsymbol{PD_{Ref}} \cong\ & + 0.022 \\
& + 0.096 \times \boldsymbol{CDD/100} \\
& + 0.044 \times \boldsymbol{PrimaryUseDummy} \\
& + 0.316 \times \boldsymbol{SizeInCuFt/100} \\
& + 0.004 \times \boldsymbol{AgeInYears/100} \\
& + 0.032 \times \boldsymbol{Pre1993Dummy} \\
& + 0.033 \times \boldsymbol{SidebySideDummy} \\
& - 0.053 \times \boldsymbol{SingleDoorDummy} \\
& - 0.139 \times (\boldsymbol{CDD/100}) \times \boldsymbol{PrimaryUseDummy}
\end{aligned}
$$

Equation A-4. Peak Demand for Freezers (kW)

$$
\begin{aligned}
\boldsymbol{PD_{Frz}} \cong\ & + 0.088 \\
& + 0.174 \times \boldsymbol{CDD/100} \\
& - 0.215 \times \boldsymbol{SizeInCuFt/100} \\
& - 0.062 \times \boldsymbol{AgeInYears/100} \\
& + 0.048 \times \boldsymbol{Pre1993Dummy} \\
& - 0.027 \times \boldsymbol{UprightDummy} \\
& + 1.532 \times \boldsymbol{SizeInCuFt/100} \times \boldsymbol{AgeInYears/100}
\end{aligned}
$$

The evaluation team used program tracking data to calculate the appropriate values for the variables in the above equations. In addition, data from the participant survey were used to estimate part-use and summer-use adjustment factors, which were used to adjust savings based on whether appliances were used year-round and during the summer peak period. The results of these calculations are presented in the next section.

A.3 Adjusted Impact Evaluation Results

This section presents the results of the adjusted impact evaluation, including a description of parameters that affect savings, adjusted energy and demand savings, and program realization rates.

A.3.1 Adjusted Savings Parameters

As presented in the equations in the previous section, the evaluation team used several key impact variables to calculate adjusted savings. The evaluation team determined the values for these impact parameters based on the AEP Ohio program tracking data. The values of key adjusted impact parameter for refrigerators are presented in Table A-1. Most refrigerators were secondary units. The average size for recycled refrigerators was 18.76 ft^3. The average age was 20 years, with a range from 2 to 76 years. The variable for Cooling Degree Days (CDD) was only used to estimate peak demand savings, and thus was based on the AEP Ohio Peak Demand Period for 2013, which was July 17, 2013, from 2:00-3:00 p.m.

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Table A-1. Refrigerator Impact Equation Parameters, from Program Tracking Data

Variable	Mean Value	Minimum	Maximum
CDD	28	28	28
PrimaryUseDummy	0.22	0	1
SizeInCuFt	18.76	6	32
AgeInYears	20.08[(a)]	2	76
SideBySideDummy	0.26	0	1
SingleDoorDummy	0.05	0	1
Pre1993Dummy	0.43	0	1

(a) this average value was assumed for the 9 refrigerators with “MeasVintage” = 0 in the tracking data

The values of key *ex post* impact parameters for freezers are presented in Table A-2. The average size of freezers recycled through the program was 16.26 ft^3. The average age was 24 years, with a range from 2 to 66. Sixty-six percent of the units were upright freezers, and sixty-five percent of the units were manufactured before 1993. As with refrigerators, the CDD value based on the AEP Ohio Peak Demand Period for 2013.

Table A-2. Freezer Impact Equation Parameter Values

Variable	Mean Value	Minimum	Maximum
CDD	28	28	28
SizeInCuFt	16.26[(a)]	10	30
AgeInYears	24.19	2	66
UprightDummy	0.66	0	1
Pre1993Dummy	0.65	0	1

(a) this average value was assumed for the 4 freezers with “MeasVintage” = 0 in the tracking data

Next, the evaluation team adjusted per-unit savings values based participant survey data related to the frequency and timing of when the recycled appliances were in use. First, the evaluation team calculated a Part-Use Factor (PUF) to account for those customers who reported using the recycled appliances for only part of the year. The PUF was based on the average of self-reported participant survey data for the number of months over the year that the appliance would have been plugged in and running in the absence of the program (i.e., if the appliance had not been removed) divided by 12 months. This adjustment is summarized in Equation A-5.

Equation A-5. Adjusted Savings with Part-Use Adjustment

$$Adjusted\ Energy\ Savings = PUF * \sum UEC_i$$

Second, the evaluation team estimated a summer use adjustment factor (SUAF) based on the proportion of units that survey respondents reported were operational during the summer, when peak demand occurs. The calculated SUAF was applied to unit demand consumption (UDC) to adjust savings values for summer use, as shown in Equation A-6.

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Equation A-6. Adjusted Demand Savings with Summer Use Adjustment Factor

$$\boldsymbol{Adjusted\ Demand\ Savings = SUAF * \sum UDC_i}$$

The evaluation team estimated values for PUF and SUAF separately for refrigerators and freezers using the 2013 Appliance Recycling Participant Survey responses. These values are summarized in Table A-3.

Table A-3. Part Use Factor and Summer Use Adjustment Factor for Refrigerators and Freezers

Appliance Type	Part Use Factor	Summer Use Adjustment Factor
Refrigerators	0.933	0.960
Freezers	0.924	1.000

A.3.2 Calculated Adjusted Energy and Demand Impacts

The evaluation team determined adjusted savings using the equations and parameter values discussed in the previous sections. The average annual adjusted UEC for refrigerators is 998 kWh and the average annual per unit UEC for freezers is 932 kWh. Full program adjusted energy savings are presented in Table A-4.

Table A-4. Adjusted Energy Savings (kWh) for Refrigerators and Freezers

Appliance Type	Average Unit Energy Consumption (kWh)	Count	Part-Use Factor (PUF)	Total Adjusted Energy Savings (kWh)
Refrigerators	998.34	15,549	0.933	14,483,083
Freezers	931.99	3843	0.924	3,309,447
Total	~	19,392	~	17,792,530

Likewise, the evaluation team determined adjusted demand savings using the equations and parameter values in the previous sections. The average demand for refrigerators is 0.13 kW and the average demand for freezers is 0.16 kW. Full program adjusted demand savings are presented in Table A-5.

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Table A-5. Adjusted Demand Savings (kW) for Refrigerators and Freezers

Appliance Type	Average Unit Demand (kW)	Count	Summer Use Adjustment Factor (SUAF)	Total Adjusted Demand Savings (kW)
Refrigerators	0.129	15,549	0.960	1,932
Freezers	0.161	3,843	1.000	617
Total	~	19,392	~	2,549

Overall adjusted energy and demand savings are presented in

Table A-6. Total adjusted energy savings were 17,793 MWh. Refrigerators accounted for 14,483 MWh (81%) of this total; freezers accounted for the remaining 3,309 (19%). Total adjusted demand savings was 2.55 MW. Refrigerators accounted for 1.93 MWh (76% of total) and freezers accounted for the remaining 0.62 MW (24%).

Table A-6. Overall Adjusted Energy (MWh) and Demand (MW) Savings

Appliance Type	Count	Total Adjusted Energy Savings (MWh)	Total Adjusted Demand Savings (MW)	Percent of Energy Savings	Percent of Demand Savings
Refrigerators	15,549	14,483	1.932	81%	76%
Freezers	3,843	3,309	0.617	19%	24%
Total	19,392	17,793	2.549	~	~

Compared to *ex ante* and audited values, freezers provide relatively more of the program adjusted demand savings. This may be due to a number of factors, such as the relatively older vintage of program freezers (average age of freezers was 24 years, compared to 20 years for refrigerators) and the tendency for freezers to be located in unconditioned space (which increases the effect of the peak period's high temperature on demand). In addition, the metered freezer units on which the equations were based had higher peak demand, on average, than the metered refrigerators.

A.3.3 Adjusted Savings Realization Rates

Realization rates for the adjusted energy savings are presented in Table A-7. The overall realization rate for program energy impacts is 0.68. This value is the ratio of the adjusted energy savings (calculated through the 2013 metering study regression) to the *ex ante* program savings (based on values from the Draft Ohio TRM).

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Table A-7. *Ex Post* Energy Savings Realization Rates

Appliance Type	*Ex Ante* Energy Savings (MWh)	Adjusted Energy Savings (MWh)	Realization Rate
Refrigerator	21,398	14,483	0.68
Freezer	4,782	3,309	0.69
Total	26,180	17,793	0.68

Likewise, the realization rates for the adjusted demand savings are presented in Table A-8. The demand savings realization rate for program freezers (0.80) was considerably higher than the realization rate for refrigerators (0.56). The overall realization rate for program demand impacts is 0.61.

Table A-8. *Ex Post* Demand Savings Realization Rates

Appliance Type	*Ex Ante* Demand Savings (MW)	*Ex Post* Demand Savings (MW)	Realization Rate
Refrigerator	3.42	1.93	0.56
Freezer	0.77	0.62	0.80
Total	4.19	2.55	0.61

The realization rates for energy and demand savings are likely less than 1.00 due to a number of factors, including the fact that the original source for the TRM deemed values is now several years old and may not accurately reflect the distribution of appliances that are now being recycled, as discussed below.

A.4 Data Collection Instruments

A.4.1 AEP Ohio Appliance Recycling Participant Survey

SURVEY OBJECTIVES:

- Determine part-use adjustment factors and coincidence factors to inform impact analysis, by appliance type
- Determine how participants became aware of program.
- Determine participant satisfaction with the program: sign-up, monetary incentive, appliance pickup, scheduling, time between pickup and rebate receipt, overall satisfaction with the program, and satisfaction with AEP Ohio
- Assess what participants would have done with old appliances in the absence of the program.

Note: Survey calls will be made during a mix of weekday daytime, weekday evening, and weekend days to protect against bias.

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SURVEY QUOTAS BY APPLIANCE TYPE:

Strata	Strata Name	Number of Target Completes	Percent of Target Completes [(a)]
1	Refrigerator	307	81%
2	Freezer	70	19%
TOTAL		**377**	**100%**
(a) Percentages reflect the population of appliances recycled in PY 2013 as of September 13, 2013.			

INTRODUCTION

Hello, this is [SURVEYOR NAME] from Blackstone Group calling on behalf of AEP Ohio, your electric utility. This is not a sales call. We are contacting customers who had refrigerators or freezers removed through an appliance pickup and recycling program offered by AEP Ohio. May I please speak with [CUSTOMER_NAME]?

Are you the person who was most involved and familiar with the refrigerator or freezer removal? (IF NOT: May I please speak with the person who was most involved with the removal?)

IF NO REFRIGERATOR OR FREEZER PICKED UP: **RECORD AS SPECIAL DISPOSITION CODE**, THANK, AND TERMINATE

CONTINUE WITH RIGHT PERSON: We are conducting a study to evaluate AEP Ohio's appliance pickup and recycling program and would like to include your opinions. Is this a good time for you? **[IF NO, SCHEDULE A TIME]**

(IF NEEDED: It will take about 15 minutes.)
This call may be monitored or recorded for quality purposes.

SCREENING QUESTIONS

S0. Is your electric company AEP Ohio, Ohio Power (OP), Columbus Southern Power (CSP) or another company?

1. AEP OHIO, OHIO POWER COMPANY (OPC) OR COLUMBUS SOUTHERN POWER (CSP)

04. ANOTHER COMPANY (SPECIFY) **[TERMINATE]**
98. DON'T KNOW **[TERMINATE]**
99. REFUSED**[TERMINATE]**

NAVIGANT

S1. Our records show that you had a refrigerator or freezer picked up by AEP Ohio's subcontractor JACO. Is this correct?

1. YES, CORRECT
2. NO, IT WAS_________ **[RECORD VERBATIM AND TERMINATE; RECORD AS SPECIAL DISPOSITION CODE]**
98. DON'T KNOW **[TERMINATE]**
99. REFUSED **[TERMINATE]**

S2. Was the appliance that was picked up used at your primary residence?

1. YES
2. NO, IT WAS __________ **[RECORD VERBATIM AND TERMINATE; RECORD AS SPECIAL DISPOSITION CODE]**
98. DON'T KNOW **[TERMINATE]**
99. REFUSED**[TERMINATE]**

[IF STRATA = 1 (REFRIGERATOR) READ SECTIONS A AND B. If STRATA = 2 (FREEZER), SKIP TO SECTION C.]

SECTION A: REFRIGERATOR CHARACTERISTICS

A1a. ***Now I'm going to ask you some specific questions about the refrigerator that was picked up by AEP Ohio.***

[IF NEEDED: I would like to ask you questions specifically about the refrigerator that was picked up by AEP Ohio in [EstProjComDate].

Was the refrigerator that was picked up being used as your main refrigerator OR was it a spare/secondary unit?

[READ IF NEEDED: A main refrigerator is typically in the kitchen, a spare/secondary unit is usually kept someplace else, and might or might not be running all the time]
[CLARIFICATION: If customer had recently bought a new refrigerator to use as main refrigerator and was just waiting for the old main refrigerator to be picked up, it should be classified as "main."]
[DO NOT READ RESPONSE LIST; RECORD ONLY ONE RESPONSE]

1. MAIN
2. SPARE/SECONDARY
3. N/A - RESPONDENT IS NOT PRIMARY USER OF FRIDGE (LANDLORD, ETC.) **[TERMINATE]**
98. DON'T KNOW **[TERMINATE]**
99. REFUSED**[TERMINATE]**

A1b. Was the refrigerator that was picked up replaced with another one?

1. YES

NAVIGANT

2. NO
98. DON'T KNOW
99. REFUSED

A2. How old was the refrigerator when AEP Ohio removed it? **[IF CUSTOMER IS UNSURE:]** Your best guess is fine.

[NUMERIC RANGE 1-50; RECORD IN YEARS]
00. LESS THAN ONE YEAR
98. DON'T KNOW
99. REFUSED

A4. What was the **MAIN** reason you chose to dispose of the old refrigerator? **[DO NOT READ RESPONSE LIST; RECORD ONLY ONE RESPONSE]**

1. THE REFRIGERATOR WAS EXPENSIVE TO RUN
2. THE REFRIGERATOR WAS NOT WORKING PROPERLY
3. THE REFRIGERATOR WAS A SPARE THAT I DID NOT USE VERY MUCH/ I DID NOT WANT IT ANYMORE/NO LONGER NEEDED IT
4. THE REFRIGERATOR WAS OLD
5. I WANTED A BIGGER REFRIGERATOR
6. I WANTED A NEW REFRIGERATOR/SOMETHING WITH MORE MODERN FEATURES
7. I WANTED TO TAKE ADVANTAGE OF AEP OHIO'S OFFER TO REMOVE IT FOR FREE
8. I GOT A NEW PRIMARY REFRIGERATOR, SO WANTED TO REPLACE THE SECONDARY WITH THE OLD PRIMARY
9. THE REFRIGERATOR WAS NOT ENERGY EFFICIENT

97. OTHER (SPECIFY:___)
98. DON'T KNOW
99. REFUSED

NAVIGANT

A4b. [SKIP IF A4 = 98 OR 99]Were there any other reasons you chose to dispose of the refrigerator? **[DO NOT READ RESPONSE LIST; ALLOW FOR MULTIPLE RESPONSES] [ELIMINATE THE CHOICE SELECT IN A4]**

1. THE REFRIGERATOR WAS EXPENSIVE TO RUN
2. THE REFRIGERATOR WAS NOT WORKING PROPERLY
3. THE REFRIGERATOR WAS A SPARE THAT I DID NOT USE VERY MUCH/ I DID NOT WANT IT ANYMORE/NO LONGER NEEDED IT
4. THE REFRIGERATOR WAS OLD
5. I WANTED A BIGGER REFRIGERATOR
6. I WANTED A NEW REFRIGERATOR/SOMETHING WITH MORE MODERN FEATURES
7. I WANTED TO TAKE ADVANTAGE OF AEP OHIO'S OFFER TO REMOVE IT FOR FREE
8. I GOT A NEW PRIMARY REFRIGERATOR, SO WANTED TO REPLACE THE SECONDARY WITH THE OLD PRIMARY
9. THE REFRIGERATOR WAS NOT ENERGY EFFICIENT

97. OTHER (SPECIFY:___)
96. NO OTHER REASON
98. DON'T KNOW
99. REFUSED

[IF A1a = 1 SKIP TO B1; IF A1a = 2 THEN CONTINUE WITH A5]

SPARE/SECONDARY REFRIGERATOR BATTERY:

A5. Thinking just about the past year, before you decided to have the refrigerator removed, was the spare/secondary refrigerator plugged in and running…? **[READ RESPONSE LIST]**

1. All the time, **[SKIP TO A8]**
2. For special occasions only,
3. During certain months of the year only, or
4. Was it never plugged in and running? **[SKIP TO A8]**

98. DON'T KNOW **[DO NOT READ] [SKIP TO A8]**
99. REFUSED **[DO NOT READ] [SKIP TO A8]**

NAVIGANT

A6. [ASK IF A5 = 2 OR 3] In the past year, how often would you estimate your refrigerator was plugged in and running, in days, weeks, or months?

[DAYS; NUMERIC, RANGE 1 TO 365]
[WEEKS; NUMERIC, RANGE 1 TO 52]
[MONTHS; NUMERIC, RANGE 1 TO 12]
00. LESS THAN 1 DAY
998.DON'T KNOW
999. REFUSED

A7. [ASK IF A5 = 2 OR 3] Was the refrigerator running…? **[READ RESPONSE LIST]**

1. Only during the summer,
2. Mainly other times of the year, or
3. A mix of both summer and other times of the year
98. DON'T KNOW **[DO NOT READ]**
99. REFUSED**[DO NOT READ]**

A8. In what location did the refrigerator operate before it was removed by AEP Ohio?
[CLARIFICATION: If they moved the refrigerator while they waited to have it picked up, we are interested in where it was located before they decided to have it removed, not where it was located while they were waiting for it be picked up.]
[DO NOT READ LIST; RECORD ONLY ONE RESPONSE]

1. KITCHEN
2. GARAGE
3. PORCH/PATIO
4. BASEMENT
97. OTHER **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

SECTION B: REFRIGERATOR CONSIDERATION OF ALTERNATIVES

B1. Suppose that the AEP Ohio Appliance Recycling program hadn't been available. Would you have still disposed of the refrigerator or would you have kept it?

1. DISPOSED OF IT
2. KEPT IT **[SKIP TO B3]**
98. DON'T KNOW **[SKIP TO G1-INTRO]**
99. REFUSED **[SKIP TO G1-INTRO]**

NAVIGANT

B2. Please tell me which of the following ways you would have most likely used to dispose of this refrigerator if the program hadn't been available. Would you have…?**[READ RESPONSE LIST; RANDOMIZE; RECORD ONLY ONE RESPONSE]**

1. Sold it
2. Given it away for free
3. **[ASK IF A1B=1]** Had it removed by the dealer you got your new or replacement refrigerator from
4. Taken it to a dump or recycling center
5. Hired someone to take it to a dump or recycling center
6. Kept it

98. DON'T KNOW **[DO NOT READ]**
99. REFUSED**[DO NOT READ]**

[ASK IF B1 = 2 OR B2=6; ELSE SKIP TO G1-INTRO]
B3. If you had kept the refrigerator, would it have been…? **[READ RESPONSE LIST]**

1. Stored unplugged, or **[SKIP TO G1-INTRO]**
2. Used as a secondary refrigerator at least some of the time

98. DON'T KNOW **[SKIP TO G1-INTRO]**
99. REFUSED **[SKIP TO G1-INTRO]**

B4. Would you have kept your secondary refrigerator in a…?

1. Insulated room/space, or
2. Uninsulated room/space

98. DON'T KNOW
99. REFUSED

[READ SECTIONS C AND D IF STRATA = 2]

SECTION C: FREEZER CHARACTERISTICS

Next, I'm going to ask you some specific questions about the freezer that was picked up by AEP Ohio. [IF NEEDED: I would like to ask you questions specifically about the freezer that was picked up by AEP Ohio in [EstProjComDate].

C1. How old was the freezer when AEP Ohio removed it? **[IF CUSTOMER IS UNSURE:]** Your best guess is fine.

[YEARS; NUMERIC OPEN END, RANGE 1-75]
00. LESS THAN ONE YEAR
98. DON'T KNOW
99. REFUSED

NAVIGANT

C3. What was the **MAIN** reason you chose to dispose of the old freezer that was picked up by AEP Ohio? **[DO NOT READ RESPONSE LIST; RECORD ONLY ONE RESPONSE]**

1. THE FREEZER WAS EXPENSIVE TO RUN
2. THE FREEZER WAS NOT WORKING PROPERLY
3. I DID NOT USE THE FREEZER VERY MUCH/ I DID NOT WANT IT ANYMORE/NO LONGER NEEDED IT
4. THE FREEZER WAS OLD
5. I WANTED A BIGGER FREEZER
6. I WANTED A NEW FREEZER/SOMETHING WITH MORE MODERN FEATURES
7. I WANTED TO TAKE ADVANTAGE OF AEP OHIO'S OFFER TO REMOVE IT FOR FREE

9. THE FREEZER WAS NOT ENERGY EFFICIENT

97. OTHER **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

C3b. Were there any other reasons you chose to dispose of the freezer? **[DO NOT READ RESPONSE LIST; AND ALLOW FOR MULTIPLE RESPONSES]**

1. THE FREEZER WAS EXPENSIVE TO RUN
2. THE FREEZER WAS NOT WORKING PROPERLY
3. I DID NOT USE THE FREEZER VERY MUCH/ I DID NOT WANT IT ANYMORE/NO LONGER NEEDED IT
4. THE FREEZER WAS OLD
5. I WANTED A BIGGER FREEZER
6. I WANTED A NEW FREEZER/SOMETHING WITH MORE MODERN FEATURES
7. I WANTED TO TAKE ADVANTAGE OF AEP OHIO'S OFFER TO REMOVE IT FOR FREE

9. THE FREEZER WAS NOT ENERGY EFFICIENT

97. OTHER **[SPECIFY]**

96. NO OTHER REASON

98. DON'T KNOW
99. REFUSED

C4. Thinking just about the past year, before you decided to have the freezer removed, was the freezer plugged in and running …?**[READ RESPONSE LIST; RECORD ONLY ONE RESPONSE]**

1. All the time, **[SKIP TO C7]**
2. For special occasions only,
3. During certain months of the year only, or
4. Was it never plugged in and running **[SKIP TO C8]**

98. DON'T KNOW [DO NOT READ] **[SKIP TO C7]**
99. REFUSED [DO NOT READ] **[SKIP TO C7]**

NAVIGANT

C5. Over the past year, how often would you estimate your freezer was plugged in and running, in days, weeks, or months?

[DAYS; NUMERIC, RANGE 0-365]
[WEEKS; NUMERIC, RANGE 1 TO 52]
[MONTHS; NUMERIC, RANGE 1 TO 12]
00. LESS THAN 1 DAY
998.DON'T KNOW
999. REFUSED

C6. Was the freezer running during the summer or was it mainly running during other times of the year? **[DO NOT READ RESPONSE LIST]**

1. RUNNING DURING THE SUMMER
2. MAINLY RUNNING OTHER TIMES OF THE YEAR
3. A MIX OF BOTH SUMMER AND OTHER TIMES OF THE YEAR
98. DON'T KNOW
99. REFUSED

C7. In what location did the freezer operate before it was removed by AEP Ohio?
[CLARIFICATION: If they moved the freezer while they waited to have it picked up, we are interested in where it was located before they decided to have it removed, not where it was located while they were waiting for it be picked up.]
[DO NOT READ LIST; RECORD ONLY ONE RESPONSE]

1. KITCHEN
2. GARAGE
3. PORCH/PATIO
4. BASEMENT
97. OTHER **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

C8. [ASK ALL] Did you replace the freezer with another one?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

NAVIGANT

SECTION D: FREEZER CONSIDERATION OF ALTERNATIVES

D1. Now suppose that the AEP Ohio Appliance Recycling program hadn't been available. Would you have still disposed of the freezer or would you have kept it? **[RECORD ONLY ONE RESPONSE]**

1. DISPOSED OF IT
2. KEPT IT **[SKIP TO D3]**
98. DON'T KNOW **[SKIP TO G1-INTRO]**
99. REFUSED **[SKIP TO G1-INTRO]**

D2. [ASK IF D1 = 1] Please tell me which of the following ways you would have most likely used to dispose of this freezer if the program hadn't been available. Would you have…? **[READ RESPONSE LIST; RANDOMIZE; RECORD ONLY ONE RESPONSE]**

1. Sold it
2. Given it away for free
3. **[ASK IF C8=1]** Had it removed by the dealer you got your new or replacement freezer from
4. Taken it to a dump or recycling center
5. Hired someone to take it to a dump or recycling center
6. (Kept it)
98. DON'T KNOW
99. REFUSED

[ASK IF D1 = 2 OR D2=6; ELSE SKIP TO G1-INTRO]
D3. If you had kept the freezer, would it have been stored unplugged or would you have continued using it?

1. STORED IT UNPLUGGED **[SKIP TO G1-INTRO]**
2. CONTINUED USING IT AT LEAST SOME OF THE TIME
98. DON'T KNOW **[DO NOT READ] [SKIP TO G1-INTRO]**
99. REFUSED **[DO NOT READ] [SKIP TO G1-INTRO]**

D4. Would you have kept this freezer in a…?

1. Insulated room/space, or
2. Uninsulated room/space
98. DON'T KNOW
99. REFUSED

NAVIGANT

SECTION G: PROCESS QUESTIONS

G1-INTRO: ***Next I have some questions about your experiences with the AEP Ohio Appliance Recycling Program.***

G1. How did you <u>first</u> learn about the Appliance Recycling Program? **[DO NOT READ LIST; RECORD ONLY ONE RESPONSE]**

1. BILL INSERT
2. TV AD
3. FRIEND/RELATIVE/NEIGHBOR
4. AEP OHIO WEBSITE
5. AEP OHIO EMPLOYEE/ CUSTOMER SERVICE REPRESENTATIVE
6. NEWSPAPER
7. COMMUNITY EVENT
8. FROM A STORE SALES ASSOCIATE WHERE BOUGHT NEW APPLIANCE, E.G. SEARS **[SPECIFY RETAILER]**
9. STORE POSTINGS ADVERTISING THE APPLIANCE RECYCLING PROGRAM **[SPECIFY RETAILER]**
10. AEP OHIO HOME ENERGY REPORT
11. PREVIOUS PARTICIPATION IN THE APPLIANCE RECYCLING PROGRAM
12. RADIO
97. OTHER**[SPECIFY]**
98. DON'T KNOW
99. REFUSED

NAVIGANT

G2. Since you first learned about the program, did you hear about the program from any of these other sources? **[READ RESPONSE LIST; DO NOT READ RESPONSE SELECTED IN G1. ALLOW FOR MULTIPLE RESPONSES]**

		Yes	No	DON'T KNOW	REFUSED
G2a.	BILL INSERT	1	2	98	99
G2b.	TV AD	1	2	98	99
G2c.	FRIEND/RELATIVE/NEIGHBOR	1	2	98	99
G2d.	AEP OHIO WEBSITE	1	2	98	99
G2e.	AEP OHIO CUSTOMER SERVICE REPRESENTATIVE	1	2	98	99
G2f.	NEWSPAPER	1	2	98	99
G2g.	COMMUNITY EVENT	1	2	98	99
G2h.	FROM A STORE SALES ASSOCIATE WHERE YOU BOUGHT A NEW REFRIGERATOR/FREEZER **[SPECIFY RETAILER]**	1	2	98	99
G2i.	STORE POSTINGS ADVERTISING THE APPLIANCE RECYCLING PROGRAM **[SPECIFY RETAILER]**	1	2	98	99
G2j.	AEP OHIO HOME ENERGY REPORT	1	2	98	99
G2k.	PREVIOUS PARTICIPATION IN THE APPLIANCE RECYCLING PROGRAM	1	2	98	99
G2l.	RADIO	1	2	98	99
G2m.	ANY OTHER WAY?**[SPECIFY]**	1	2	98	99

NAVIGANT

G3. There are a number of ways you could have disposed of your appliance or appliances. What is the MAIN reason you chose the AEP Ohio Appliance Recycling Program instead of disposing of your appliance or appliances in some other way? **[DO NOT READ RESPONSE LIST]**

1. THE CASH INCENTIVE/INCENTIVE CHECK/REBATE PAYMENT
2. THE CONVENIENCE OF THE HOME PICKUP/DON'T HAVE TO TAKE IT SOMEPLACE MYSELF
3. PICKUP WAS FREE
4. APPLIANCE WAS RECYCLED/WAS DISPOSED OF IN A WAY THAT WAS GOOD FOR ENVIRONMENT
5. WAS RECOMMENDED BY FRIEND/FAMILY
6. WAS RECOMMENDED BY RETAILER **[SPECIFY RETAILER]**
7. DID NOT KNOW OF ANY OTHER WAY/NO OTHER OPTION

97. OTHER **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

G4. Were there any other reasons? **[DO NOT READ RESPONSE LIST; DO NOT SHOW ANSWER SELECTED IN G3; ALLOW FOR MULTIPLE RESPONSES]**

1. THE CASH INCENTIVE/INCENTIVE CHECK/REBATE PAYMENT
2. THE CONVENIENCE OF THE HOME PICKUP/DON'T HAVE TO TAKE IT SOMEPLACE MYSELF
3. PICKUP WAS FREE
4. APPLIANCE WAS RECYCLED/WAS DISPOSED OF IN A WAY THAT WAS GOOD FOR ENVIRONMENT
5. WAS RECOMMENDED BY FRIEND/FAMILY
6. WAS RECOMMENDED BY RETAILER **[SPECIFY RETAILER]**
7. DID NOT KNOW OF ANY OTHER WAY/NO OTHER OPTION

97. OTHER **[SPECIFY]**

96. NO OTHER REASON

98. DON'T KNOW
99. REFUSED

G4b. On a scale of 1 to 5, where 1 is "not at all" and 5 is "very much", how much did the rebate motivate you to participate in Appliance Recycling program?

1. 1**[NOT AT ALL]**
2. 2
3. 3
4. 4
5. 5**[VERY MUCH]**

98. DON'T KNOW

99. REFUSED

G5. Are you the person that signed up for the program, or did someone else in your household sign up?
1. I SIGNED UP
2. SOMEONE ELSE SIGNED UP **[SKIP TO G18]**
98. DON'T KNOW **[SKIP TO G18]**
99. REFUSED **[SKIP TO G18]**

WEBSITE SIGNUP BATTERY:

[ASK G9-11 ONLY FOR RESPONDENTS WHERE "SOURCE" FIELD = WEBSITE]

G9. Was it easy to find the sign up screen on the website?
1. YES
2. NO
98. DON'T KNOW
99. REFUSED

G10. Did the website answer all your questions about the program?
1. YES
2. NO **[PROBE AND CLARIFY: Which questions did you have that were unanswered?]**
96. NOT APPLICABLE
98. DON'T KNOW
99. REFUSED

G11. Did you receive confirmation that your sign up had been successful?
1. YES
2. NO
96. NOT APPLICABLE
98. DON'T KNOW
99. REFUSED

NAVIGANT

PHONE SIGNUP BATTERY:

[ASK G12-13 ONLY FOR RESPONDENTS WHERE "SOURCE" FIELD = PHONE]

G12. On a scale of 1 to 5, where 1 is "not at all " and 5 is "very much", how would you rate the phone representative in terms of being polite and courteous during your phone sign up of the program?

1. 1 **[NOT AT ALL POLITE/COURTEOUS]**
2. 2
3. 3
4. 4
5. 5 **[VERY POLITE/COURTEOUS]**

98. DON'T KNOW
99. REFUSED

G13. Did the representative answer all your questions about the program?

1. YES
2. NO **[PROBE AND CLARIFY: Which questions did you have that were unanswered?]**

96. NOT APPLICABLE
98. DON'T KNOW
99. REFUSED

G16. On a scale of 1 to 5, where 1 is "very dissatisfied" and 5 is "very satisfied," how satisfied were you with the sign-up experience?

1. 1 [VERY DISSATISFIED]
2. 2
3. 3 **[SKIP TO G18]**
4. 4 **[SKIP TO G18]**
5. 5 [VERY SATISFIED] **[SKIP TO G18]**

98. DON'T KNOW **[SKIP TO G18]**
99. REFUSED **[SKIP TO G18]**

G17. [ASK IF G16 < 3] Why did you rate it that way? **[PROBE TO CLARIFY]**

[OPEN END; RECORD VERBATIM]

98. DON'T KNOW
99. REFUSED

NAVIGANT

FOR ALL PARTICIPANTS:

G18. Were you able to schedule a pickup date and time that was convenient for you?
1. YES
2. NO
98. DON'T KNOW
99. REFUSED

G19. How much time passed between when you scheduled the appointment and when your appliance(s) was/were picked up? **[NOTE TO INTERVIEWER: IF RESPONDENT SAYS "ABOUT A WEEK", RECORD AS 1 WEEK, ETC.] [Range 0-6] for Days and [1-52] for Weeks**
[ENTER DAYS; NUMERIC OPEN END]
[ENTER WEEKS; NUMERIC OPEN END]
98. DON'T KNOW
99. REFUSED

G20a. On a scale of 1 to 5 were 1 is "very dissatisfied" and 5 is "very satisfied," how satisfied are you with the time it took between when you scheduled the appliance pickup and when it actually was picked up?
1. 1 [VERY DISSATISFIED]
2. 2
3. 3 **[SKIP TO G21]**
4. 4 **[SKIP TO G21]**
5. 5 [VERY SATISFIED]**[SKIP TO G21]**
98. DON'T KNOW **[SKIP TO G21]**
99. REFUSED **[SKIP TO G21]**

G20b. [ASK IF G20a < 3] Why did you rate it that way?
[RECORD OPEN END]
98. DON'T KNOW
99. REFUSED

G21. Just before the pickup took place, did you or anyone in your household receive a call in advance to confirm the appointment or to let you know the collection team was coming?
1. YES
2. NO
96. NOT APPLICABLE
98. DON'T KNOW
99. REFUSED

NAVIGANT

G22. Did the collection team arrive during the scheduled appointment time period?

1. YES
2. NO
96. NOT APPLICABLE
98. DON'T KNOW
99. REFUSED

G23. On a scale of 1 to 5 were 1 is "very dissatisfied" and 5 is "very satisfied", how satisfied were you with the collection team who picked up your appliance(s)?

1. 1 [VERY DISSATISFIED]
2. 2
3. 3 **[SKIP TO G25]**
4. 4 **[SKIP TO G25]**
5. 5 [VERY SATISFIED]**[SKIP TO G25]**
11. (Wasn't at home)**[SKIP TO G25]**
98. DON'T KNOW **[SKIP TO G25]**
99. REFUSED **[SKIP TO G25]**

G24. **[ASK IF G23 < 3]** Why did you rate it that way?

[RECORD OPEN END]
98. DON'T KNOW
99. REFUSED

G25. How satisfied were you with the rebate <u>payment amount</u>? Would you say you were: **[READ LIST]**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied **[SKIP TO G27]**
4. Somewhat satisfied **[SKIP TO G27]**
5. Very satisfied **[SKIP TO G27]**
98. DON'T KNOW **[SKIP TO G27]**
99. REFUSED **[SKIP TO G27]**

G26. **[ASK IF G25 < 3]** What size rebate payment would you have been satisfied with? **[PROBE TO CLARIFY]**

[NUMERIC OPEN-END, RANGE $0 - $1000]
9998. DON'T KNOW
9999. REFUSED

NAVIGANT

G27. From the time you had your appliance picked up, about how many weeks did it take to receive your check? **[DO NOT READ RESPONSE LIST]**

1. 1 WEEK OR LESS
2. MORE THAN ONE WEEK TO 2 WEEKS
3. MORE THAN 2 WEEKS TO 3 WEEKS
4. MORE THAN 3 WEEKS TO 4 WEEKS
5. MORE THAN 4 WEEKS TO 5 WEEKS
6. MORE THAN 5 WEEKS TO 6 WEEKS
7. MORE THAN 6 WEEKS TO 7 WEEKS
8. LONGER THAN 7 WEEKS **[SPECIFY NUMBER OF WEEKS] _______________**
9. HAVE NOT RECEIVED MY CHECK YET **[SPECIFY HOW LONG THEY'VE BEEN WAITING IN WEEKS] ________________ [SKIP TO G30A]**

98. DON'T KNOW **[SKIP TO G30a]**
99. REFUSED **[SKIP TO G30a]**

G28. How satisfied were you with how long it took to receive the payment? Would you say you were: **[READ LIST]**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied **[SKIP TO G30a]**
4. Somewhat satisfied **[SKIP TO G30a]**
5. Very satisfied **[SKIP TO G30a]**

98. DON'T KNOW **[SKIP TO G30a]**
99. REFUSED **[SKIP TO G30a]**

G29. **[ASK IF G28 < 3]** What amount of time would be reasonable to receive the payment? **[PROBE TO CLARIFY; RECORD OPEN END DAYS AND WEEKS] Range[1-50]**

98. DON'T KNOW
99. REFUSED

G30a. In the course of participating in the AEP Ohio program, how often did you contact AEP Ohio or program staff with questions? [If SOURCE=PHONE: Please keep in mind that we mean the time period **after** the initial scheduling call]

1. NEVER **[SKIP TO G31a]**
2. ONCE
3. 2 OR 3 TIMES
4. 4 TIMES OR MORE

98. DON'T KNOW **[SKIP TO G31a]**
99. REFUSED **[SKIP TO G31a]**

NAVIGANT

G30b. How did you contact them? **[ALLOW MULTIPLE RESPONSES]**

1. PHONE
2. EMAIL
3. LETTER
98. DON'T KNOW
99. REFUSED

G30c. And how satisfied were you with your communications with AEP Ohio and program staff ? Would you say you were: **[READ LIST]**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied **[SKIP TO G31a]**
4. Somewhat satisfied **[SKIP TO G31a]**
5. Very satisfied **[SKIP TO G31a]**
98. DON'T KNOW **[SKIP TO G31a]**
99. REFUSED **[SKIP TO G31a]**

G30d. Why were you dissatisfied?

[RECORD VERBATIM]
98. DON'T KNOW
99. REFUSED

[ASK IF G30A = 2, 3, OR 4]
G30e. When you communicated with the AEP Ohio program staff, did they make you aware of any other energy efficiency programs? **[IF YES, RECORD SPECIFIC PROGRAM]**

1. Yes **[SPECIFY]**
2. No
98. DON'T KNOW
99. REFUSED

G31a. Have you noticed any savings on your electric bill since removing your old [IF STRATA 1 OR 3: refrigerator / IF STRATA 2: freezer]?

1. YES
2. NO **[SKIP TO G32]**
98. DON'T KNOW **[SKIP TO G32]**
99. REFUSED **[SKIP TO G32]**

G31b. How satisfied are you with any savings you noticed on your electric bill since removing your old [IF STRATA 1 OR 3: refrigerator / IF STRATA 2: freezer]? Would you say you were:**[READ LIST]**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied
4. Somewhat satisfied
5. Very satisfied
98. DON'T KNOW
99. REFUSED

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G32. If you were rating your overall satisfaction with the AEP Ohio Appliance Recycling Program, would you say you were: **[READ LIST]**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied **[SKIP TO G33]**
4. Somewhat satisfied **[SKIP TO G33]**
5. Very satisfied **[SKIP TO G33]**
98. DON'T KNOW **[SKIP TO G33]**
99. REFUSED **[SKIP TO G33]**

G32b. Why do you give it that rating?

[RECORD VERBATIM]
98. DON'T KNOW
99. REFUSED

G33. What suggestions, if any, do you have to improve the program?

[RECORD VERBATIM]
96. NO SUGGESTIONS
98. DON'T KNOW
99. REFUSED

G33b. Do you have any suggestions for how AEP Ohio can better get the word out about its energy efficiency programs?

[RECORD VERBATIM]
96. NO SUGGESTIONS
98. DON'T KNOW
99. REFUSED

G34a. Based on your overall experience with AEP Ohio's service, how satisfied are you with having them as your electric company? Would you say you are: **[READ LIST]?**

1. Very dissatisfied
2. Somewhat dissatisfied
3. Neither satisfied nor dissatisfied **[SKIP TO G35]**
4. Somewhat satisfied **[SKIP TO G35]**
5. Very satisfied **[SKIP TO G35]**
98. DON'T KNOW **[SKIP TO G35]**
99. REFUSED **[SKIP TO G35]**

G34b. Why did you rate it that way**? [PROBE FOR CLARITY AND SPECIFICITY IF NEEDED:** ***Was there something in particular you had in mind when you chose a rating of [RATING]?*****]**

[OPEN END]
98. DON'T KNOW
99. REFUSED

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G35. Would you say participating in this program has made you feel more favorable, less favorable, or no different about AEP Ohio?

1. MORE FAVORABLE ABOUT AEP OHIO
2. LESS FAVORABLE ABOUT AEP OHIO
3. NO DIFFERENT ABOUT AEP OHIO
98. DON'T KNOW
99. REFUSED

G36. For how many years have you been an AEP Ohio customer at any location? This can include any time you had Ohio Power or Columbus Southern Power as a service provider as well. **Range[1-75]**

[RECORD NUMERIC OPEN END]
00. LESS THAN ONE YEAR
98. DON'T KNOW
99. REFUSED

SECTION H: DEMOGRAPHICS

I have just a few questions left for background purposes only.

H1. Which of the following best describes your home/residence? **[READ LIST]**

1. Single-family home, detached construction [not a duplex, townhome, or apartment; attached garage is ok]
2 Factory-manufactured/modular [single family home]
3 Mobile home [single family]
4 Row house
5 Two or three family attached residence
6 Apartment (4 + families)
7 Condominium
97. OTHER: (SPECIFY________________________________)
98. DON'T KNOW
99. Refused

H1b. Do you own or rent this residence?

1. OWN **[SKIP TO H3]**
2. RENT
98. DON'T KNOW **[SKIP TO H3]**
99. REFUSED [**SKIP TO H3]**

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H2. Do you pay your own electric bill or is it included in your rent?

1. PAY BILL
2. INCLUDED IN RENT
98. DON'T KNOW **[DO NOT READ]**
99. REFUSED **[DO NOT READ]**

H3. Approximately when was your home constructed? [**DO NOT READ]**

1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006 OR LATER
98. DON'T KNOW
99. REFUSED

H3b. How many people live in your household year-round? Range [1-50]

[**NUMERIC OPEN END]**
98. DON'T KNOW
99. REFUSED

H4. Which range does your age fall into? Are you…?**[READ LIST]**

1. Under 18
2 18-24
3. 25-34
4. 35-44
5. 45-54
6. 55-64
7. 65-74
8. 75-84
9. 85 or older
98. DON'T KNOW
99. REFUSED

H5a. How many square feet is the above-ground living space [IF NECESSARY: This excludes walk-out basements.]?

NUMERICAL OPEN END [RANGE 0-99,997] **[SKIP TO H6a]**
99998. REFUSED
99999. DON'T KNOW

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H5b. [ASK IF H5a=99998, 99999] Would you estimate the above-ground living space is about: **[READ LIST]**

1. Less than 1,000 sqft
2. Between 1,000 and 2,000 sqft
3. Between 2,000 and 3,000 sqft
4. Between 3,000 and 4,000 sqft
5. Between 4,000 and 5,000 sqft
6. Greater than 5,000 sqft
98. DON'T KNOW
99. REFUSED

H6a. How many square feet of conditioned living space is below-ground [IF NECESSARY: This includes walk-out basements.]?

NUMERICAL OPEN END [RANGE 0-99,997] **[SKIP TO H7]**
99998. REFUSED
99999. DON'T KNOW

H6b. [ASK IF H6a=99998, 99999] Would you estimate the below-ground living space is: **[READ LIST]**

1. Less than 1,000 squarefeet
2. Between 1,000 and 2,000 squarefeet
3. Between 2,000 and 3,000 squarefeet
4. Between 3,000 and 4,000 squarefeet
5. Between 4,000 and 5,000 squarefeet
6. Greater than 5,000 squarefeet
98. DON'T KNOW
99. REFUSED

H7. Approximately how many years have you lived at your current residence?

[RECORD YEARS] RANGE[1-97]
00. LESS THAN 1 YEAR
98. DON'T KNOW
99. REFUSED

H8. What is the highest level of education you have completed? **[READ RESPONSE LIST]**

1. Less than high school
2. High school graduate or equivalent (e.g., GED)
3. Attended some college (includes junior/community college)
4. Bachelor's degree
5. Advanced degree **[SPECIFY]**
6. Technical or trade school
97. OTHER **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

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H9. Was your total family income in 2012 before taxes UNDER OR OVER $50,000?

1. UNDER $50,000
2. OVER $50,000**[SKIP TO H11]**
3. EXACTLY $50,000**[SKIP TO END]**
98. DON'T KNOW **[SKIP TO END]**
99. REFUSED [**SKIP TO END]**

H10. Was it under $15,000, between $15,000 and $30,000 or between $30,000 and $50,000? **[INTERVIEWER NOTE: IF EXACTLY $30,000 ENTER AS '3. $30,000-$50,000']**

1. UNDER $15,000**[SKIP TO END]**
2. $15,000-$30,000**[SKIP TO END]**
3. $30,000-$50,000**[SKIP TO END]**
98. DON'T KNOW **[SKIP TO END]**
99. REFUSED [**SKIP TO END]**

H11. [ASK IF H9=2] Was it between $50,000 and $75,000, or between $75,000 and $100,000, or was it over $100,000? **[INTERVIEWER NOTE: IF EXACTLY $75,000 ENTER AS '2. $75,000-$100,000'. IF EXACTLY $100,000, ENTER AS '3. OVER $100,000']**

1. $50,000-$75,000
2. $75,000-$100,000
3. OVER $100,000
98. DON'T KNOW
99. REFUSED

END. Those are all the questions I have. Thank you so much for your participation!

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A.5 Appliance Metering Memorandum

The following was presented as the memorandum "AEP Ohio Appliance Recycling 2013: Appliance Metering Study." This document presents an overview of the metering study objectives and results, followed by a discussion of the research methodology, description of the study sample, further detail on the resulting equations, and a discussion of normalized annual load shapes that the research team developed from the metered data.

A.5.1 Overview

The evaluation team conducted an Appliance Recycling Metering Study to collect in situ electricity demand data from refrigerators and freezers recycled in the AEP Ohio territory. This data was used to model the energy consumption and demand of appliances, given key appliance characteristics such as size and age. This metering study, conducted during 2013, is in keeping with best practices for appliance recycling programs.[12] The resulting equations will serve to replace the current savings estimation methods, which relied on older metering studies conducted in other states and service territories.

The goals of this metering study were to develop:

- Equations for unit energy consumption (UEC) for the Appliance Recycling program
- Equations for peak demand for refrigerators and freezers for the Appliance Recycling program
- Peak adjustment factors for the refrigerators and freezers purchased through the Efficient Products program

Each of these final products is given here in the overview. The remaining document presents the methodology in the study (Methodology), characteristics of appliances included in the study (Unit Characteristics), further detail on the final equations (Equation Details), and modeled annual load shapes (Load Shapes). Additional supporting information, including correlation tables, model output, and 8760 load profile data are in a separate Technical Supporting Document.

UEC Equations

The final equations for estimating UEC from this metering study are presented in Equation A-8 for refrigerators and Equation A-7 for freezers.

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[12] Studies that utilize regressions in Appliance Recycling Impact include:
a. ADM Associates, Inc. *Evaluation Study of the 2004-2005 Statewide Residential Appliance Recycling Program, Final Report* April 2008 (http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf)
b. The Cadmus Group. 2012. *Rocky Mountain Power Utah See ya later, refrigerator® 2009-2010 Evaluation Final Report* (http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/UT_SYLR_Evaluation_Report.pdf)
c. The Cadmus Group. 2011. *Consumers Energy Annual Evaluation 2010 Report* (http://efile.mpsc.state.mi.us/efile/docs/16670/0027.pdf)

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Equation A-7. Annual UEC for Refrigerators

$$UEC_{Ref} \cong 184.30 + 287.20 \times PrimaryUseDummy + 29.27 \times SizeInCuFt + 309.22 \times SidebySideDummy + 286.17 \times Pre1993Dummy$$

Equation A-8. Annual UEC for Freezers (kWh)

$$UEC_{Frz} \cong +409.38 + 0.71\ SizeInCuFt \times AgeInYears + 372.30 \times Pre1993Dummy$$

Peak Demand Equations

The final equations for estimating peak demand from this metering study are presented in Equation A-9 for refrigerators and Equation A-10 for freezers.

Equation A-9. Peak Demand for Refrigerators (kW)

$$PD_{Ref} \cong 0.022 + 0.096 \times CDD/100 + 0.044 \times PrimaryUseDummy + 0.316 \times SizeInCuFt/100 + 0.004 \times AgeInYears/100 + 0.032 \times Pre1993Dummy + 0.033 \times SidebySideDummy - 0.053 \times SingleDoorDummy - 0.139 \times (CDD/100) \times PrimaryUseDummy$$

Equation A-10. Peak Demand for Freezers (kW)

$$PD_{Frz} \cong 0.088 + 0.174 \times CDD/100 - 0.215 \times SizeInCuFt/100 - 0.062 \times AgeInYears/100 + 0.048 \times Pre1993Dummy - 0.027 \times UprightDummy + 1.532 \times SizeInCuFt/100 \times AgeInYears/100$$

Peak Adjustment Factors

The peak adjustment factor represents the relatively higher demand at peak over average demand. This is used to estimate adjusted peak demand savings in the Efficient Products evaluation. The peak adjustment factors for refrigerators and freezers are different and are shown in Table A-9.

Table A-9. Peak Adjustment Factors

		Freezer	Refrigerator
Average Normalized Demand	(A)	0.112	0.112
Average Normalized Peak Demand	(B)	0.152	0.121
Peak Adjustment Factor	(B/A)	1.36	1.08

A.5.2 Methodology

The team employed the methodology described in the Appliance Recycling Metering Analysis Plan of May 2013. Additional details regarding the analysis steps are included in the Technical Supporting Document.

Data Collection

The team coordinated with the appliance removal contractor, who collects appliances for AEP Ohio, to identify customers who were interested in having appliances removed. The team recruited from this list

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of customers, and collected information on their units to ensure balanced representation of appliances within the metering study. The team coordinated with the metering contractor to schedule and conduct on-site visits to install meters on the units. Meters were installed to measure the power demand, the unit internal temperature, and unit light operation, as listed in Table A-10.

Table A-10. Collected Metering Data

Data Point	Application	Data collection method
Power (5 minute interval)	Energy usage and demand	Eagle Loggers
Internal temperature (5 minute interval)	QA/QC power data (e.g., start and end dates/time of unit usage)	HOBO Loggers
Light usage (on/off)	Identify usage (door openings) and QA/QC power data	HOBO Loggers
Metering start and end dates & times	Clean power data and append weather	Technician report

A summary of the in-situ metered data, including door openings, internal temperature, and power draw is presented in Table A-11.

Refrigerators were opened more frequently than freezers, as expected, and refrigerators also had much greater variation in use. Door openings were classified by a change of state of the interior light from a state of off to a state of on. Flicker and constant on observations required removal of 1121 state observations of lighting data. One very high observation of 79 refrigerator door openings was far outside of the mean, but the data were examined and the light did not appear to be under flicker.

Cabinet temperature was generally reasonable, but five units did not work consistently, with unit temperatures the same as or very near the outside temperature for at least one observation during the study period In two cases, these units were not still drawing power, so these units were dropped from the study.

Table A-11. Observed Variables for 82 Refrigerators and 50 Freezers

Refrigerators	Min	Max	Mean	SD
Door openings (per day)[(a)]	0	79	3.4	35.4
Cabinet Temperature (ºF)	-4.4	91.1	39.0	13.7
Hourly Average Demand (kW)	0.00	0.58	0.11	0.07
Freezers	Min	Max	Mean	SD
Door openings (per day)[(a)]	0	17	0.2	1.2
Cabinet Temperature (ºF)	-22.9	94.0	10.4	25.3
Hourly Average Demand (kW)	0.00	0.72	0.11	0.07
(a) Approximated by light on/off				

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The team also collected the characteristic data presented in Table A-12. These were considered in the development of the appliance energy and demand consumption models. Only characteristics that could be collected through program tracking data *and* with a statistically significant impact on consumption were included in the final regression equations.

Table A-12. Collected Characteristic Data

Data Point	Application	Source	Data Entry Example
Participant ZIP code	Look up local weather data	Participant self-report and technician verification	"13245"
Unit configuration (e.g. top freezer, side-by-side, chest)	Potential regression variable	Participant self-report and technician verification	"Top-Freezer"
Defrost (e.g. Manual, Automatic)	Potential regression variable	Program Tracking Data	"Manual"
Additional Features (i.e. ice-maker)	Potential regression variable	Program Tracking Data	"Yes"
Age	Potential regression variable	Technician report and Program Tracking Data, calculated value from year	*Calculated, ex:* 2013 - 1993 = 20
Pre-1993	Potential regression variable	Technician report and Program Tracking Data, calculated value from year	Binary, for given year
Internal Capacity (size)	Potential regression variable	Technician report and Program Tracking Data	"18 cu.ft."
Nameplate information (Brand & Model)	Look up additional information, if needed	Technician report and Program Tracking Data	"Frigidaire, Model XXX123"
Primary/secondary unit	Potential regression variable	Participant self-report	"Primary"
Location in home	Potential regression variable	Participant self-report and technician verification	"Kitchen"
Air conditioned space (in summer) (Yes/No)	Potential regression variable, conditioned space factor	Participant self-report and technician verification	"Yes"
Heated space (in winter) (Yes/No)	Potential regression variable, conditioned space factor	Participant self-report and technician verification	"No"
Household occupants (#)	Potential regression variable	Participant self-report	"3"
Occupants by age group	Potential regression variable	Participant self-report	Children in Household = "2"
Dry Bulb Temperature (°F)	Potential regression variable	Hourly temperature data matched to Columbus, OH	*Matched values*
Temperature Humidity Index (THI)	Potential regression variable	Calculated Temperature Humidity Index (WTHI) from hourly weather data	*Calculated values*

Analysis

The team merged the data from the meters with the characteristic data. Data on the meters from before the meter installation and after the meter removal were removed from the dataset, and observations were averaged to hourly estimates for demand, door openings, and unit internal temperature.

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The hourly demand was matched to hourly weather data and then normalized to develop annual load shapes for each unit based on the unit fixed effects, the time of day, day of week, and weather. These load shapes were then used to build the average annual consumption and peak demand equations.

Before developing the equations, the team evaluated the data for relationships between characteristics and power demand. The findings were in keeping with expected relationships from previous studies. Based on the observed relationships and theory for appliance demand and consumption, the team developed sets of possible equations. Then, terms were removed from the equations to arrive at the most parsimonious equations that still represented the observed demand and consumption.

Quality Assurance

The team ensured quality throughout the study. Analysis plans, protocols, and data collection instruments were reviewed by multiple evaluators and AEP Ohio before being put in place. During data collection, the team shadowed the metering contractors to observe the on-site process and ensure proper meter installation and data collection. The team reviewed initial data from the first completed sites to verify that data being collected were as expected.

After data collection, the team checked meter validity by comparing cabinet temperatures, door openings, and power demand. Due to missing and erroneous data, 16 units were not included in the final analysis.[13] During data analysis, the analysis was subject to review by senior analysts with experience with regression modeling and refrigeration appliance loads.

A.5.3 Unit Characteristics

This section presents a series of bar charts that describe the characteristics of the units that were included in the metering study. In total, 89 refrigerators and 58 freezers were included in the study. Due to meter failure and missing meters, 16 units were not able to be included in the final equation analysis. The final equations are based on 81 refrigerators and 50 freezers.[14]

These unit characteristics are presented to ensure that researchers using the equations presented here are applying them to similar populations. Generally, models are only appropriate for estimating for similar populations. The team cautions that a population of recycled appliances that are particularly old, new, small, or large would not be well represented by these equations, and other methods should be used to estimate savings from such a program.

While recruiting for the metering study, the team asked metering study participants whether the refrigerator or freezer that they were recycling was their primary appliance or if it served a secondary purpose. The majority of the refrigerators and freezers included in the study were secondary

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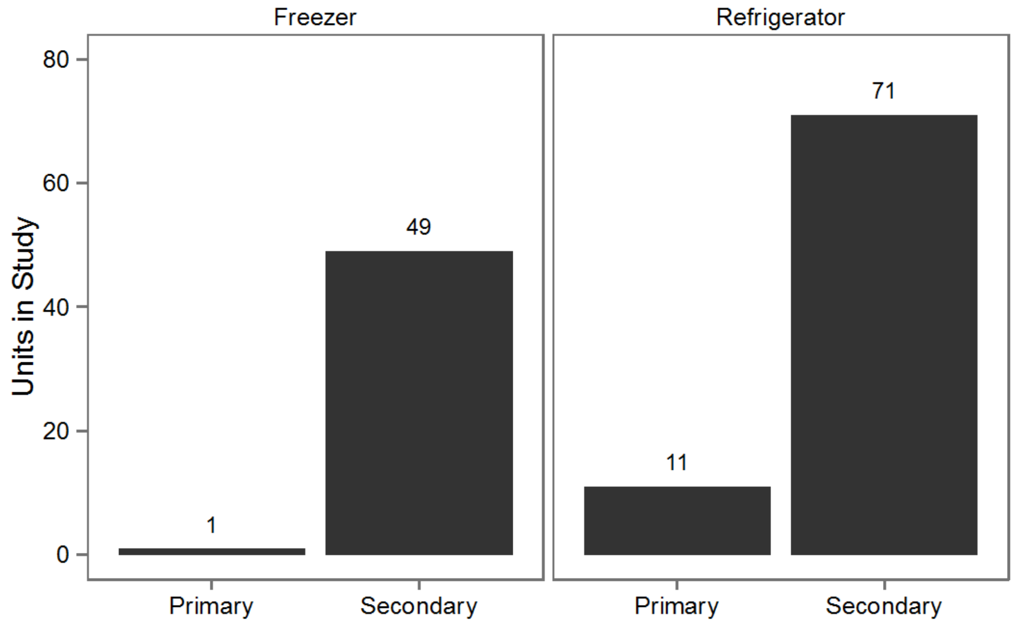
[13] Four units were dropped because they did not draw power. Twelve units were dropped for missing or unreadable power logger data.

[14] All data except size are known for one refrigerator, which was included for the annual load shape estimates. However, size is an important aspect for unit demand, so that unit was dropped for missing data before developing the energy and demand equations. As such, 82 refrigerators are included in the characteristics charts.

appliances.[15] Generally, stand alone freezers are assumed to be secondary to the freezer included within the refrigerator; however, one metering study participant indicated that the freezer was a primary unit.

Figure A-6. Primary or Secondary Use, by Appliance Type



[15] Customers who were recycling primary appliances were more difficult to recruit in to the metering study.

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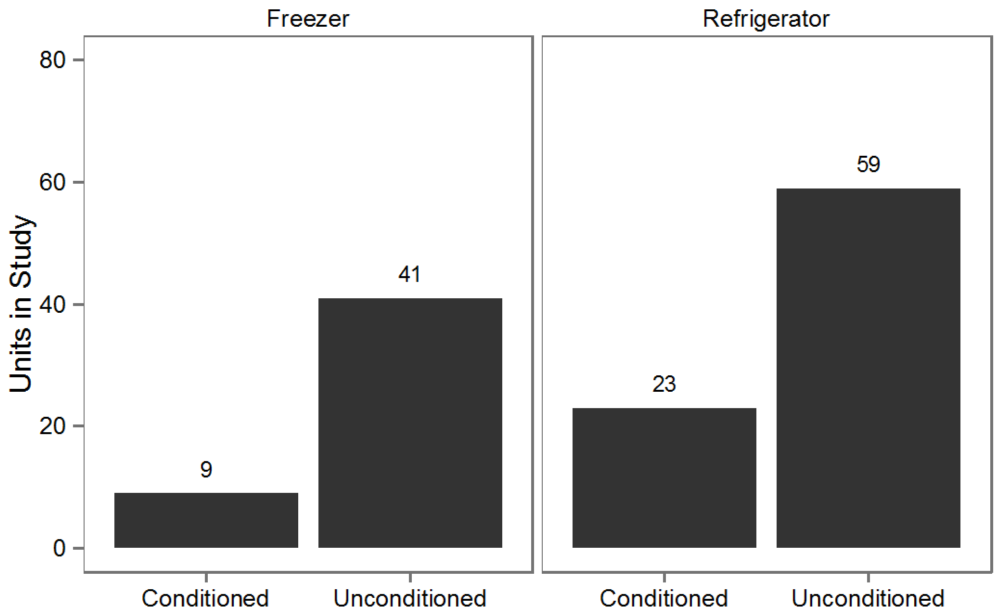
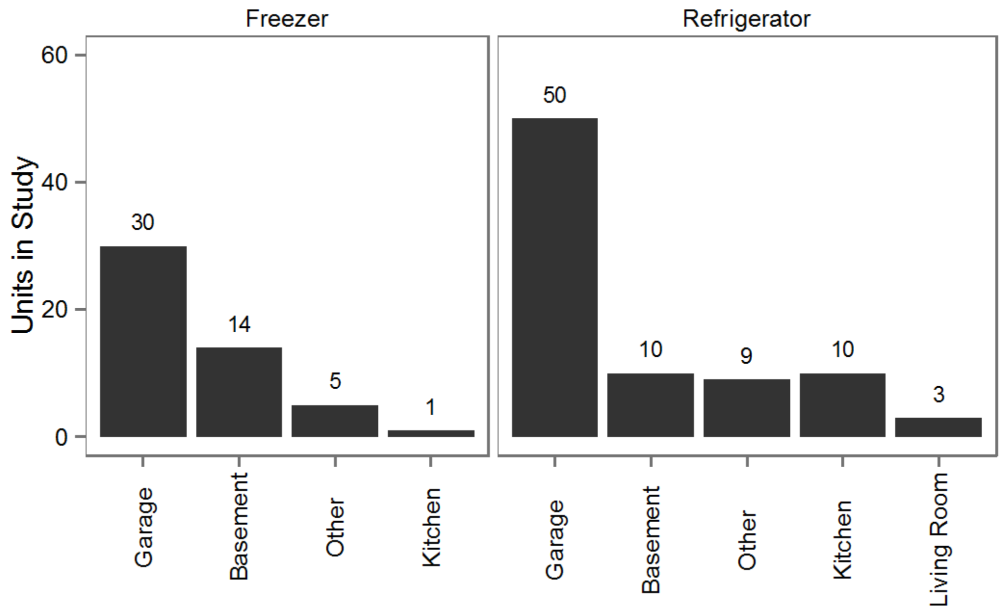
The metering technicians asked metering study participants whether they conditioned (maintained comfortable air temperatures) the spaces where their units were located. The majority of units were in unconditioned spaces, such as garages and unconditioned basements. The distribution of units is shown in Figure A-7.

Figure A-7. Unit in a Conditioned Space, by Appliance Type



As noted above, most units were located in garages, as shown in Figure A-8.

Figure A-8. Unit Location by Appliance Type



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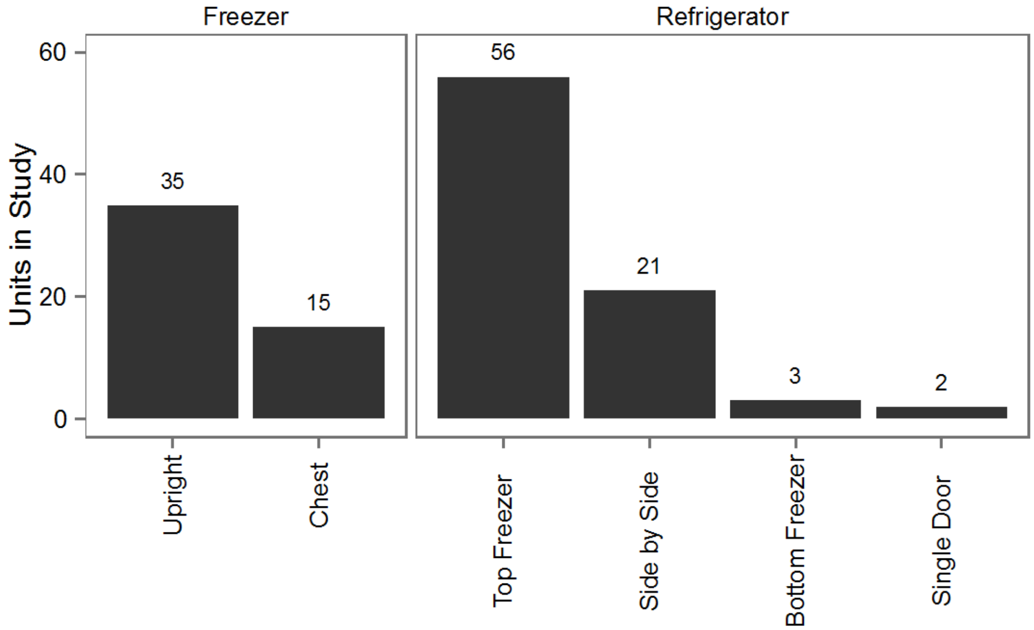
The metering technician collected information on the configuration of the refrigerators and freezers included in the study. The majority of freezers had an upright configuration, and the majority of refrigerators had a top freezer configuration, see Figure A-9.

Figure A-9. Configuration by Appliance Type



The majority of refrigerators and freezers were between 21 and 30 years old, and the next most common age group was between 11 and 20 years old. The distributions of unit ages are shown in Figure A-10.

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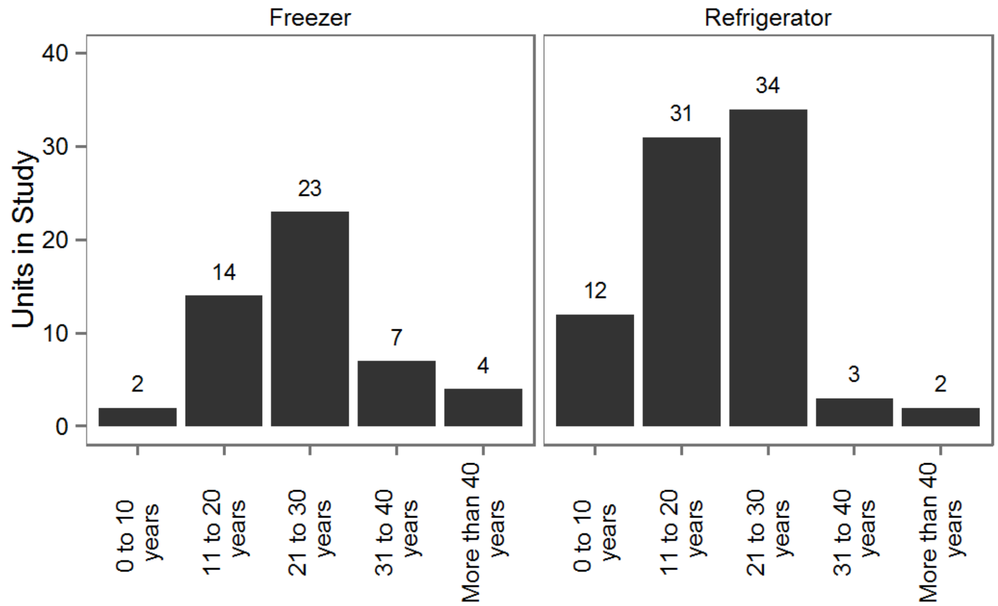
Figure A-10. Unit Age by Appliance Type



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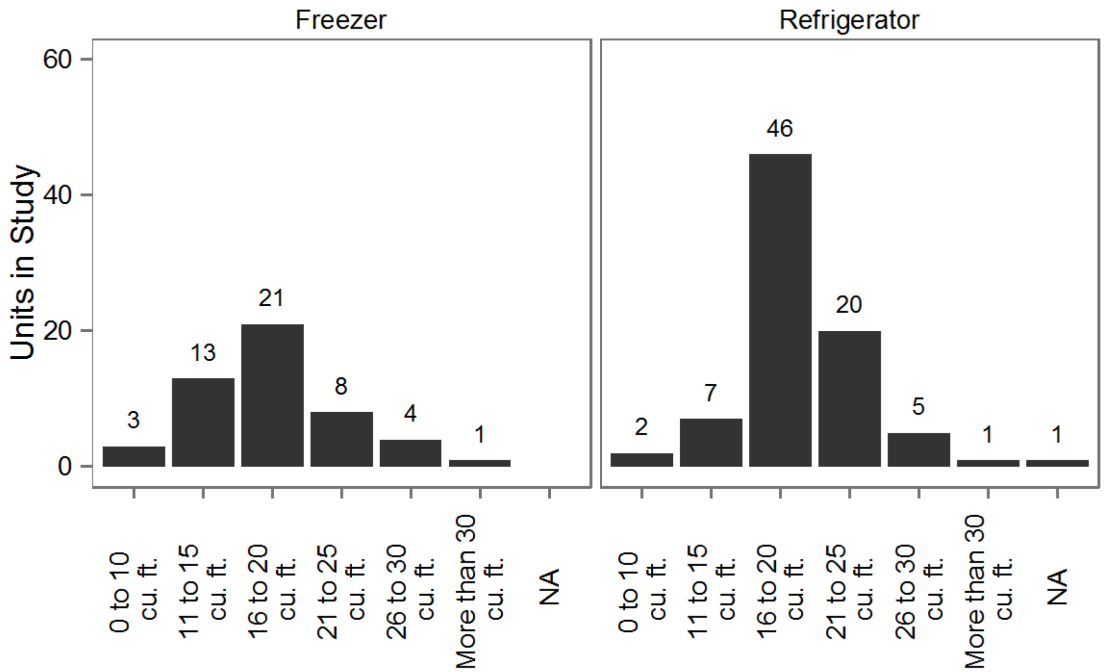
The refrigerators and freezers included in the metering study were most commonly between 16 and 20 cubic feet. A small number of units were less than 10 cubic feet and more than 30 cubic feet in size; distributions are shown in Figure A-11. For one refrigerator, the size was not able to be determined.[16]

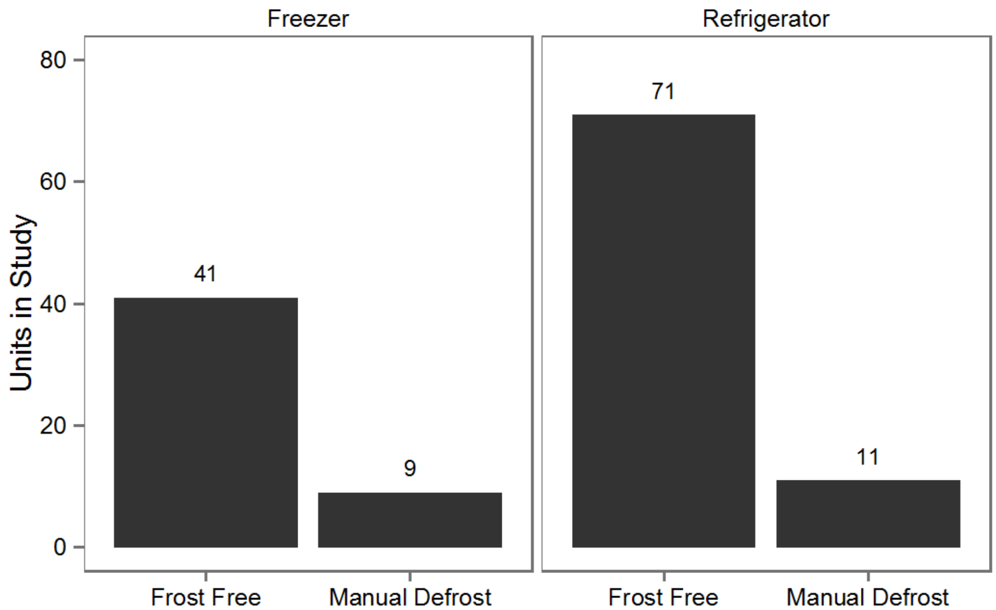
Figure A-11. Unit Size by Appliance Type



The metering technician collected labeled information about the type of defrosting employed by the refrigerators and freezers. The majority of both types were automatic defrost, or "frost free" units, as shown in Figure A-12.

[16] Model data was not found on the unit, and dimensions were not collected.

Figure A-12. Manual or Automatic Defrost by Appliance Type



The metering technician collected information regarding the refrigerator or freezer having an ice maker as a feature. The majority of the units in the metering study did not have an ice maker, as shown in Figure A-13.

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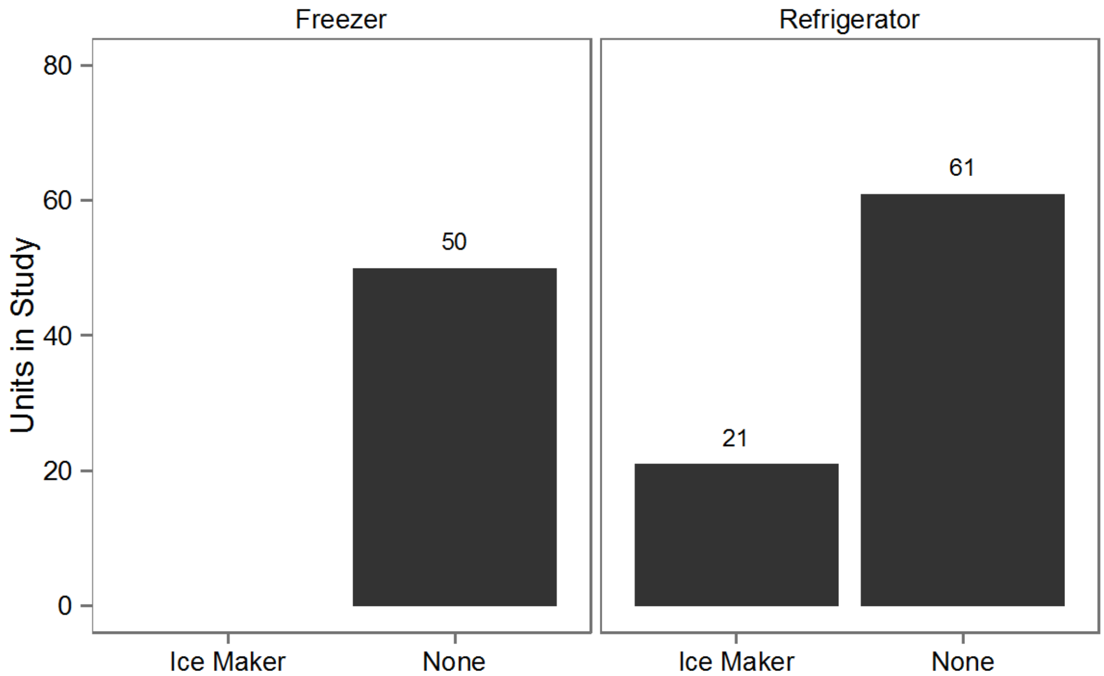
Figure A-13. Units with Ice Makers by Appliance Type



A.5.4 Equation Details

This section explains the role and use of the confidence intervals and then presents the final equations again, along with confidence intervals for coefficients and explanations for the coefficients in each equation.

Confidence Intervals

The equations presented in this brief are models to estimate the energy consumption or demand for refrigerators and freezers. These estimates are expected to represent the real energy consumption or demand with a degree of error. In the equations presented here, values for the lower and upper bounds of the 90% confidence intervals are included. These confidence intervals represent the range of values within which the evaluation team is 90% confident the real value lies.

The consumption models (UEC) have wider confidence intervals than desired due to small numbers of valid data points. The team sought to compare this result to other studies and found that confidence intervals are generally not reported or used. As such, we cannot speak to the size of typical confidence intervals or uncertainty in other studies.

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The team understands that reporting *ex ante* values will require the use of a point estimate. For decision-making, the team strongly recommends calculating the 90% confidence interval, rather than only the point estimates, to consider the risk associated with savings in an appliance recycling program.

Freezer UEC

In Section 1, the freezer annual consumption equation was given with just the estimated coefficient. In Table A-13, the energy coefficients are presented again along with significance and the 90% confidence interval for each coefficient.

Table A-13. Annual UEC for Freezers (kWh) [17]

Variable	Coefficient	90% Conf. Interval
Unit Size (cu.ft.) X Unit Age (years)	0.71**	(0.22, 1.20)
Pre 1993	372.30**	(120.35, 624.25)
Constant	409.38***	(226.54, 592.22)

Note. *p<0.1; **p<0.05; ***p<0.01

Each of the variables included in the equation for freezer annual consumption is described here.

- **Unit Size (cu.ft.)* Unit Age (years)**: The variable is the product of the size of the unit in cubic feet and the age of the unit in years. The coefficient is positive, reflecting that larger and older units have larger consumption, but that the relationship with consumption is non-linear.
- **Pre 1993**: The variable is a dummy variable that is one for units manufactured before 1993 and zero for newer units. The coefficient is positive, reflecting that older units have larger consumption.

Table A-14. An example of using this equation for the average unit: Upright configuration, 17.81 cu. Ft., 24.98 years old[18]

Variable	Value		Coefficient		
Unit Size (cu.ft.) X Unit Age (years)	444.89	X	0.71	=	315.87
Pre 1993	1	X	372.30	=	372.30
Constant	1	X	409.38	=	409.38
Estimated Annual UEC (kWh) for Example Freezer					1097.55

[17] Observations = 50; $R^2 = 0.446$; Adjusted $R^2 = 0.422$

[18] The 90% confidence interval for this estimate is 444.77 to 1750.34.

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Refrigerator UEC

In Section 1, the refrigerator annual consumption equation was given with just the estimated coefficient. In Table A-15, the energy coefficients are presented again along with significance and the 90% confidence interval for each coefficient.

Table A-15. Annual UEC for Refrigerators (kWh) [19]

Variable	Coefficient	90% Conf. Interval
Primary Use	287.20*	(42.83, 531.56)
Unit Size (cu.ft.)	29.27*	(2.72, 55.82)
Side by Side	309.22**	(84.52, 533.92)
Pre 1993	286.17***	(115.37, 456.97)
Constant	184.3	(-328.28, 696.89)

Note. *p<0.1; **p<0.05; ***p<0.01

Each of the variables included in the equation for refrigerator annual consumption is described here.

- **Primary Use**: The variable is a dummy that is equal to one for primary units and zero for secondary units. The coefficient is positive. All else being equal, a primary unit consumes 287.2 kWh more per year than a secondary unit. This could be because the space for primary units is often conditioned, while secondary units would be in an unheated space.[20] The metering team did not collect information regarding the heating cycles of the space conditioning to test that theory.
- **Unit Size (cu.ft.)**: The variable is the size of the unit in cubic feet.[21] The coefficient is positive, reflecting that larger units have larger consumption. For an additional cubic foot of adjusted volume, the refrigerator consumption is estimated to be 1 X 29.27 kWh higher per year, all else being equal.
- **Side by Side**: The variable is a dummy that is equal to one for units with side by side configuration and zero for all others. The coefficient is positive, reflecting higher demand for these units. All else being equal, a side by side unit has estimated annual consumption 309.22 kWh higher than other units.
- **Pre 1993**: The variable is a dummy that is equal to one for units manufactured before 1993 when appliance standards came into effect. The coefficient is positive, reflecting higher demand for these units. All else being equal, a unit manufactured before 1993 has estimated annual consumption 286.17 kWh higher than newer units.

[19] Observations = 78; $R^2 = 0.253$; Adjusted $R^2 = 0.214$. Three of 81 observations were dropped for outlier behavior; these units were all older with lower demand. Dropped because they were outliers for size response.
[20] The conditioned space variable was more explanatory than primary use for these units. However, the program tracks primary use, and it does not track conditioned space.
[21] This is adjusted size, which takes into account the relative size of the freezer and refrigerator portions.

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Table A-16. An example of using this equation for the average unit: Top freezer configuration, secondary unit, 19.18 cu. Ft., 19.62 years old[22]

Variable	Value		Coefficient		
Primary Use	0	X	287.20	=	0.00
Unit Size (cu.ft.)	19.18	X	29.27	=	561.40
Side by Side	0	X	309.22	=	0.00
Pre 1993	0	X	286.17	=	0.00
Constant	1	X	184.3	=	184.30
Estimated Annual UEC (kWh) for Example Refrigerator					745.7

Freezer Demand

In Section 1, the freezer peak demand equation was given with just the estimated coefficient. In Table A-17, the peak demand coefficients are presented again along with significance and the 90% confidence interval for each coefficient.

Table A-17. Peak Demand for Freezers (kW)[23]

Variable	Coefficient	90% Conf. Interval
CDD/100	0.174***	(0.157, 0.192)
Unit Size (cu.ft.)/100	-0.215***	(-0.278, -0.151)
Unit Age (years)/100	-0.062**	(-0.108, -0.016)
Pre 1993	0.048***	(0.045, 0.051)
Upright	-0.027***	(-0.029, -0.025)
Unit Size/100 X Unit Age/100	1.532***	(1.278, 1.786)
Constant	0.088***	(0.077, 0.099)

Note. *p<0.1; **p<0.05; ***p<0.01

Each of the variables included in the equation for peak demand for freezers is described here.

- **CDD/100**: The variable is the hourly CDD (degrees greater than 65 F) divided by 100. The coefficient is positive, reflecting higher demand at higher temperatures. For an additional degree above 65, the demand for a secondary unit is estimated to be 1/100 X 0.174 or 0.00174 kW higher, all else being equal.
- **Unit Size (cu.ft.)/100**: The variable is the size of the unit divided by 100. The variable cannot be considered in isolation because it is also included in an interaction term, **Unit Size (cu.ft.)/100XUnit Age (years)/100.** The coefficient is negative, but the coefficient on the

[22] The 90% confidence interval for this estimate is 0 to 1767 kWh.

[23] Observations = 13,014; R^2 = 0.339; Adjusted R^2 = 0.339

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interaction term is large and positive. The overall meaning of size from the two terms is that larger older units have higher demand than smaller older units.

- **Unit Age (years)/100**: The variable is the age of the unit divided by 100. The coefficient is positive, reflecting that older units have larger demand. The square of this variable **(Unit Age (years)/100)**^{2} and an interaction term, **Unit Size (cu.ft.)/100XUnit Age (years)/100,** are also included because the relationship between demand and age is non-linear and related strongly with size. The overall meaning of age from the two terms is that larger older units have higher demand, but the effect of age has a decreasing positive effect. On the margins, an additional year of age will have less of an addition to demand.
- **Pre 1993**: The variable is a dummy that is equal to one for units manufactured before 1993 when appliance standards came into effect. The coefficient is positive, reflecting higher demand for these units. All else being equal, a unit manufactured before 1993 has estimated annual consumption 0.048 kW higher than newer units.
- **Upright**: The variable is a dummy that is equal to one for units with upright configuration and zero for chest configuration. The coefficient is negative, reflecting lower demand for these units. All else being equal, an upright unit has estimated demand 0.027 kW lower than a chest unit.

Table A-18. An example of using this equation during an 85F hour for the average unit: Upright configuration, 17.81 cu. Ft., 24.98 years old[24]

Variable	Value		Coefficient		
CDD/100	0.200	X	0.174	=	0.035
Unit Size (cu.ft.)/100	0.178	X	-0.215	=	-0.038
Unit Age (years)/100	0.250	X	-0.062	=	-0.015
Pre 1993	1	X	0.048	=	0.048
Upright	1	X	-0.027	=	-0.027
Unit Size X Unit Age	0.044	X	1.532	=	0.068
Constant	1	X	0.088	=	0.088
Estimated Peak Demand (kW) for Example Freezer					0.158

Refrigerator Demand

In Section 1, the refrigerator peak demand equation was given with just the estimated coefficient. In Table A-19, the peak demand coefficients are presented again along with significance and the 90% confidence interval for each coefficient.

[24] The 90% confidence interval for this estimate is 0.105 to 0.212.

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Table A-19. Peak Demand for Refrigerators (kW) [25]

Variable	Coefficient	90% Conf. Interval
CDD/100	0.096***	(0.085, 0.107)
Primary Use	0.044***	(0.040, 0.049)
Unit Size (cu.ft.)/100	0.316***	(0.298, 0.333)
Pre 1993	0.032***	(0.031, 0.034)
Side by Side	0.033***	(0.031, 0.034)
Single Door	-0.053***	(-0.057, -0.050)
CDD X Primary Use	-0.139***	(-0.169, -0.108)
Constant	0.022***	(0.018, 0.026)

Note. *p<0.1; **p<0.05; ***p<0.01

Each of the variables included in the equation for peak demand for refrigerators is described here.

- **CDD/100**: The variable is the hourly CDD (degrees greater than 65 F) divided by 100. However, this variable is also included within an interaction term with primary use, **CDD X Primary Use**. That means that the impact of CDD must be considered separately for primary and secondary refrigerators. For secondary refrigerators, the dummy "Primary Use" is equal to zero, so the only term of concern is CDD/100. The coefficient is positive, reflecting higher demand at higher temperatures. For an additional degree above 65, the demand for a secondary unit is estimated to be 1/100 X 0.096 or 0.00096 kW higher, all else being equal. In the case of a primary unit, there is an additional term for weather. For an additional degree above 65, the demand for a primary unit is estimated to be the sum of the two terms, (1/100 X 0.096 - 1/100 X 0.139), or (0.00096 kW - 0.00139 kW) or -0.00043 kW lower, all else being equal.
- **Primary Use**: The variable is a dummy that is equal to one for primary units and zero for secondary units. The coefficient is positive. All else being equal, a primary unit demand is 0.044 kW higher than secondary unit demand. This variable is also included in an interaction term with CDD, **CDD X Primary Use**, which is negative meaning that primary units generally have higher demand during periods where CDD is zero, or the outside temperature is less than 65F. This could be because the space is then heated, while secondary units would be in an unheated space. The metering team did not collect information regarding the heating cycles of the space conditioning to test that theory.
- **Unit Size (cu.ft.)/100**: The variable is the size of the unit divided by 100. The coefficient is positive, reflecting that larger units have larger demand. For an additional cubic foot of adjusted volume, the refrigerator demand is estimated to be 1/100 X 0.316 kW, or 0.00316 kW higher, all else being equal.
- **Pre 1993**: The variable is a dummy that is equal to one for units manufactured before 1993 when appliance standards came into effect. The coefficient is positive, reflecting higher demand for

[25] Observations = 21,707; R^2 = 0.245; Adjusted R^2 = 0.245

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these units. All else being equal, a unit manufactured before 1993 has estimated annual consumption 0.032 kW higher than newer units.

- **Side by Side**: The variable is a dummy that is equal to one for units with side by side configuration and zero for all others. The coefficient is positive, reflecting higher demand for these units. All else being equal, a side by side unit has estimated demand 0.033 kW higher than other units.
- **Single Door**: The variable is a dummy that is equal to one for units with single door configuration and zero for all others. The coefficient is negative, reflecting lower demand for these units. All else being equal, a single door unit has estimated demand 0.053 kW lower than other units.

Table A-20. An example of using this equation during an 85F hour for the average unit: Top freezer configuration, secondary unit, 19.18 cu. Ft., 19.62 years old[26]

Variable	Value		Coefficient		
CDD/100	0.2	X	0.096	=	0.019
Primary Use	0	X	0.044	=	0
Unit Size (cu.ft.)/100	0.1918	X	0.316	=	0.061
Pre 1993	0	X	0.032	=	0.000
Side by Side	0	X	0.033	=	0.000
Single Door	0	X	-0.053	=	0
CDD X Primary Use	0	X	-0.139	=	0
Constant	1	X	0.022	=	0
Estimated Peak Demand (kW) for Example Refrigerator					0.102

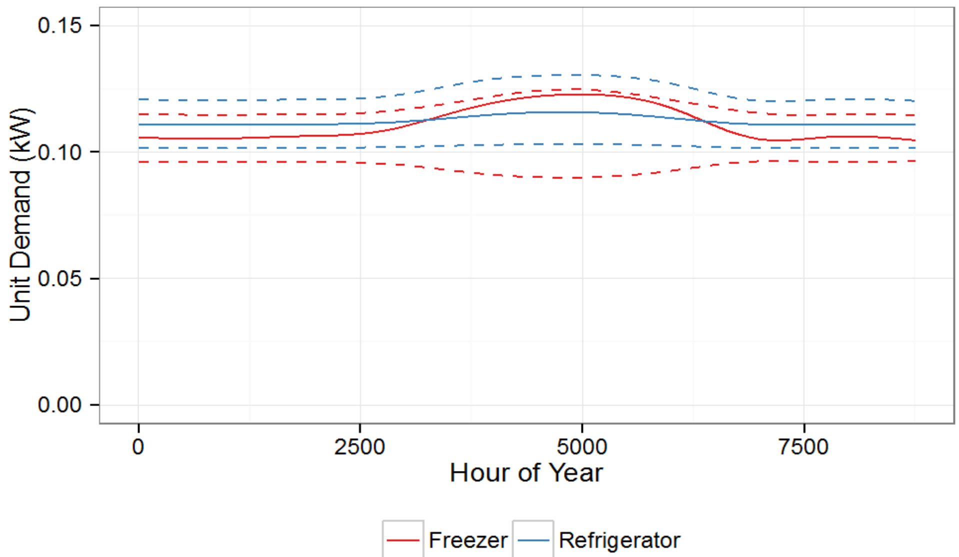
A.5.5 Load Shapes

The evaluation team developed normalized annual load shapes from the metered data.[27] These load shapes were developed for each unit based on the unit, hour of day, day of week, and weather. Figure A-14 shows the average expected demand for each hour of the year for each appliance type; the demand is averaged over 82 units for refrigerators and 50 units for freezers. The solid line represents the average expected value while the dashed lines represent the upper and lower confidence intervals for the expected value. The greatest uncertainty occurs in summer, which mostly reflects the difference in space

[26] The 90% confidence interval for this estimate is 0.092 to 0.111.
[27] The normalization process is to ensure that the load shapes are based on normal weather data rather than only the observed weather during the metering study. The team used Columbus airport station (724280TY) normal weather from source: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/by_state_and_city.html

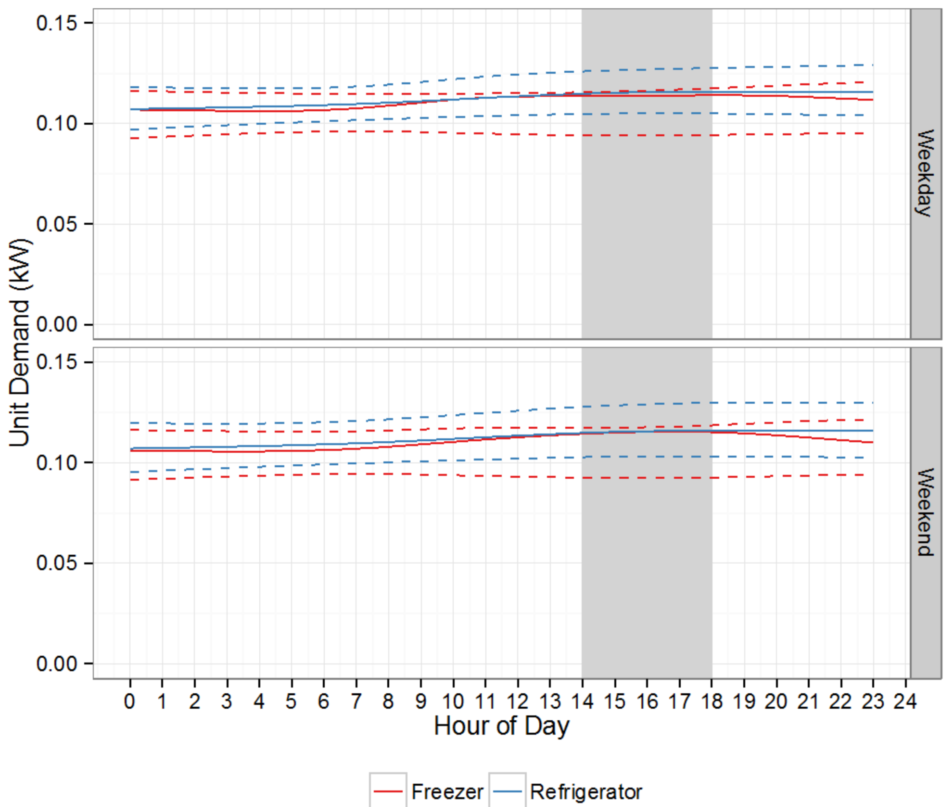
conditioning for units during the hottest temperatures. There is greater uncertainty on the lower limits of the confidence interval for freezers because they are generally more sensitive to space temperature.

Figure A-14. Refrigerator and Freezer Normalized Annual Load Shape



There is variation over the hours of the day as well, as shown in Figure A-15. The shaded area represents the peak hours for AEP Ohio. The solid lines are the expected values and the dashed lines represent the upper and lower bounds of the 90% confidence interval.

Figure A-15. Daily Load Shape, by Hour and Appliance Type, with Shading for Peak Hours



A.5.6 Conclusion

These models are reasonable and give expected results based on the manufacturing characteristics for models observed. The characteristics of the units included in the metering study were compared to the population of recycled appliances in AEP Ohio's 2013 Appliance Recycling program and is representative, except for the oldest units collected.

The equations presented in this brief can be applied to estimate the savings from Appliance Recycling programs. As the characteristics of units recycled through the program change, updated metering is recommended to ensure that estimated savings from the program reflect the observed savings.

APPENDIX D

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e^3smart^{SM} Program:

Program Year 2013 Evaluation Report

Prepared for:
AEP Ohio

AEP OHIO®
A unit of American Electric Power

May 12, 2014

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Executive Summary

This report presents the results of an evaluation of AEP Ohio's *e³smart*SM Program for the 2012-2013 school year. This Executive Summary provides a high-level description of the program, key impact findings, conclusions, and recommendations stemming from these findings. Detailed methodology and findings are described in the body of the report following the Executive Summary.

Program Description

The primary goal of the *e³smart* Program is to educate teachers, students and the community about household steps that lead to greater energy efficiency. This program is intended to influence students (Grades 5 to 12) about energy efficient choices early on so that they will be more cognizant of and receptive to energy efficiency choices throughout their lives.

The program also achieves energy savings from the measures included in Energy Efficiency Kits (kits) for students to take home, which are provided to the students free of charge through the program. The kits include low cost energy efficiency measures for students to install in their homes. Students bring the kits home and, with the help of a parent or guardian, install the measures appropriate for their household. Each student is asked to fill out a survey reporting the measures installed and replaced.

AEP Ohio contracted with the non-profit Ohio Energy Project (OEP) to administer the program. OEP is Ohio's National Energy Education Day (NEED) affiliate and has been implementing energy education programs in schools throughout Ohio for over 25 years.

The program creates a curriculum for teachers that focus on energy sources, transformation of energy, and energy uses. These lessons were created to teach the fundamentals of energy and energy efficiency, as well as to instruct students on how to properly install the measures included in the kit. The lessons fulfill several components of the Ohio teaching requirements. OEP trains teachers at a one-day professional development workshop. During the professional development workshop, teachers are taught the key points of the different lessons.

The 2012-2013 school year home energy kit contained the following energy efficiency measures:

- » Two 23 W Bright White CFLs
- » Two 13 W Soft White CFLs
- » Earth Massage Showerhead
- » LED Nightlight
- » Kitchen Faucet Aerator (1.5 GPM)
- » Bathroom Faucet Aerator (1.0 GPM)
- » Closed Cell Foam Weather-Strip (17" roll)
- » Self-adhesive Door Sweep

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- » Hot Water Temperature Gauge Card
- » Small Roll of Teflon Tape
- » Flow Meter Bag
- » Furnace Filter Alert Whistle
- » Refrigerator/Freezer Thermometer
- » Marketing material for AEP Ohio's other Energy Efficiency Programs

Key Impact Findings and Recommendations

The Home Energy Efficiency Kits were distributed to 24,189 students, faculty, staff and community members (participants) during the 2012-2013 school year through 331 teachers participating from 236 different schools. The program was delivered to public and private schools in urban and rural locations.

Table ES-1 shows the 2012-2013 program goals, *ex ante* savings claimed by the program, and the *ex post* savings. The *ex post* energy and demand savings for the 2012-2013 school year were 7,452 MWh and 0.91MW, respectively.

AEP Ohio calculated the *ex ante* savings from the 18,464 participant surveys that were submitted. However, only 16,191 households reported actually installing any measures. The evaluation team calculated the installation rate from the participant survey and applied this rate to the program population of 24,189 participants. The realization rate increase is due to the application of the student survey installation rate to the entire population of students that received energy kits.

Table ES-1. 2012-2013 Overall Evaluation Results

	2013 Program Goals	*Ex Ante*[1] Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)	Percent of Goal
Energy Savings (MWh)	7,064	4,723	7,452	158%	105%
Demand Savings (MW)	1.462	0.62	0.91	147%	62%

[1]*Ex ante* differs slightly from AEP Ohio Portfolio Status Report due to different final data sets.

The *ex post* saving estimates for the *e³smart*℠ Program were developed using the installation rates gathered from the student installation survey and applied these to all the distributed kits. This is similar to the approach that AEP Ohio uses for its In-Home Energy Program that distributes a similar energy kit. The evaluation team also conducted a parent/guardian telephone survey to verify installation rates.

1. **Finding:** The parent/student online survey was returned by 76 percent of the participant population. The Navigant team believes that the surveys are representative of the program population.

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Impact Recommendation #1: The installation rates gathered from the online surveys should be applied to the entire population of students who received a kit to estimate *ex ante* savings in the future.

2. **Finding:** Participant goals were not met in the 2012 -2013 school year. OEP achieved 76 percent of its participation goal by distributing 24,189 energy efficiency kits. The program goal for the 2012 – 2013 school year was 32,000 participants. OEP has met its participation goals in the previous years of this program. Part of the reason OEP did not meet its goals is related to a declining target population. The *e³smart*SM Program will not offer the program to students who have already participated in the program, which limits the pool of available classrooms. OEP's commitment to retaining only high performing teachers from previous years also reduces the potential participant population pool.

   Impact Recommendation #2: The Navigant team suggests reevaluating the participation goals for the *e³smart* Program to reflect the declining population pool.

3. **Finding:** AEP Ohio's per-unit savings estimate for the bathroom aerator is the same as the kitchen aerator. However, the bathroom aerator is rated at 1.0 gallons per minute (GPM) while the kitchen aerator is rated at 1.5.

   Impact Recommendation #3: The Navigant team suggests adjusting the bathroom savings estimates to reflect the 1.0 GPM rating. The adjusted per unit savings for the bathroom aerator would be 42.03 kWh and 0.005 kW, rather than the kitchen aerators estimates of 24.51 kWh and 0.003 kW.

Key Process Findings and Recommendations

The objectives of the process evaluation were to develop an understanding of the final program design and implementation strategies, as well as to document program processes and tracking efforts, and to identify and recommend potential program improvements. The data collection approach for the process evaluation was in-depth interviews with AEP Ohio program staff, the program administrator, program implementers, and teachers. Teacher surveys conducted by OEP were examined for program process suggestions. The parent/guardian telephone survey included process related questions.

Participants are satisfied with most aspects of the program. The participant's average satisfaction level with the overall program was 9.19, on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied") (from the evaluation parent/guardian telephone survey), indicating that parents were quite satisfied with various elements of the program.

In a survey administered by OEP, the teachers rated their satisfaction at 6.28 on a scale of 1 to 7 (where 1 was "extremely dissatisfied" and 7 was "extremely satisfied"). As the teachers are the primary implementers of this program, their satisfaction is essential to the success of the program.

Process Recommendation #1: The Navigant team suggests that OEP modify its teacher online survey to the same 1 to 10 scale as AEP Ohio's phone survey, or allow for a better comparison.

Educational Impact and Raising Energy Efficiency Awareness. Parents report that they learned something about energy efficiency from the program and that they have discussed the kit with their

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children. In the parent survey, the parent was asked if he or she had discussed the kit with the child, 91 percent said yes, and 70 percent said they continue to have energy efficiency discussions with their child. When asked if they learned anything new about energy efficiency from the program 60 percent of parents said they had.

Community Outreach In the 2012-2013 school year. The OEP curriculum includes ways the class can reach out to the local media. Over one hundred teachers mentioned that their class did some type of outreach to local newspapers, local TV media, or a presentation to the community regarding the *e³smart* Program**.**

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1. Program Description

This section provides an overview of the AEP Ohio *e³smart*^{SM} Program. The section begins with a brief description, followed by a summary of various aspects of the implementation strategy.

1.1. Program Overview and Description

The *e³smart*^{SM} Program has multiple goals. One goal is to educate teachers, students and the community about household steps that lead to greater awareness and appreciation for energy efficiency. Another goal is to determine the energy and demand savings impacts of the kits that students install in their homes.

The *e³smart*^{SM} Program is designed to teach 5th through 12th grade students and their families the benefits of energy efficiency. A kit is provided to each participating student with energy efficiency measures to install in their home. AEP Ohio contracted with the Ohio Energy Project (OEP) to administer this program. OEP has been implementing energy education programs in schools throughout Ohio for over 25 years.

The program begins with creating a curriculum for teachers that focuses on energy sources, how energy is transformed and energy uses. These lessons were created to teach the fundamentals of energy and energy efficiency, as well as to instruct students on how to properly install the measures included in the kit. The lessons fulfill several components of the State of Ohio teaching requirements. OEP trains teachers at a one-day professional development class. OEP has created a detailed curriculum divided into seven lesson plans. Each lesson has a classroom and at home component. Teachers are provided with a stipend once their students return the surveys. The teachers also receive continuing education credits for the professional development training session and a reduced rate for graduate credits at Ashland University.

Each student takes a kit home and with the help of their parent or guardian installs the measures appropriate for the home. Each student is instructed to fill out an online survey reporting the measures installed. If filling out the survey online is not possible a paper option is available.

The Energy Efficiency Kit contains a combination of the following measures:

» Two 23 W Bright White CFLs

» Two 13 W Soft White CFLs

» Earth Massage Showerhead

» LED Nightlight

» Kitchen and Bathroom Faucet Aerators

» Closed Cell Foam Weather-Strip (17" roll)

» Self-adhesive Door Sweep

- » Hot Water Temperature Gauge Card
- » Small Roll of Teflon Tape
- » Flow Meter Bag
- » Furnace Filter Alert Whistle
- » Refrigerator/Freezer Thermometer
- » Energy Use Gauge Thermometer
- » U.S. DOE Energy Savers Booklet

1.2. *Evaluation Objectives*

The objectives of the evaluation are to: (1) report energy and peak demand savings estimates from the kits; and (2) assess process performance, satisfaction, program operational conditions, and ways to improve the program. The evaluation will seek to answer the following key research questions.

Impact Questions

1. What is the level of annual energy (kWh) and peak demand (kW) savings induced by the program?
2. What were the program measure realization rates?
3. What are reasonable saving estimates for each of the home energy kit measures?
4. What are the benefits and costs and cost effectiveness of this program?

Process Questions
Program Characteristics and Barriers

1. Is the program meeting its participation goals?
2. How have teachers incorporated the program into their lesson plan?

Administration and Delivery

1. Is the program administration functioning as expected?
2. Are there any problems with implementing the program?
3. Are program tracking systems adequate? Do they contain all data required to support program tracking and evaluation?

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2. Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the process evaluation of the *e³smart* Program, including the data sources and sample designs used as the foundation for the data collection activities and analysis.

2.1 *Overview of Approach*

To meet the objectives of this evaluation, Navigant undertook the following activities:

1. **Development of Evaluation Questions.** Key evaluation questions were established from the development of the 2012-2013 evaluation plan with AEP Ohio staff and a review of the key outcomes of the 2011-2012 program evaluation.
2. **Tracking Data Review.** The program tracking data collected by OEP were reviewed. OEP conducted the participant online survey.
3. **Primary Data Collection.** Four primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, 2) a participant telephone survey, 3) participant surveys, and 4) teacher interviews.
4. **Methods Used to Analyze Impact Data.** Reviewed algorithms and tracking system to verify measure eligibility and correct application of energy and demand savings.
5. **Methods Used to Analyze Process Data.** The effectiveness of the program processes was assessed by analyzing program tracking data, in-depth interview data, and participant survey data.

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Table 2-1 summarizes data collection activities, along with the details regarding the sampling and timing.

Table 2-1. Summary of Data Collection Activities

ata Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis (Participant Online Survey)	All Program Participants	Tracking Database	-	18,464	June 2013
In-depth Telephone Interview	AEP Ohio Program Coordinator	Contact from AEP Ohio	Program Coordinator	1	March 2014
In-depth Telephone Interview	Implementation Contractor	Contact from OEP	Program Implementer	1	January 2014
CATI Telephone Surveys	Program Participants (Parents)	Provided on participant online survey	Random Sample of Program Participants	47	March 2014
Teacher Surveys	Program Participants	Teacher Survey	Random Sample of Program Participants	6	January 2014

2.2 *Tracking System Review*

Navigant conducted a review of program data in the AEP Ohio *e³smart* Audit tracking system to assess its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program.

2.3 *Engineering Algorithm Review*

Navigant conducted a review of measure savings algorithms and underlying assumptions for each measure compared to the State of Ohio Draft Energy Efficiency Technical Reference Manual (the Draft Ohio TRM) algorithms[1]. Navigant also calculated energy and demand savings for each measure in the tracking database to ensure that algorithms were applied correctly.

2.4 *Audited Savings Evaluation Methods*

Program savings were audited using the program tracking data, and the Draft Ohio TRM. Navigant conducted a review of measure savings recorded in the tracking system to verify that the algorithms matched the TRM and were correctly applied for each project. The evaluation team independently calculated energy savings for each measure in the database using the *ex ante* calculation methods based on the TRM. For measures not included in the TRM, the evaluation team examined AEP Ohio's

[1] State of Ohio Energy Efficiency Technical Reference Manual 2010, accessed at: http://amppartners.org/pdf/TRM_Appendix_E_2011.pdf.

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calculation methods and evaluated them against calculation methods identified from secondary sources (recent TRMs from nearby states). *Ex post* savings estimates were then used to calculate adjusted energy and demand savings for each measure.

2.5 *Parent/Guardian Telephone Survey*

The evaluation team conducted telephone surveys of 47 parent/guardians of participating student in March 2014. The surveys were designed to serve several purposes:

- To calculate installation rates for the program measures
- To measure participant satisfaction with the program design and implementation
- To measure satisfaction with the program measures and reasons for the participant not using or removing the measure
- To gain insight into the impact the program has on making participants aware of energy efficiency
- To elicit customer suggestions for program improvement.

2.6 *Teacher Interviews*

In-depth interviews were conducted with six participating teachers to engage in conversation with the people that are most intimately involved with the delivery of the *e³smart* Program. The list of interview candidates was developed based on a review of the teacher survey database. The majority of questions were opened ended to facilitate open discussion of the topics.

2.7 *Program Material Review*

Navigant reviewed all program materials provided to date by AEP Ohio and the implementer. A summary list of program materials reviewed to date for this report includes:

- Program tracking data
- Program impact algorithms and assumptions
- Program lesson plans and teacher instructions
- Program implementation plans

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3. Program Level Results

This section presents the AEP Ohio *e³smart* Program impact and process evaluation results.

3.1 *Impact Evaluation Results*

The Home Energy Efficiency Kits were distributed to 24,189 participants during the 2012-2013 school year through 331 teachers participating from 236 different schools. The program was delivered to public and private schools in urban and rural locations.

3.1.1 Program Impact Results

AEP Ohio and the evaluation team estimated savings based on the participant online survey. This approach relied on responses provided by program participants in an online survey. **Error! Reference source not found.** and Table 3-3 present the program saving estimates.

Table 3-1. Energy Savings Estimates

Measure	*Ex Ante* Number of installed measures (a)	*Ex Post* Number of installed measures (b)	*Ex Ante* kWh Savings per measure (c)	*Ex Post* kWh Savings per measure (d)	*Ex Ante* kWh (e) = (a) * (c)	*Ex Post* kWh (f) = (b) * (d)
23W CFLs (2 Bulbs)	19,355	31,024	56.96	49.70	923,323	1,541,796
13W CFLs (2 Bulbs)	23,839	24,370	47.70	49.54	1,357,921	1,207,221
Kitchen Aerators (1.5 GMP)	4,157	8,567	24.50	24.51	101,847	210,006
Bathroom Aerators (1.0 GMP)	4,406	9,016	24.50	42.03	107,947	378,894
LED Nightlight	5,650	17,602	21.07	21.07	119,073	370,958
Lower Hot Water Heater Temperature	2,783	2,783	132	132	367,356	367,356
Earth Massage Showerhead	5,349	10,735	237.01	237.01	1,267,766	2,544,221
Weatherstripping	7,219	9,457	3.90	11.12	28,154	105,198
Door sweep	7,868	10,308	57.09	70.42	449,184	725,862
Total					**4,722,571**	**7,451,512**

1 The savings per measure for 23W CFLs is a weighted average of the reported replaced wattage bulbs.
2 The savings per measure for 13W CFLs is a weighted average of the reported replaced wattage bulbs.
* Note: The numbers in this table are the actual numbers from the evaluation analysis. Totals may not sum due to rounding.

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Table 3-2. Demand Savings Estimates

Measure	*Ex Ante* Number of installed measures (a)	*Ex Post* Number of installed measures (b)	*Ex Ante* kW Savings per measure (c)	*Ex Post* kW Savings per measure (d)	*Ex Ante* kW (e) = (a) * (c)	*Ex Post* kW (f) = (b) * (d)
23W CFLs (2 Bulbs)	19,355	31,024	0.006	0.006	110	184
13W CFLs (2 Bulbs)	23,839	24,368	0.007	0.006	162	144
Kitchen Aerators (1.5 GMP)	4,157	8,567	0.002	0.003	13	26
Bathroom Aerators (1.0 GMP)	4,406	9,016	0.002	0.005	13	47
LED Nightlight	5,650	17,602	0.002	0.002	14	42
Lower Hot Water Heater Temperature	2,783	2,783	0	0	0	0
Earth Massage Showerhead	5,349	10,735	0.03	0.03	162	325
Weatherstripping	7,219	9,457	0.013	0.001	67	13
Door sweep	7,868	10,308	0.009	0.012	73	126
Total					**614**	**909**

1 The savings per measure for 23W CFLs is a weighted average of the reported replaced wattage blubs.
2 The savings per measure for 13W CFLs is a weighted average of the reported replaced wattage blubs.
* Note: The numbers in this table are the actual numbers from the evaluation analysis. Totals may not sum due to rounding.

3.1.2 Measure Installation Rates

The evaluation calculated installation rates for each measure using data from the parent/student online surveys. The online parent/student survey was offered to every student who received a kit. 24,189 kits were distributed and 18,465 surveys were returned, which is a 76 percent return rate. The sample for the parent/guardian telephone survey came from the parents/guardians who volunteered their contact information on the parent/student online survey.

Table 3-3 illustrates the evaluation team's calculation of audited, ex post measures installed. The evaluation team applied the parent/student online survey installation rate to the total possible measures installed based on the number of kits distributed.

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Table 3-3. 2012-2013 School Year – *Ex Post* Number of Measures Installed

Measure	Installation Rate based on returned surveys	Installation Rate based on parent survey	Number of installed Measures
23W CFLs (2 Bulbs)	64%	84%[1]	31,024
13W CFLs (2 Bulbs)	50%		24,370
Kitchen Aerator (1.5 GPM)	35%	44%	8,567
Bathroom Aerator (1.0 GPM)	37%	46%	9,016
LED Nightlight	72%[2]	91%	17,602
Lower Hot Water Heater Temperature	5%	50%	1,212
Earth Massage Showerhead	44%	51%	10,735
Weather-stripping	39%	45%	9,457
Door Sweep	42%	53%	10,308

[1] The parent/guardian telephone survey did not ask separate questions for 23W and 13W bulbs resulting in only one installation rate for CFLs.
[2]The evaluation team summed all reported installed LED nightlights. AEP Ohio only accounted for LED nightlights that were reported to have replaced an incandescent nightlight.

The *e³smart*[SM] Program provides these measures to participating students and their families. A program with this level of installation uncertainty may have lower installation rates than other energy efficiency programs. The *e³smart* Program's savings goals reflect the understanding of the uncertainty of installation.

Figure 3-1, Figure 3-2, and **Error! Reference source not found.** illustrate the reasons for removing or not installing the energy efficient kit measures. Six of the 47 survey participants stated the CFLs did not work. Two participants said the CFL did not work when they received it. One participant said the CFL broken when they received it, and three participants said the CFLs had stopped working since they installed them.

Of the twelve surveyed participants who stated they did not install all four CFLs, a variety of reasons were given. There was no common theme for the reason they did not install the CFLs.

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Figure 3-1. Why CFLs were Removed (n=7)

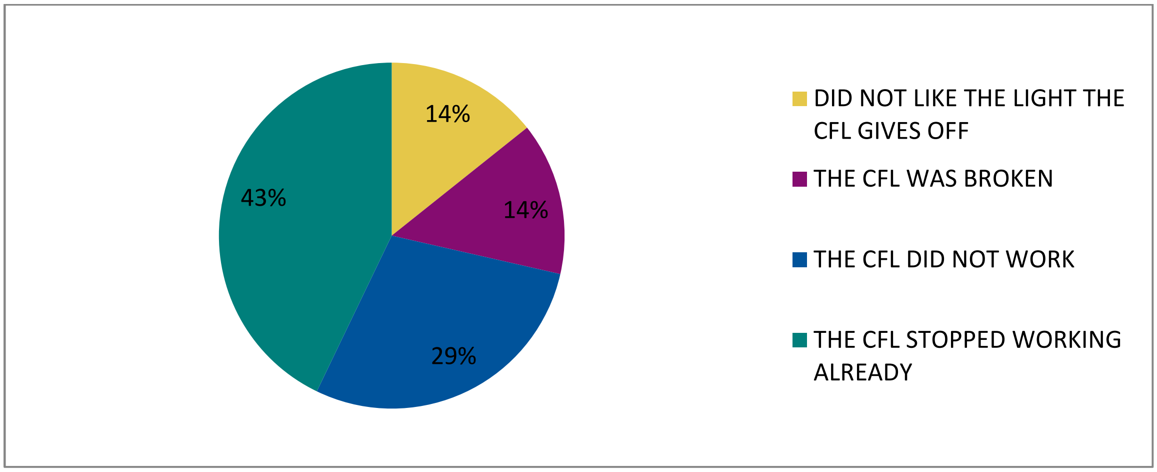

Figure 3-2. Reason for not installing Showerhead (n=23)

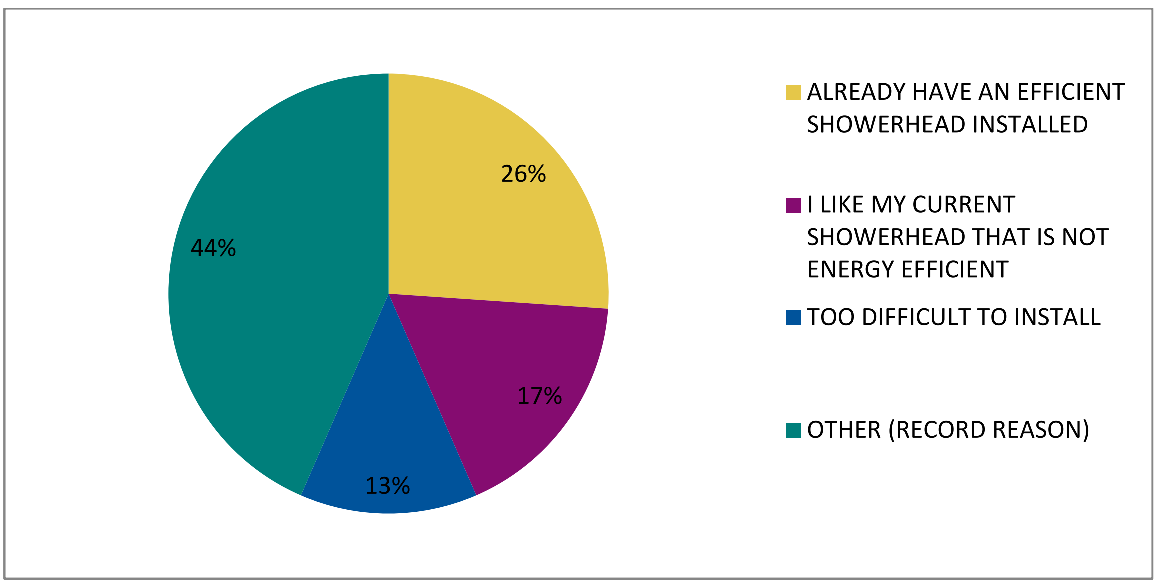

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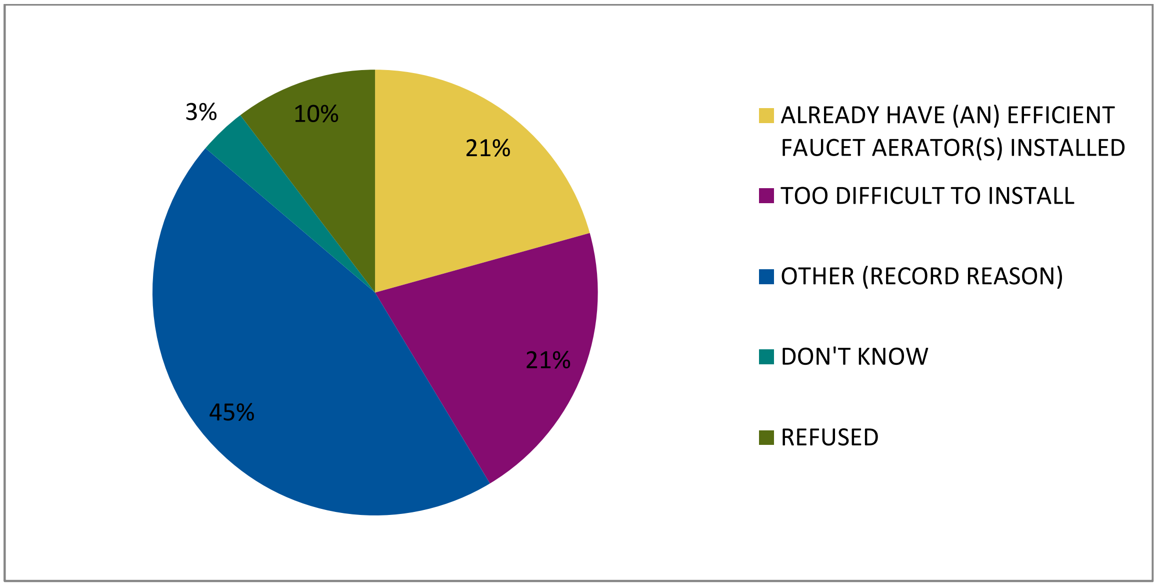
Figure 3-3. Reason for not installing Faucet Aerators (n=34)



3.1.3 **Tracking System Review**

Navigant conducted a review of program data in the AEP Ohio *e³smart* Program tracking system to verity its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. The OEP tracking data extract contained separate databases for parent/student online surveys and teacher surveys. The parent/student survey dataset contained 70 data fields and over 18,000 records. The tracking system was well organized and accurate.

3.1.4 **Audited Savings Evaluation (Algorithm Review)**

Navigant conducted a review of measure savings recorded in the tracking system to verify that the algorithms matched the Draft Ohio TRM and were correctly applied for each measure. The evaluation team independently calculated energy savings for each measure in the database using the *ex ante* calculation methods based on the Draft Ohio TRM. Navigant's algorithm review found that, with only the exception of aerators, the energy and demand savings algorithms have been constructed and applied properly.

3.1.5 **CFLs**

The Navigant team used a combination of the Draft Ohio TRM specified deemed values and program gathered values of delta watts and installation rates from our evaluation to achieve the most accurate savings estimate possible.

For 23W CFLs the parent/student survey recorded 23,681 installed bulbs. Of those 23,681 installed bulbs 17,800 reported the wattage of the incandescent bulb it replaced. For 13W CFLs the parent/student survey recorded 18,602 installed bulbs. Of those 18,602 installed bulbs 10,157 reported the wattage of the incandescent bulb it replaced. For the CFLs that did not report replaced bulb wattage, the evaluation team used the Draft Ohio TRM delta watts multiplier.

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The difference in the *ex ante* and *ex post* CFL counts are due to the evaluation team counting all the reported CFLs, while AEP Ohio only counted CFLs when a replacement bulb was listed. The CFL counts also differed due to the evaluation team applying the participant survey installation rate to the entire program participant population, while AEP Ohio only counted CFLs from the returned participant surveys.

Equation 3-1and Equation 3-2 present the equations used to calculate the CFL savings when the wattage of the replaced bulb was reported in the tracking system. The in-service rates are already applied to the measure count. Table 3-4 lists the key parameters used in the equations.

Equation 3-1. Engineering Calculation for Energy Savings for CFLs

Annual kWh Savings = (Replaced Bulb Watts - CFL Watts) / 1000 * HOURs * WHF

Equation 3-2. Engineering Calculation for Demand Savings for CFLs

Summer Coincident Peak kW Savings = ((Replaced Bulb Watts - CFL Watts)/1000) * WHF_d * CF

Table 3-4. Key Parameters for CFLs

Parameter Description	Parameter	Value	Source
Average hours of use per year	HOURs	1040	Draft Ohio TRM
Waste Heat Factor for Energy	WHFe	1.07	Draft Ohio TRM
Waste Heat Factor for Demand	WHFd	1.21	Draft Ohio TRM
Summer Peak Coincidence Factor	CF	0.11	Draft Ohio TRM
Change in CFL Watts	Delta Watts	Varies by size	Evaluation
Installation rate 23W CFLs	IR	64%	Participant Survey
Installation rate13W CFLs	IR	50%	Participant Survey

If the tracking data did not include the wattage of the bulb replaced then the Draft Ohio TRM specifies deemed values for CFLs based on CFL wattages and delta watts multipliers (see Table 3-55), which capture the differences in wattages between various types of CFLs and their incandescent equivalent. Equation 3-3 and Equation 3-4 show those calculations. Table 3-6 presents the savings results.

Equation 3-3. Draft Ohio TRM-Specified Energy Savings for CFLs

Annual kWh Savings = (CFLWatts * DeltaWattsMultiplier) * HOURs * WHF_E / 1000

Equation 3-4. Draft Ohio TRM-Specified Demand Savings for CFLs

Summer Coincident Peak kW Savings = (CFLWatts * DeltaWattsMultiplier) * WHFd * CF / 1000

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Table 3-5. Draft Ohio TRM-Specified Values for the Delta Watts Multiplier for CFLs

CFL Wattage	Delta Watts Multiplier			
	2009 - 2011	2012	2013	2014 and Beyond
15 or less	3.25	3.25	3.25	2.05
16 – 20	3.25	3.25	2.00	2.00
21 or greater	3.25	2.06	2.06	2.06

Source: *State of Ohio Energy Efficiency Technical Reference Manual (2010)*

Table 3-6. CFL Algorithm Review Findings

Measure Type	*Ex Ante* per-unit kWh Savings (a)	*Ex Ante* per-unit kW Savings (b)	*Ex Post* per-unit kWh Savings (c)	*Ex Post* per-unit kW Savings (d)	kWh Realization Rate (e) = (c) / (a)	kW Realization Rate (f) = (d) / (b)
23W CFL	56.96	0.006	49.70	0.006	94%	104%
13W CFL	47.70	0.007	49.05	0.006	103%	87%

*** Note:** ***The Ex Ante and Ex Post per-unit savings are weighted averages. The savings values varied based on the bulb it replaced.***

3.1.6 Energy and Demand Savings Calculations for Low-Flow Showerheads

The Draft Ohio TRM specifies a formula and deemed values for low-flow showerheads. Equation 3-5 and Equation 3-6 present the formulas for energy and demand savings for low-flow showerheads. AEP Ohio and the evaluation team used these formulas for calculating savings. Table 3-4 lists the key parameters used in the equations. Table 3-10 presents the results.

Equation 3-5. Draft Ohio TRM-Specified Energy Savings for Low-Flow Showerheadfs

Annual kWh savings per low-flow Showerhead = (GPMbase – GPMlow) * kWh/GPMreduced

Equation 3-6. Draft Ohio TRM-Specified Demand Savings for Low-Flow Showerhead

Annual kW savings per low-flow showerhead = kWh savings /Hours * CF

Table 3-7. Key Parameters for Low-Flow Showerheads

Parameter Description	Parameter	Draft Ohio TRM Value
Gallons Per Minute of baseline showerhead	GPMbase	2.87
Gallons Per Minute of low flow showerhead	GPMlow	1.5 program specified
Assumed kWh savings per GPM reduction	kWh/GPMreduced	173 kWh[1]
Hours of Use per Year	Hours	29
Summer Peak Coincidence Factor	CF	0.0037

[1]VEIC Response 11/15/2010

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Table 3-8. Low-Flow Showerhead Algorithm Review Findings

Low-Flow Showerheads	*Ex Ante* Savings (a)	*Ex Post* Savings (b)	Realization Rate (c) = (b) / (a)
Energy (kW)	237.01	237.01	100%
Demand (kW)	0.03	0.0	100%

3.1.7 **Energy and Demand Savings Calculations for Faucet Aerators**

The Draft Ohio TRM specifies deemed values for faucet aerators. The energy savings kit includes two faucet aerators one for kitchen faucets that have a GPM rating of 1.5 and the other for bathroom faucets which have a GPM rating of 1.0. AEP Ohio's saving estimate for the bathroom faucet aerator has the same kWh and kW saving estimates as the kitchen aerator. The faucet aerators will have different saving impacts due to the different GPM ratings and so adjusted the savings value. The per unit savings for the bathroom aerator should be 42.03 kWh and 0.005 kW rather than the kitchen aerators estimates of 24.51 kWh and 0.003 kW.

Table 3-9. Bathroom Aerator Algorithm Review Findings

Bathroom Aerator (1.0 GPM)	*Ex Ante* Savings (a)	*Ex Post* Savings(b)	Realization Rate (c) = (b) / (a)
Energy (kW)	24.5	42.0	171%
Demand (kW)	0.003	0.005	167%

The equations used to calculate energy and demand savings are specified in Equation 3-7 and Equation 3-8. Table 3-4 lists the key parameters used in the equations.

Equation 3-7. Draft Ohio TRM-Specified Energy Savings for Faucet Aerators

Annual kWh savings = ((GPMbase – GPMlow) / GPMbase) * # people * gals/day * days/year * DR) / F/home) * 8.3 * (Tft - Tmains) / 1,000,000) / DHW Recovery Efficiency / 0.003412

Equation 3-8. Draft Ohio TRM-Specified Demand Savings for Faucet Aerators

Annual kW Savings = kWh savings/ hours * CF

Table 3-10. Key Parameters for Faucet Aerators

Parameter Description	Parameter	Draft Ohio TRM Value
Gallons Per Minute of baseline faucet	GPMbase	2.2
Gallons Per Minute of low flow faucet	GPMlow	1.5 GPM for kitchen faucet aerators 1.0 GPM for bathroom faucet aerators Program specified

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Average number of people per household	# people	2.46
Average gallons per day used by all faucets in home	gals/day	10.9
Days faucet used per year	days/y	365
Percentage of water flowing down drain	DR	50%
Average number of faucets in the home	F/home	3.5
Constant to convert gallons to lbs.		8.3
Assumed temperature of water used by faucet	Tft	80
Assumed temperature of water entering house	Tmains	57.8
Recovery efficiency of electric hot water heater	DHW Recovery Efficiency	0.98
Constant to converts MMBtu to kWh		0.003412
Average number of hours per year spent using faucet	Hours	21
Summer Peak Coincidence Factor	CF	0.00262

3.1.8 Weather Stripping

Weather-stripping is not included in the Draft Ohio TRM. The evaluation team reviewed other sources of information to construct the ex post estimate of energy and demand savings for the measure. Table 3-11 shows a summary of the total *ex ante* and *ex post* savings for the measure, followed by detail on the adjustments made.

Table 3-11. Total Savings for Weather-Stripping

Measure	*Ex Ante* Savings (kW)	*Ex Post* Savings (MW)	Realization Rate (c) = (b) / (a)
Weather-stripping (17" roll)	0.009	0.0014	108%

Equation 3-9 and Equation 3-6 present the energy and demand savings for weather-stripping. Table 3-4 and Table 3-4 list the key parameters used in the equations.

Equation 3-9. Audited Energy Savings for Weatherstripping

Annual kWh savings per foot of weather-stripping = (Maximum savings potential from weatherization) * (Fraction of air leaks through windows, ceiling, walls, and floors) * (Fraction of heat transfer due to air leakage [versus conductive heat transfer]) * (Percentage of total leakage area covered per foot of weather-stripping)

Maximum savings potential from weatherization = (Average annual usage* Maximum energy savings potential from weatherization measures)

Average annual usage = All Electric Residences Average Annual Usage * Percentage of homes that are all electric + Non-All Electric Residences Average Annual Usage * (1- Percentage of homes that are all electric)

Percentage of total leakage area covered per foot of weather-stripping = Area covered per foot of weather stripping / Average leakage area per house

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Table 3-12. Key Parameters for Weather-stripping Energy Savings

Parameter Description	Audited Value
All Electric Residences Average Annual Usage	15,202[2]
Percentage of homes that are all electric	19.27%[3]
Non-All Electric Residences Average Annual Usage	10,469[3]
Maximum energy savings potential from weatherization measures	35%[3]
Fraction of air leaks through windows, ceiling, walls, and floors	41%[4]
Fraction of heat transfer due to air leakage	60%[5]
Area covered per foot of weather stripping	12 * Average width of leakage area
Average width of leakage area	0.25[6]
Average leakage area per house	374.4 square inches[7]

Equation 3-10. Audited Demand Savings for Weather-stripping

Annual kW savings per foot of weather-stripping = Cooling savings per foot of weather-stripping / Full Load Cooling Hours * Percent runtime during peak period * Summer peak coincidence factor

Cooling savings per foot of weather-stripping = kWh savings * Percent of HVAC kWh expenditure on cooling

[2]http://www.puco.ohio.gov/puco/assets/File/EE%20ramp%20up%20page/AEPOHIO%20All%20Electric%20Homes%20J_Williams%207_26_12.ppt

[3] http://energy.gov/articles/weatherized-homes-saving-money-families-across-us.

[4] Navigant engineering estimate.

[5] Navigant engineering estimate.

[6] Navigant engineering estimate.

[7] Energy Audit for Building Systems by Moncef Krarti, page 165.

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Table 3-13. Key Parameters for Weather-stripping Demand Savings

Parameter Description	Audited Value
Percent of HVAC kWh expenditure on cooling	50%[8]
Full Load Cooling Hour	503.1[9]
Percent runtime during peak period	25%[10]
Summer peak coincidence factor	35%[11]
Fraction of air leaks through windows, ceiling, walls, and floors	0.5[12]
Fraction of heat transfer due to air leakage	60%[13]
Area covered per foot of weather stripping	12 * Average width of leakage area
Average width of leakage area	0.25[14]
Average leakage area per house	374.4 square inches[15]

3.1.9 Door Sweep

Door sweeps are not included in the Draft Ohio TRM. The evaluation team reviewed other sources of information to construct a reasonable ex post estimate of energy and demand savings for the measure. Table 3-11 shows a summary of the total *ex ante* and *ex post* savings for the measure, followed by detail on the adjustments made.

Table 3-14. Total Savings for Weatherization Measures

Measure	*Ex Ante* Savings (kW)	*Ex Post* Savings (MW)	Realization Rate (c) = (b) / (a)
Door Sweep	0.009	0.0122	136%

Equation 3-11 and Equation 3-12 present the energy and demand savings for door sweeps. Table 3-4 and Table 3-4 list the key parameters used in the equations.

Equation 3-11. Audited Energy Savings for Door Sweeps

Annual kWh savings per door sweep = Maximum savings potential from weatherization * Fraction of air leaks through doors * Fraction of heat transfer due to air leakage (versus conductive heat transfer) * Door sweep savings per door / Average number of doors

Maximum savings potential from weatherization = (Average annual usage* Maximum energy savings potential from weatherization measures)

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[8] Navigant engineering estimate.
[9] Draft Ohio TRM - Average of all locations.
[10] Navigant engineering estimate.
[11] http://energy.gov/articles/weatherized-homes-saving-money-families-across-us.
[12] Draft Ohio TRM.
[13] Navigant engineering estimate.
[14] Navigant engineering estimate.
[15] Energy Audit for Building Systems by Moncef Krarti, page 165.

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Average annual usage = All Electric Residences Average Annual Usage * Percentage of homes that are all electric + Non-All Electric Residences Average Annual Usage * (1- Percentage of homes that are all electric)

Table 3-15. Key Parameters for Door Sweep Energy Savings

Parameter Description	Audited Value
All Electric Residences Average Annual Usage	15,202[16]
Percentage of homes that are all electric	19.27%[17]
Non-All Electric Residences Average Annual Usage	10,469[18]Error! Bookmark not defined.
Maximum energy savings potential from weatherization measures	35%[19]
Fraction of air leaks through doors	11%[20]
Fraction of heat transfer due to air leakage	60%[21]
Door sweep savings per door	75[22]
Average number of doors	2.8[23]
Average leakage area per house	374.4 square inches[24]

Equation 3-12. Audited Demand Savings for Door Sweeps

Annual kW savings per door sweep = Maximum cooling savings per door sweep / Full Load Cooling Hours * Percent runtime during peak period * Summer peak coincidence factor

Maximum cooling savings per door sweep = kWh savings per door sweep * Percent of HVAC kWh expenditure on cooling

Table 3-16. Key Parameters for Door Sweep Demand Savings

Parameter Description	Audited Value
Percent of HVAC kWh expenditure on cooling	50%[25]
Full Load Cooling Hours	503.1[26]
Percent runtime during peak period	25%[27]
Summer peak coincidence factor	0.5[28]

[16] http://www.puco.ohio.gov/puco/assets/File/EE%20ramp%20up%20page/AEPOHIO%20All%20Electric%20Homes%20J_Williams%207_26_12.ppt
[17] http://www.puco.ohio.gov/puco/assets/File/EE%20ramp%20up%20page/AEPOHIO%20All%20Electric%20Homes%20J_Williams%207_26_12.ppt
[18] http://www.puco.ohio.gov/puco/assets/File/EE%20ramp%20up%20page/AEPOHIO%20All%20Electric%20Homes%20J_Williams%207_26_12.ppt
[19] http://energy.gov/articles/weatherized-homes-saving-money-families-across-us
[20] http://www.iowaenergycenter.org/wp-content/uploads/2012/03/HomeSeries1.pdf
[21] Navigant Engineering estimate.
[22] Navigant Engineering estimate.
[23] AEP Ohio 2013 Existing Residential Baseline Study.
[24] Energy Audit for Building Systems by Moncef Krarti, page 165.
[25] Navigant engineering estimate.
[26] Draft Ohio TRM - Average of all locations.
[27] Navigant engineering estimate.

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3.2 *Process Evaluation Results*

Data sources for the process evaluation included in-depth interviews with program staff, parent/student surveys, teacher surveys, teacher telephone interviews, as well as the Computer-Assisted Telephone Interviewing (CATI) telephone surveys with a sample of program participants (parents).

3.2.1 Participant Satisfaction

The parents reported that their satisfaction with various elements of the *e³smart* Program was quite high Table 3-17). The parents' average satisfaction with the overall program was 9.19 on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied"). The lowest rating the program received was a 6 by one participant.

Table 3-17. Participant Satisfaction Ratings – Navigant Survey

Program Satisfaction Rating, Scale of 1 to 10	Number of Respondents who reported this rating (N=47)
10	29
9	6
8	5
7	6
6	1
Average program rating	**9.19**

The comment below is similar to the dozens we heard in the parent telephone survey. The comments generally stated that the parents were glad that their child received the education, that they the parent learned new things about energy efficiency and they were pleased with the items in the energy efficiency kit.

> *"They gave a lot of free items out that I felt were very useful and it makes people aware of how much energy you can save using the light bulbs, also it teaches the future generation about energy savings."*

Teachers reported to OEP that they were also very satisfied (in a survey administered by OEP). As the teachers are the primary implementers of this program their satisfaction is essential to the program's success. Table 3-18 displays the teacher satisfaction ratings for different aspects of the program. The teacher's overall rating was high at 6.28 on a scale of 1 to 7 (where 1 was "extremely dissatisfied" and 7 was "extremely satisfied"). The lowest rating was support and participation from families at 4.71. The teachers told our interviewers that this program is one of the only opportunities to engage the parents with what is going on in the classroom. All the interviewed teachers said they had positive feedback from some parents. None of the interviewed teachers said they had negative feedback from parents. The teachers said that some of the parents were not engaged. The teachers were appreciative of the educational material, the activities, and a chance to engage with parents and the community. The following comment is similar to the majority of comments we received in the survey.

[28] Draft Ohio TRM.

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"Thank you for letting us participate in the program. The materials were excellent and my students were excited about the program."

Table 3-18. Mean Satisfaction Scores – OEP Survey

Program Aspect	Satisfaction Rating* Mean (n = 343)
Clarity of instructions (Easy to follow)	6.42
Ease of using activities	6.29
Acceptability of preparation	6.31
Age appropriateness of energy content	5.92
Interest and motivation of students	5.83
Support and participation of families	4.71
Academic standards met	5.74
Effectiveness of home to school approach	5.50
Ability to positively affect attitudes about energy	6.10
Students overall evaluation of unit	5.79
Your (teacher) overall evaluation of unit	5.79

** Where 1 was "extremely dissatisfied" and 7 was "extremely satisfied".*

3.2.2 Educational Impact and Raising Energy Efficiency Awareness

OEP created a curriculum that focuses on energy sources, transformation of energy, and energy uses. These lessons were created to teach the fundamentals of energy as well as energy efficiency, and instruct students on how to properly install the home energy kit measures. In our teacher interviews, all the teachers had implemented some part of the curriculum and were planning on incorporating more components in the coming year.

The Navigant parent/guardian telephone survey attempted to gauge the influence the program had on the student's families. Parents/guardians were asked if they had discussed the energy kit with their child, 91 percent said they had and 70 percent said they continue to have energy efficiency discussions with their child. When asked if they learned anything new about energy efficiency from the program, 60 percent of parents said they had.

3.2.3 Community Outreach

In the 2012-2013 school year the program reached over 24,000 participants. Beyond the student and family engagement, the OEP curriculum includes ways the class can reach out to the local media that incorporates educational requirements. Over one hundred teachers mentioned that their class did some type of outreach to local newspapers, local TV media, or a presentation to the community regarding the *e³smart* Program.

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3.2.4 **Program Marketing and Channeling to Other Programs**

The program included 189 teachers in the 2010-2011 school year, 401 in the 2011-2012 school year, and 331 teachers in the 2012-2013 school year.

OEP sends teacher applications to every school in the AEP Ohio territory. The application can also be obtained from OEP's website. OEP also attends numerous energy conferences in the region to promote the *e³smart* Program.

AEP Ohio set a student goal of 16,000 participants its first year (2009-2010) and OEP met the target. The next year AEP Ohio set a participation goal of 32,000 participants. OEP adjusted their efforts and met that goal in the 2011-2012 school year. OEP was unable to meet the participation goal of 32,000 in the 2012-2013 school year achieving 76% of their goal by distributing 24,189 energy efficiency kits. Navigant recommends that AEP Ohio reevaluate the participation goals. Certain factors may be limiting the participant population pool. The program does not offer the program to classrooms that have students who may have taken the program in previous years. Also, OEP only allows teachers to participate again if they have demonstrated they are committed to the *e³smart*SM Program by achieving a high participant survey submission rate.

The *e³smart* Program provides a marketing opportunity for AEP Ohio's other residential energy efficiency programs. The program met this opportunity with materials that include the URL to AEP Ohio's energy efficiency programs web site,[29] and information about AEP Ohio's energy efficiency/peak demand reduction (EE/PDR) programs. The evaluation team recommends that the *e³smart* Program continue to channel its participants to other AEP Ohio programs.

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[29]. https://www.aepohio.com/save/Default.aspx?ctype=h

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3.3 *Cost-Effectiveness Review*

This section addresses the cost effectiveness of the *e³smart* Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 3-19 summarizes the unique inputs used in the TRC test.

Table 3-19. Inputs to Cost-Effectiveness Model for *e³smart* Program

Item	Value
Average Measure Life	9
Units	122,288
Annual Energy Savings (MWh)	7,244
Coincident Peak Savings (kW)	909
Third Party Implementation Costs	278,797
Utility Administration Costs	51,940
Utility Incentive Costs	366,711
Participant Contribution to Incremental Measure Costs	0

Based on these inputs, the TRC ratio is 3.7. Therefore, the program passes the TRC test. Table 3-20 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 3-20. Cost Effectiveness Results for the *e³smart* Program

Test Results for *e³smart*	
Total Resource Cost	3.7
Participant Cost Test	14.3
Ratepayer Impact Measure	0.4
Utility Cost Test	3.7

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

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4. Conclusions and Recommendations

This section highlights the findings from the evaluation of the *e³smart* Program for the 2012-2013 school year.

4.1 *Key Impact Findings and Recommendations*

The *e³smart* program sent energy kits with 24,189 participants during the 2012-2013 school year. 331 teachers participated in the program from 236 different schools.

Table 4-1 shows the 2012-2013 program goals, *ex ante* savings claimed by the program, and the *ex post* savings. The *ex post* energy and demand savings for the 2012-2013 school year were 7,451 MWh and 0.91 MW, respectively.

AEP Ohio calculated the *ex ante* savings from the 18,464 participant surveys that were submitted. The evaluation team calculated the installation rate from the participant survey and applied this rate to the program population of 24,189 participants. The realization rate increase is due to the application of the student survey installation rate to the entire population of students that received energy kits.

Table 4-1. 2012-2013 School Year Overall Evaluation Results

	2013 Program Goals	*Ex Ante*[1] Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)	Percent of Goal
Energy Savings (MWh)	7,064	4,723	7,451	158%	105%
Demand Savings (MW)	1.462	0.61	0.91	147%	62%

[1]*Ex ante* differs slightly from AEP Ohio Portfolio Status Report due to different final data sets.

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The *ex post* saving estimates for the *e³smart*SM Program were developed using the installation rates gathered from the student installation survey and applied these to all the distributed kits. This is similar to the approach that AEP Ohio uses for its In-Home Energy Program that distributes a similar energy kit. The evaluation team also conducted a parent/guardian telephone survey to verify installation rates. Table 4-2 presents the program saving estimates and the number of measures installed by the program.

Table 4-2. 2012-2013 School Year Savings Estimates

Measure	Number of installed measures (a)	kWh Savings per measure (b)	kWh (c) = (a) * (b)	* kW Savings per measure (d)	kW (e) = (a) * (d)
23W CFLs (2 Bulbs)	31,024	49.70[1]	1,541,796	0.0059	184.4
13W CFLs (2 Bulbs)	24,368	49.54[2]	1,207,221	0.0059	144.4
Kitchen Aerators	8,567	24.5	210,006	0.0031	26.2
Bathroom Aerators	9,016	42.0	378,894	0.0052	47.3
LED Nightlight	17,602	20.59	370,958	0.0024	42.3
Lower Hot Water Heater Temperature	2,783	132	367,356	0	0
Earth Massage Showerhead	10,734	237.01.1	2,544,221	0.0261	325.5
Weatherstripping	9,457	11.1	105,198	0.00138	13.1
Door sweep	10,308	70.42	725,862	0.012247	126.2
Total	**-**	**-**	**7,451,512**	**-**	**909.3**

[1] The savings per measure for 23W CFLs is a weighted average of the reported replaced wattage blubs.
[2] The savings per measure for 13W CFLs is a weighted average of the reported replaced wattage blubs.
* *Note: The numbers in this table are the actual numbers from the evaluation analysis. Totals may not sum due to rounding.*

Verification of Installation Rates. Most of the saving estimates for *the e³smart* Program were developed using algorithms and assumptions in the draft Ohio TRM, with some parameters adjusted by evaluation data from a participant self-report installation survey. The evaluation team used the installation rates gathered from the student installation survey and applied it to all the distributed kits. This is similar to the approach that AEP Ohio uses for their In-Home Energy Program that distributes a similar energy efficiency kit. The evaluation team also conducted a parent/guardian telephone survey to verify installation rates.

1. **Finding:** The participant online survey was returned by 76 percent of the participant population. The Navigant team believes that the surveys are representative of the program population.

   Impact Recommendation #1: The installation rates gathered from the online surveys should be applied to the entire population of students who received a kit to estimate *ex ante* savings in the future.

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2. **Finding:** Participant goals were not met in the 2012 -2013 school year. OEP achieved 76 percent of its participation goal by distributing 24,189 energy efficiency kits. The program goal for the 2012 – 2013 school year was 32,000 participants. OEP has met its participation goals in the previous years of this program. Part of the reason OEP did not meet its goals is related to a declining target population. The *e³smart*SM Program will not offer the program to students who have already participated in the program, which limits the pool of available classrooms. OEP's commitment to retaining only high performing teachers from previous years also reduces the potential participant population pool.

   Impact Recommendation #2: The Navigant team suggests reevaluating the participation goals for the *e³smart* Program to reflect the declining population pool.

3. **Finding:** AEP Ohio's per-unit savings estimate for the bathroom aerator is the same as the kitchen aerator. However, the bathroom aerator is rated at 1.0 gallons per minute (GPM) while the kitchen aerator is rated at 1.5.

   Impact Recommendation #3: The Navigant team suggests adjusting the bathroom savings estimates to reflect the 1.0 GPM rating. The adjusted per unit savings for the bathroom aerator would be 42.03 kWh and 0.005 kW, rather than the kitchen aerators estimates of 24.51 kWh and 0.003 kW.

Key Process Findings and Recommendations

The objectives of the process evaluation were to develop an understanding of the final program design and implementation strategies, as well as to document program processes and tracking efforts, and to identify and recommend potential program improvements. The data collection approach for the process evaluation was in-depth interviews with AEP Ohio program staff, the program administrator, program implementers, and teachers. Teacher surveys conducted by OEP were examined for program process suggestions. The parent/guardian telephone survey included process related questions.

Participants are satisfied with most aspects of the program. The participant's average satisfaction level with the overall program was 9.19, on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied") (from the evaluation parent/guardian telephone survey), indicating that parents were quite satisfied with various elements of the program.

In a survey administered by OEP, the teachers rated their satisfaction at 6.28 on a scale of 1 to 7 (where 1 was "extremely dissatisfied" and 7 was "extremely satisfied"). As the teachers are the primary implementers of this program, their satisfaction is essential to the success of the program.

Process Recommendation #1: The Navigant team suggests that OEP modify its teacher survey to the same 1 to 10 scale as AEP Ohio's phone survey, or allow for a better comparison.

Educational Impact and Raising Energy Efficiency Awareness. Parents report that they learned something about energy efficiency from the program and that they have discussed the kit with their children. In the parent survey, the parent was asked if he or she had discussed the kit with the child, 91 percent said yes, and 70 percent said they continue to have energy efficiency discussions with their child. When asked if they learned anything new about energy efficiency from the program 60 percent of parents said they had.

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Community Outreach In the 2012-2013 school year. The OEP curriculum includes ways the class can reach out to the local media. Over one hundred teachers mentioned that their class did some type of outreach to local newspapers, local TV media, or a presentation to the community regarding the *e³smart* Program**.**

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Appendix A. 2012-2013 School Year Online Student Survey

2012-13 FAMILY INSTALLATION SURVEY
Columbia Gas of Ohio / AEP Ohio

LIGHTING

1) How many of the **23 watt CFLs** did you install?
   One Two None

2) When installing the **23 watt CFLs**, how many of the following bulbs did you replace?

CFLs	One	Two	None	40w IL	One	Two	None
60w IL	One	Two	None	75w IL	One	Two	None
100w IL	One	Two	None	Other	One	Two	None

3) How many of the **13 watt CFLs** did you install?
   One Two None

4) When installing the **13 watt CFLs**, how many of the following bulbs did you replace?

CFLs	One	Two	None	40w IL	One	Two	None
60w IL	One	Two	None	75w IL	One	Two	None
100w IL	One	Two	None	Other	One	Two	None

5) Did you install the **LED nightlight**?
   Yes No

If Yes, did you replace an incandescent nightlight?
   Yes No

INSULATION

1) Did you install the **weather stripping** from the energy efficiency items provided?
   Yes No

2) Did you install the **door sweep** from the energy efficiency items provided?
   Yes No

HVAC

1) What type of **primary heating system** does your home use?
   Gas furnace Electric furnace Heat pump Baseboard/In-wall unit
   Other

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Don't Know

2) What type of **primary cooling system** does your home use?

Central AC Window AC Heat pump Other Don't Know

3) Did you install the **furnace filter whistle**?

Yes No

4) Did you (or will you) and your family **lower** your thermostat setting for **HEATING**?

Yes, we lowered (or will lower) the setting

No, our thermostat is already at the recommended setting of 68°F

No, other reason

If you answered **YES**, how much did you lower the setting?

1-2° F 3-4° F 5-6° F 7-8° F 9° F or more Don't Know

6) Did you (or will you) and your family **increase** your thermostat setting for **COOLING**?

Yes, we increased (or will increase) the setting

No, our thermostat is already at the recommended setting of 78°F

No, other reason

If you answered **YES**, how much did you increase the setting?

1-2° F 3-4° F 5-6° F 7-8° F 9° F or more Don't Know

WATER

1) What type of **water heater** does your home use?
Natural Gas Electric Other Don't Know

2) Did you (or will you) and your family change your **thermostat setting for your water heater** to the recommended
setting of 120°F?

Yes, we lowered (or will lower) the setting

No, it was already at the recommended setting

No, other reason

If you answered **YES**, how much did you lower the setting?
1-9°F 10-20°F 21-29°F 30-39°F 40°F or more

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3) Did you install the **kitchen faucet aerator**?
Yes No

4) Did you install the **bathroom faucet aerator**?
Yes No

5) Did you install the **low-flow showerhead**?
Yes No

REFRIGERATOR/FREEZER

1) Did you adjust the setting on your **refrigerator** to the recommended setting (34-40°F)?
Yes No

2) Did you adjust the setting on your **freezer** to the recommended setting (0-5°F)?
Yes No

CONCLUSION

1) How many people live in your home?
2 3 4 5 6+

2) What type of home do you live in?
Single Family Home Apartment/Condo/Duplex

3) ***OPTIONAL - Parent/Guardian Permission only:***
Please provide your address and phone number below for possible contact regarding this educational program.

Street: ________________________ City: __________________ Zip Code: ________

Phone with Area Code: (___ ___ ___) ___ ___ ___ - ___ ___ ___ ___

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Appendix B. Appendix B. e³smart℠ Teacher Evaluation Form

e³smart TEACHER EVALUATION FORM

Name________________________ School_______________________

District____________________

1. Grade Level/Class in which you used the unit_____

2. Number of participating students _____

3. Average pre-poll score_____ Average post-poll score_____

4. Did you use the entire unit?

_____Yes _____No If no, circle which lessons/activities you used.

#1: Intro to E #2: Insulation #3: Heating & Cooling #4: Saving Water #5: Lightbulbs #6: Appliances #7 E Synopsis

5. Circle the lesson(s)/activity(ies) that were most effective.

#1: Intro to E #2: Insulation #3: Heating & Cooling #4: Saving Water #5: Lightbulbs #6: Appliances #7 E Synopsis

6. Please rate the following aspects of the program.

Poor ___________________________ Excellent

a- Clarity of instructions (Easy to follow 1 2 3 4 5 6 7

b- Ease of using activities 1 2 3 4 5 6 7

c- Acceptability of preparation 1 2 3 4 5 6 7

d- Age appropriateness of energy content 1 2 3 4 5 6 7

e- Interest and motivation of students 1 2 3 4 5 6 7

f- Support and participation of families 1 2 3 4 5 6 7

g- Academic standards met 1 2 3 4 5 6 7

h- Effectiveness of home to school approach 1 2 3 4 5 6 7

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i- Ability to positively affect attitudes about energy 1 2 3 4 5 6 7
including the importance of conservation and efficiency

j- Students' overall evaluation of unit 1 2 3 4 5 6 7

k- Your (teacher) overall evaluation of unit 1 2 3 4 5 6 7

7. How many student kits were you provided? _______

8. How many student kits were given to students? _______

9. How many student kits were completely installed in some other manner? _______

A. school members _____ B. community members _____ C. service projects _____ D. others _____

Please explain:

10. How many student kits are being stored by you? _______

11. Did you obtain any publicity during the unit? Explain.

12. Would you conduct the unit again? Explain.

13. What recommendations do you have to improve the unit or lessons?

14. What would make the unit more useful to you?

15. Do you believe the unit changed student and/or family attitudes or behavior about energy conservation and energy efficiency? Explain.

16. Any other comments or suggestions.

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Appendix C. Parent/Guardian Telephone Survey

AEP Ohio e³smart Program: Parent/Guardian Interview Guide
Updated: 03/05/14

Module	Questions	Research Questions
Screener	S1	
Program-Specific Verification Questions	PR1 CFL1-CFL9 SH1- SH5 FA1-FA4 LED1-LED4 INS1-INS5 OM1-OM8	Feedback on permission request process Verify measure installations, and measure retention
Program Satisfaction	PS1-PS7	Satisfaction with the program Suggestions for program improvements
Other Programs/Channeling	OP1 – OP7	Have participants participated in any other EE programs. For example, did the Appliance Recycling program influence this participation?

INTRODUCTION AND SCREENER

Hello, this is [INTERVIEWER NAME] calling from The Blackstone Group on behalf of AEP Ohio, your electric utility.

INTRO. We are contacting customers whose middle school children participated in an AEP Ohio sponsored school energy efficiency program called **e³smart** to gather information that will help improve the program. The program included both in-classroom instruction on energy and a take-home energy kit with items that could be installed in your home as part of the learning experience, including compact fluorescent light bulbs, a low-flow showerhead, kitchen and bathroom faucet aerators, and an LED nightlight. This is not a sales call, and all responses will be kept anonymous.

Depending on your responses, the survey will take about 10 minutes to complete.

A. Are you the person who is most familiar with what was done with the e³smart energy efficiency take-home kit? (IF NOT: May I please speak with the person who is most familiar with that?)
   1. YES
   2. NO **[Is the person who is most familiar available now OR SCHEDULE CALL-BACK]**
   3. DID NOT PARTICIPATE IN PROGRAM **[THANK AND TERMINATE]**
   98. DON'T KNOW **[THANK AND TERMINATE]**
   99. REFUSED **[THANK AND TERMINATE]**

B. IF PARTICIPANT NEEDS TO RESCHEDULE: What would be a better time for us to call you back? (ONLY ASK THIS IF THEY SAY THEY DON'T HAVE TIME FOR THE INTERVIEW RIGHT NOW)
(Name of person who should be contacted)

   1. (TAKE TIME/DAY) _______/__________
   2. No (THANK AND TERMINATE)
   99. REFUSED (THANK AND TERMINATE)

NAVIGANT

SCREENING QUESTIONS

S1. Does AEP Ohio provide electric service to your home?

1. Yes
2. No, another company [SPECIFY - RECORD VERBATIM] [IF COLUMBUS SOUTHERN POWER OR OHIO POWER COMPANY, CONTINUE, DO NOT TERMINATE; OTHERWISE **THANK AND TERMINATE]**
98. DON'T KNOW
99. REFUSED

PARTICIPATION REQUEST AND MEASURE INSTALLATION

PR1. Do you recall receiving the permission slip for your child to participate in the e^{3}smart program?

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

Measure Installation:

I am now going to ask you about the items in the take-home energy kit.

CFL1. The take-home energy kit included four Compact Fluorescent Lights or CFLs. How many of the CFLs did you install in your home?

1. One
2. Two
3. Three
4. Four
5. None **[SKIP TO CFL9]**
98. DON'T KNOW **[SKIP TO CFL9]**
99. REFUSED **[SKIP TO CFL9]**

CFL2. Of those **<RESPONSE FROM CFL1>** CFL bulbs that you actually installed, how many of those replaced: **[ASK EACH OF THE FOLLOWING UNTIL YOU REACH 4]**

A. Incandescent bulbs **[RECORD 0 - 4]**
B. CFL bulbs **[RECORD 0 - 4]**
C. Halogen bulbs **[RECORD 0 - 4]**
97. Other (SPECIFY) **[RECORD 0 - 4]**
98. DON'T KNOW
99. REFUSED

[ASK IF CFL1 = LESS THAN 4. IF CFL1=4 THEN SKIP to CFL5]

CFL3. What was your reasoning for not installing the other CFLs? **[OPEN END. RECORD VERBATIM]**

1. Already have CFLs installed

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2. Do not like the light that the CFLs give off
3. The CFL was broken
4. The CFL did not work
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

CFL4. What did you do with the CFL(s) you did not install? **[ALLOW MULTIPLE RESPONSES]**

1. Stored it/them for future use
2. Stored it/them to give to someone else later
3. Stored it/them to dispose of later
4. Recycled it/them
5. Threw it/them away in the garbage
6. Gave it/them to someone else
97. OTHER **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

CFL5. How many CFLs that you did install are still installed?

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

[ASK IF CFL5=CFL1 SKIP TO CFL9, ELSE CONTINUE TO CFL6]
CFL6. Why did you remove the CFL(s)?

1. Did not like the light the CFL gives off
2. The CFL was broken
3. The CFL did not work
4. The CFL stopped working already
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

CFL7. What happened to the CFL(s) that were removed? **[ALLOW MULTIPLE RESPONSES]**

1. Thrown away
2. In storage
3. Sold or given away
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

CFL8A. **[ASK If CFL1=LESS THAN 4 CFLs]** Do you plan on installing the uninstalled CFLs? **[READ LIST]**

1. In the next month or two
2. In 3 to 6 months
3. In 7 to 12 months

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4. More than a year from now
5. As current CFLs burn out
6. I don't plan on installing the remaining CFL(s)
98. DON'T KNOW
99. REFUSED

CFL9. On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied", please tell me how satisfied were you with the CFLs?

[RECORD 0 - 10]
98. DON'T KNOW
99. REFUSED

SH1. Did you install the energy efficient showerhead you received in the energy kit?

1. YES
2. NO **[SKIP TO SH4]**
98. DON'T KNOW **[SKIP TO FA1]**
99. REFUSED **[SKIP TO FA1]**

SH2. Is the showerhead still installed?

1. Yes **[SKIP TO FA1]**
2. No
98. DON'T KNOW **[SKIP TO FA1]**
99. REFUSED **[SKIP TO FA1]**

SH3. What was your reasoning for removing the showerhead? **[ONCE THIS QUESTION IS ANSWERED SKIP TO FA1]**

1. Did not like the water flow (pressure) of the showerhead
2. Did not like the spray
3. It stopped working
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

SH4. What was your main reason for not installing the showerhead?

1. Already have an efficient showerhead installed **[SKIP TO FA1]**
2. I like my current showerhead that is not energy efficient
3. Worried about the possible reduced pressure of the showerhead
4. Too difficult to install
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

SH5A. Do you plan on installing the showerhead in the future? **[READ LIST]**

1. In the next month or two
2. In 3 to 6 months

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3. In 7 to 12 months
4. More than a year from now
5. As current showerhead stops working
6. I don't plan on installing the showerhead
98. DON'T KNOW
99. REFUSED

FA1. Did you install both kitchen and bathroom faucet aerators you received in the energy kit?

1. YES, both kitchen and bathroom aerators
2. Just the kitchen aerator
3. Just the bathroom aerator
4. NO, neither **[SKIP TO FA3]**
98. DON'T KNOW **[SKIP TO LED1]**
99. REFUSED **[SKIP TO LED1]**

FA2. Did you remove the aerator(s)?

1. Yes
2. No **[IF FA1 = 2 or 3 SKIP TO FA3]**
98. DON'T KNOW **[SKIP TO LED1]**
99. REFUSED **[SKIP TO LED1]**

FA2B. What was your reasoning for removing the faucet aerator(s)? **[ONCE THIS QUESTION IS ANSWERED SKIP TO LED1]**

1. It did not function properly
2. Do not like the pressure of the faucet aerator
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

FA3. What was your main reason for not installing the faucet aerator(s)?

1. Already have (an) efficient faucet aerator(s) installed **[SKIP TO LED1]**
2. Worried about the pressure of the faucet aerator
3. Too difficult to install
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

FA4A. Do you plan on installing the faucet aerator(s) in the future? **[READ LIST; ONCE THIS QUESTION IS ANSWERED SKIP TO LED1]**

1. Within the next month or two
2. In 3 to 6 months
3. In 7 to 12 months
4. More than a year from now
5. As current faucet aerator stops working
6. I don't plan on installing the faucet aerator
98. DON'T KNOW

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99. REFUSED

LED1. Did you install the LED nightlight you received in the energy kit?

1. Yes
2. No **[SKIP TO LED3]**
98. DON'T KNOW **[SKIP TO INS1]**
99. REFUSED **[SKIP TO INS1]**

LED1A. Is the LED nightlight still installed?

1. Yes **[SKIP TO LED2]**
2. No
98. DON'T KNOW **[SKIP TO INS1]**
99. REFUSED **[SKIP TO INS1]**

LED1B. What was your reasoning for removing the LED nightlight? **[ONCE THIS QUESTION IS ANSWERED SKIP TO INS1]**

1. I decided I did not need a nightlight where I put it
2. Do not like the type of light it provides
3. Not satisfied with the nightlight
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

LED2. Which of the following best describes how you used the LED nightlight that you installed … **[READ LIST; ONCE THIS QUESTION IS ANSWERED SKIP TO INS1]**

1. It replaced a regular incandescent nightlight,
2. It replaced an older efficient nightlight, or
3. You used it in a location that didn't have a nightlight?
98. DON'T KNOW
99. REFUSED

LED3. What was your main reason for not installing the efficient nightlight?

1. Waiting for existing nightlight to burn out
2. Haven't gotten around to it yet
3. Not satisfied with the nightlight **[SKIP TO INS1]**
4. Do not like the type of light it provides **[SKIP TO INS1]**
5. Do not have the need for another nightlight **[SKIP TO INS1]**
6. Do not have a need for nightlights **[SKIP TO INS1]**
97. Other specify **[RECORD VERBATIM]**
98. DON'T KNOW
99. REFUSED

LED4A. Do you plan on installing the nightlight in the future? **[READ LIST]**

1. Within the next month or two
2. In 3 to 6 months
3. In 7 to 12 months
4. More than a year from now

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5. When the current nightlight burns out
6. I don't plan on installing the nightlight
98. DON'T KNOW
99. REFUSED

INS1. The take home energy kit included two insulation measures: a door sweep, and weather-stripping. Which of these two measures did you install?

03.Installed both measures **[SKIP TO INS3]**
04.Installed door sweep and weather-stripping
05.Just installed the door sweep
06.Just installed the weather-stripping
07.Did not install any of the measures
98. DON'T KNOW **[SKIP TO INS3]**
99. REFUSED **[SKIP TO INS3]**

NAVIGANT

INS1A.What was your reasoning for not installing all the insulation measures?

04.Already have some of the measures installed
01.Too difficult to install
02.Haven't gotten around to it yet
03.Not satisfied with the measures
97.OTHER **[RECORD RESPONSE]**
98.DON'T KNOW
99.REFUSED

INS3. Did you remove any of the insulation measures?

1. Yes
2. No **[IF INS1 = 3 SKIP TO OM1, ELSE GO TO INS4]**
98. DON'T KNOW **[SKIP TO OM1]**
99. REFUSED **[SKIP TO OM1]**

INS4. Which measures did you remove?

4.All both measures **[ASK INS5]**
5.The door sweep and weather-stripping **[ASK INS5]**
1. Just the door sweep **[ASK INS5]**
2. Just the weather-stripping
98. DON'T KNOW **[SKIP TO OM1A]**
99. REFUSED **[SKIP TO OM1A]**

INS5. **[ASK IF INS4=1,4, OR 5** What was your reasoning for removing the door sweep?

1. I decided I did not need a door sweep
2. Not satisfied with the door sweep
3. The door sweep broke
4. The door sweep was inconvenient/got in the way
97. OTHER **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

OM1A. Did you lower your thermostat to the temperature setting recommended in the home energy kit?

1. Yes **[SKIP TO OM1B]**
2. No
98. DON'T KNOW **[SKIP TO OM1B]**
99. REFUSED **[SKIP TO OM1B]**

OM2. What was your reasoning for not lowering your thermostat to the recommended temperature setting?

1. Thought the setting was too cold
2. Do not control the thermostat
3. Thermostat is broken
4. Too difficult to adjust
97. OTHER **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

NAVIGANT

OM1B. Did you raise your air conditioner to the temperature setting recommended in the home energy kit?

1. Yes **[SKIP TO OM1C]**
2. No
3. Do not have an air conditioner **[SKIP TO OM1C]**
98. DON'T KNOW **[SKIP TO OM1C]**
99. REFUSED **[SKIP TO OM1C]**

OM3. What was your reasoning for not raising your air conditioner to the recommended temperature setting?

1. Did not think the setting was cold enough
2. Air conditioner is broken
3. Too difficult to adjust
97. OTHER **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

OM1C. Did you adjust your refrigerator to the recommended setting?

1. Yes **[SKIP TO OM1D]**
2. No
98. DON'T KNOW **[SKIP TO OM1D]**
99. REFUSED **[SKIP TO OM1D]**

OM4. What was your reasoning for not adjusting your refrigerator to the recommended temperature setting?

1. Thought the recommended temperature was too warm
2. Thought the recommended temperature was too cold
3. Too difficult to adjust
97. OTHER **[RECORD RESPONSE]**
98. DON'T KNOW
99. REFUSED

OM1D. Did you adjust your freezer to the recommended setting?

1. Yes **[SKIP TO PS1]**
2. No
3. Do not have a freezer **[SKIP TO PS1]**
98. DON'T KNOW **[SKIP TO PS1]**
99. REFUSED **[SKIP TO PS1]**

OM5. What was your reasoning for not adjusting your freezer to the recommended temperature setting?

1. Thought the recommended temperature was too warm
2. Thought the recommended temperature was too cold
3. Too difficult to adjust
97. OTHER **[RECORD RESPONSE]**

NAVIGANT

98. DON'T KNOW
99. REFUSED

Program Satisfaction

PS1. On a scale of 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, please rate your overall satisfaction with the e^{3}smart program.

[RECORD 0-10]
98. DON'T KNOW [SKIP TO PS3]
99. REFUSED [SKIP TO PS3]

PS2. What was your reasoning for giving it that rating?

[OPEN-ENDED]
97. DON'T KNOW
98. REFUSED

PS3. On a scale of 0 to 10 where 0 means your child did not enjoy participating in the e^{3}smart program at all and 10 means they very much enjoyed participating in the e^{3}smart program, how much do you think your child enjoyed the program?

[RECORD 0-10]
98. DON'T KNOW
99. REFUSED

PS4. Did your child discuss the contents of the e^{3}smart kit with you?

1. Yes
2. No [SKIP TO PS7]
98. DON'T KNOW [SKIP TO PS7]
99. REFUSED [SKIP TO PS7]

PS5. Did you learn anything new about energy efficiency when discussing the e^{3}smart program with your child? If so, what did you learn?

1. Yes **[RECORD OPEN ENDED RESPONSE ABOUT WHAT THEY LEARNED]**
2. No
98. DON'T KNOW
99. REFUSED

PS6. Have you continued to have energy efficiency conversations with your child since the e^{3}smart program?

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

PS7. From your perspective, what, if anything, could be done to improve AEP Ohio's e^{3}smart program?

[OPEN-ENDED]

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98. DON'T KNOW
99. REFUSED

Kit improvements

KI1. Can you think of any other measures you would like included in the kit?

[OPEN-ENDED]
98. DON'T KNOW
99. REFUSED

KI 2. If a coupon were included in the kit that offered a discount on a large energy efficient product (such as a clothes washer, or refrigerator) would that encourage you to purchase that item?

1. Yes
2. No
98. DON'T KNOW
99. REFUSED

NAVIGANT

Other Programs/Channeling

OP1. Have you participated in any other energy efficiency programs provided by AEP Ohio?

1. Yes
2. No **[SKIP TO SO1]**

98. DON'T KNOW **[SKIP TO SO1]**
99. REFUSED **[SKIP TO SO1]**

OP2. Which other consumer energy efficiency programs offered by AEP Ohio did you participate in? **[DO NOT READ LIST, SELECT ALL THAT APPLY]**

01.Appliance Recycling Program (refrigerator and freezer pick up)
06.Energy Star Appliance Rebate Program (mail-in rebates on clothes washers, dehumidifiers, freezers, refrigerators, high efficiency electric water heaters, and electric heat pump water heaters)
09.In-Home Energy Program (choice of 3 options (energy assessment, energy audit, or online energy check-up); options include recommendations for energy efficiency improvements and rebates for installing free energy-saving items provided, such as CFLs, programmable thermostats, low-flow shower heads, and pipe wrap
02.Community Assistance Program (weatherization services and products for low income residential customers, including home energy assessment, attic and wall insulation, air sealing, CFLs, refrigerator replacement, and other energy improvements
07.Energy Star New Homes Program (homeowners purchase from participating builders to ensure their new home is built to meet stringent energy performance guidelines)
16.Home Energy Report Program (a mailed report shows customers how to save energy by taking certain steps)
05.Energy Check Toolkit Library Lending Program (LENDS ITEMS TO ASSESS HOME ENERGY USAGE)
17. Efficient Products Program (markdowns or instant coupons for CFLs and rebates for other energy efficient appliances such as clothes washers, dehumidifiers, refrigerators, freezers, high efficiency electric water heaters, and electric heat pump water heaters.)
97. Other **[RECORD RESPONSE]**
98. DON'T KNOW **[SKIP TO SO1]**
99. REFUSED **[SKIP TO SO1]**

OP3. Did you participate in any of these other consumer energy efficiency programs (besides e^3smart) specifically because of your experience with the e3smart program?

1. Yes
2. No **[SKIP TO SO1]**

98. DON'T KNOW **[SKIP TO OP7]**
99. REFUSED **[SKIP TO OP7]**

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OP4. How influential was the program in encouraging you to participate in the other energy efficiency programs? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential.

[RECORD 0-10]
98. DON'T KNOW
99. REFUSED

SO1. Have you made any other energy efficient upgrades to your home since being involved in the e³smart program? **[Example for interviewer: such as purchasing and installing more CFLs, insulation, new appliances, solar panels, etc..]**

1. Yes
2. No **[SKIP TO OP7]**
98. DON'T KNOW **[SKIP TO OP7]**
99. REFUSED **[SKIP TO OP7]**

SO1A. What upgrades have you made?

[OPEN ENDED]
98. DON'T KNOW
99. REFUSED

SO2. How influential was the **e³smart** program in encouraging you to make energy efficient upgrades? Please rate this on a 0-10 scale, where 0 means not at all influential and 10 means very influential.

[RECORD 0-10]
98. DON'T KNOW
99. REFUSED

OP7. AEP Ohio wishes to reach more customers about their energy efficiency programs. How do you suggest that AEP Ohio reach customers like yourself?

[OPEN ENDED]
98. DON'T KNOW
99. REFUSED

Conclusion: *That's all of the questions I have for you today. Thank you for your time. AEP Ohio appreciates your participation.*

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PS4. Did you and your child discuss the contents of the e[3]smart kit? [SINGLE PUNCH]

3. YES
4. NO [SKIP TO PS7]
100.DON'T KNOW [SKIP TO PS7]
101.REFUSED [SKIP TO PS7]

PS5. Did you learn anything new about energy efficiency when discussing the e[3]smart program with your child? If so, what did you learn? [SINGLE PUNCH]

3. YES (RECORD LEARNINGS) [OPEN END]
4. NO
100.DON'T KNOW
101.REFUSED

PS6. Have you continued to have energy efficiency conversations with your child since the e[3]smart program? [SINGLE PUNCH]

3. YES
4. NO
100.DON'T KNOW
101.REFUSED

PS7. What, if anything, do you recommend AEP Ohio do to improve the e[3]smart program? [SINGLE PUNCH]

97. [OPEN END]
96. NO RECOMMENDATIONS
98. DON'T KNOW
99. REFUSED

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Other Programs/Channeling

OP1. Have you participated in any other energy efficiency programs provided by AEP Ohio? [SINGLE PUNCH]

3. YES
4. NO [SKIP TO SO1]
100.DON'T KNOW [SKIP TO SO1]
101.REFUSED [SKIP TO SO1]

OP2. Which other energy efficiency programs offered by AEP Ohio have you participated in? **(**DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. **APPLIANCE RECYCLING PROGRAM** (REFRIGERATOR AND FREEZER PICK UP)
2. **COMMUNITY ASSISTANCE PROGRAM** (WEATHERIZATION SERVICES AND PRODUCTS FOR LOW INCOME RESIDENTIAL CUSTOMERS, INCLUDING HOME ENERGY ASSESSMENT, ATTIC AND WALL INSULATION, AIR SEALING, CFLS, REFRIGERATOR REPLACEMENT, AND OTHER ENERGY IMPROVEMENTS
3. **CONTINUOUS IMPROVEMENT PROGRAM** (ENERGY MANAGEMENT SUPPORT FOR LARGE INDUSTRIAL CUSTOMERS)
4. **CUSTOM PROGRAM** (BUSINESS INCENTIVES FOR SPECIALIZED ENERGY-EFFICIENT IMPROVEMENTS AND TECHNOLOGIES NOT INCLUDED IN THE PRESCRIPTIVE PROGRAM)
5. **ENERGY CHECK TOOLKIT LIBRARY LENDING PROGRAM** (LENDING OF A TOOLKIT INCLUDING A KILL-A-WATT METER AND OTHER ITEMS TO ASSESS HOME ENERGY USAGE)
6. **ENERGY STAR APPLIANCE REBATE PROGRAM** (MAIL-IN REBATES ON CLOTHES WASHERS, DEHUMIDIFIERS, FREEZERS, REFRIGERATORS, HIGH EFFICIENCY ELECTRIC WATER HEATERS, AND ELECTRIC HEAT PUMP WATER HEATERS)
7. **ENERGY STAR NEW HOMES PROGRAM** (HOMEOWNERS PURCHASE FROM PARTICIPATING BUILDERS TO ENSURE THEIR NEW HOME IS BUILT TO MEET STRINGENT ENERGY PERFORMANCE GUIDELINES)
8. **EXPRESS PROGRAM** (ENERGY EFFICIENCY UPGRADE FOR SMALL BUSINESS CUSTOMERS)
9. **IN-HOME ENERGY PROGRAM** (CHOICE OF 3 OPTIONS (ENERGY ASSESSMENT, ENERGY AUDIT, OR ONLINE ENERGY CHECK-UP); OPTIONS INCLUDE RECOMMENDATIONS FOR ENERGY EFFICIENCY IMPROVEMENTS AND REBATES FOR INSTALLING FREE ENERGY-SAVING ITEMS PROVIDED, SUCH AS CFLS, PROGRAMMABLE THERMOSTATS, LOW-FLOW SHOWER HEADS, AND PIPE WRAP
10. **NEW CONSTRUCTION PROGRAM** (BUSINESS INCENTIVES FOR ENERGY-EFFICIENT IMPROVEMENTS AND TECHNOLOGIES IN NEW CONSTRUCTION AND MAJOR RENOVATION PROJECTS)
11. **PRESCRIPTIVE PROGRAM** (BUSINESS INCENTIVES FOR HVAC, LIGHTING, MOTORS AND DRIVES, REFRIGERATION, AND MISCELLANEOUS FOOD PREPARATION & STORAGE EQUIPMENT)
12. **RETROCOMMISSIONING PROGRAM** (INCENTIVES FOR COMMERCIAL BUILDING SYSTEM TUNE-UPS)

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13. **SELF-DIRECT PROGRAM** (BUSINESS CREDIT PAYMENT OR ENERGY EFFICIENCY/PEAK DEMAND REDUCTION RIDER EXEMPTION FOR PREVIOUS ENERGY EFFICIENCY PROJECTS)
14. **SOLUTION PROVIDER NETWORK** (CONNECTS CUSTOMERS WITH CONTRACTORS, ENGINEERS, ESCOS, ARCHITECTS, SUPPLIERS, DISTRIBUTORS AND OTHER VENDORS WHO HAVE BEEN TRAINED ON AEP OHIO'S BUSINESS ENERGY EFFICIENCY PROGRAMS)
15. **T12 LIGHTING INCENTIVES** (INCENTIVES FOR T12 LAMP REPLACEMENTS)
98. OTHER (RECORD RESPONSE) [OPEN END]
100. DON'T KNOW [EXCLUSIVE] [SKIP TO SO1]
101. REFUSED [EXCLUSIVE] [SKIP TO SO1]

OP4. How much did your experience with the e^{3}smart program influence you to participate in the other energy efficiency programs? Please use a 0 to 10 scale, where 0 means "did not influence at all" and 10 means "influenced very much".

00. DID NOT AT ALL INFLUENCE
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. INFLUENCED VERY MUCH
98. DON'T KNOW
99. REFUSED

Spillover

SO1. Have you made any other energy efficient upgrades to your home since being involved in the e^{3}smart program? (EXAMPLE FOR INTERVIEWER: ANYTHING FROM MORE CFLS, INSULATION, NEW APPLIANCES, TO SOLAR PANELS AND EVERYTHING IN BETWEEN.) [SINGLE PUNCH]

3. YES
4. NO [SKIP TO END]
99. DON'T KNOW [SKIP TO END]
100. REFUSED [SKIP TO END]

SO1A. What upgrades have you made?

97. [OPEN END]
98. DON'T KNOW
99. REFUSED

SO2. How much did your experience with the e^{3}smart program influence you to make other energy efficient upgrades? Please use a 0 to 10 scale, where 0 means "did not influence at all" and 10 means "influenced very much".

00. DID NOT AT ALL INFLUENCE
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. INFLUENCED VERY MUCH
98. DON'T KNOW
99. REFUSED

END. Those are all of the questions I have for you today. Thank you for your time; AEP Ohio appreciates your participation!

APPENDIX E

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IN-HOME ENERGY PROGRAM

2013 Evaluation Report

Prepared for:
AEP Ohio

AEP OHIO®
A unit of American Electric Power

May 13, 2014

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Executive Summary

This report describes the results of an evaluation of the 2013 AEP Ohio In-Home Energy Program. This Executive Summary provides a high-level description of the program, key impact findings, conclusions, and recommendations stemming from these findings. Detailed methodology and findings are described in the body of the report following the Executive Summary.

Program Summary

The purpose of the In-Home Energy Program is to provide energy efficiency information and easy-to-install measures to help customers take action to reduce energy use. Energy efficiency products and information are provided to customers at four levels: 1) an *Online Energy Checkup*, 2) an *In-Home Energy Assessment*, 3) an *In-Home Energy Audit,* and 4) a *Multifamily Direct Install Service*. During an audit or assessment, contractors install up to 12 CFLs, an LED night light and, if electric water heating, low flow shower heads and faucet aerators. Customers are eligible for rebates for a list of measures identified during audits or assessments. The program implementation contractor (Ecova) delivers program services on behalf of AEP Ohio and contracts with local installation contractors.

Key Impact Findings and Recommendations

Navigant used engineering algorithms to verify energy and demand savings for the In-Home Energy Program. The In-Home Energy Program reported 12,047 MWh of energy savings and 2.1 MW of demand savings in 2013. The verified (*ex post*) energy and demand savings for 2013 were 10,933 MWh and 2.1 MW. *Ex post* savings achieved the program energy savings goals of 10,776 MWh, and 0.70 MW as shown in Table ES-1. The realization rates were 91 percent for MWh and 101 percent for peak kW, indicating that both the *ex ante* energy savings and the *ex ante* demand savings reported by AEP Ohio were close to the evaluation-calculated savings.

Table ES-1. 2013 Overall Evaluation Results

	2013 Program Goals	Ex-Ante Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)	Percent of Goal
Energy Savings (MWh)	10,776	12,047	10,933	0.91	101%
Demand Savings (MW)	0.7	2.1	2.1	1.01	305%

[1]Source: 2012-2014 Plan.

Geothermal Heat Pump Rebate Eligibility. The program is current paying rebates for new geothermal heat pumps replacing existing geothermal heat pumps at end-of-life. However, the baseline equipment against which savings are estimated is assumed to be an air-source heat pump (as per the Draft OH TRM). It is unlikely though that a customer would replace an existing geothermal heat pump with a new, lower efficiency, air-source heat pump, especially with existing geothermal infrastructure in place.

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For this reason, the baseline should be designated as a new geothermal heat pump and savings calculations should be adjusted accordingly.

Key Process Findings and Recommendations

The process evaluation component of the In-Home Energy Program assessed the effectiveness of the program operations, delivery for the energy audits/assessments, and rebates for retrofit measures. Navigant's process evaluation included in-depth interviews with program staff, participating customers and installation contractors, and a review of program tracking systems, reports and marketing materials. Findings follow along with recommendations.

1. **Participants are satisfied with most aspects of the program.** Respondents reported that their satisfaction with various elements of the In-Home Energy Program was quite high; the reported average satisfaction with the overall program was 8.71 on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied"). Satisfaction with the different aspects of the program did not vary substantially – all aspects scored above 8 (with the exception of low flow faucet aerators, 4.50, n=2; and the utility's contribution to towards the audit cost, 6.45, n=4). Additionally, 77 percent of participants indicated that they have already recommended the program to others (a 20% percentage point increase over 2012). Notably, showerheads received a satisfaction rating of 10 from single-family direct install customers after low-ratings in 2012 prompted a change in the showerhead models installed through the program. However, energy kit customers still gave low-flow showerheads a rating of 5.7. The low satisfaction rating for faucet aerators (4.5 for direct install measures and 5.5 for energy kit measures) corresponds to low realization rates (50%) for this measure.

   Recommendation #1: Add literature to the energy kit that explains the benefits and installation procedures for self-install measures, which may increase installation rates. It is possible that single-family direct install customers do not understand that faucet aerators have been installed during assessments. Encourage auditors/assessors to discuss the direct install measures with customers to ensure customer awareness and potentially increase customer-reported installation rates.

2. **Participant Perception of Incentive Payments.** Satisfaction with rebate amounts was quite high (9.27), though only 84 percent of respondents (n=101) indicated that they had received their rebate; twelve respondents indicated that they had not, and four did not know. Navigant verified rebate processing status for the rebate applications for individuals who indicated they had not received their rebate or did not know if they had received their rebate. The application review indicated all individuals received their rebate for all items though, in each case, the database indicated that the rebate had been paid to the contractor.

   Recommendation #2: Contractors should make it clear that customers are receiving a rebate for selecting high-efficiency equipment from AEP Ohio. Customer awareness of rebates will aid in their word-of-mouth promotion of the program.

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3. **Data tracking**. Navigant found some improvement in the quality of the data in the tracking system compared to 2012. The database contains fewer data entry errors and data needed for evaluation is being recorded, although not always completely. The implementation contractor's internal QA/QC process is finding errors, as evidenced by the number of projects negated in the tracking system due to non-compliance with rebate requirements, though it appears that some of these errors are not being caught until after the rebate has been paid.

   Many of the tracking system issues identified were due to installation contractor errors that appear to have not been caught in the initial application review process. Contractors are submitting rebate applications for some projects that do not meet minimum eligibility requirements. Rebates were often paid for these projects, though savings are reduced and sometimes eliminated once these issues are identified later on in the QA/QC process. This is a quality control issue and also a cost-effectiveness issue because these projects incur full incremental measure costs but do not achieve the full energy savings for each measure. However, due to the low frequency of these occurrences (0.5% of projects), this issue does not present a major immediate concern. Participating contractors also reported dissatisfaction with the rebate application process, citing administrative burdens and being denied rebates.

   Recommendation #3: Consider improvements to the frequency or rigor of the rebate application QA/QC processes. Every rebate claim should be reviewed upon receipt for compliance with measure rebate requirements. However, additional QA/QC processes could be decreased for high-performing contractors with a demonstrated history of compliance to decrease rebate processing times. Participating contractors should clearly be made aware of reasons for rebate denial and should be the focus of additional training and outreach.

4. **Installation Contractor Satisfaction.** Survey results indicate that the program is having an impact on the installation contractor market and is an important part of participating contractor business. Contractors are seeing more business, profits, and business offering opportunities due to the program. Furthermore, contractors on average, are satisfied with the program overall (giving the program a rating of 7.3 out of 10). However, several areas of contractor dissatisfaction and improvement were thematic in contractor feedback. These issues include dissatisfaction with rebate processing times and application procedures, rebate amounts offered for shell measures, and the level of marketing and promotion of the program to customers. In addition, about 21 percent of contractors identified skepticism about utility intentions as a barrier to customer participation, and some indicated customer skepticism towards their credibility as representatives of AEP Ohio.

   Recommendation #4a: consider changing the rebate structure for weatherization measures. Contractors identified air sealing, insulation, and windows rebates as being too low. Consider implementing a tiered incentive structure for shell measures to award higher incentives to projects that save more energy. For instance, air sealing rebates could be awarded at tiers such as 20 percent reduction, 30 percent reduction, or 40 percent reduction. Lower satisfaction for incentive amounts may reflect the end-of-year decrease in incentives for gas measures, for cost-effectiveness reasons. The 2014 evaluation survey should differentiate between gas and electric incentive amounts.

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Recommendation #4b: address customer skepticism about program intentions and contractor affiliation. The program might benefit from directly addressing customer skepticism in marketing and outreach material messaging. .

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1 Program Description

This section provides an overview of the AEP Ohio In-Home Energy Program. The section begins with a brief program description, followed by a summary of various aspects of the implementation strategy and marketing approach.

1.1 Program Description

The purpose of the In-Home Energy Program is to provide energy efficiency information and easy-to-install measures to help customers take action to reduce energy use. Energy efficiency products and information are provided to customers at four levels: 1) an *Online Energy Checkup*, 2) an *In-Home Energy Assessment,* 3) an *In-Home Energy Audit,* and 4) a Multifamily Direct Install Service. The program implementation contractor (Ecova) delivers program services on behalf of AEP Ohio and contracts with local installation contractors.

The **Online Energy Checkup** is a free web tool that uses actual customer usage history and allows AEP Ohio customers to quickly and easily calculate home energy costs and identify opportunities for savings. The Checkup includes a report with customized energy savings recommendations and each customer receives a free energy efficiency kit (if they have not already received these items in an in-home assessment or audit). After completing the Checkup, participants are also eligible for rebates for retrofit measures.

The **In-Home Energy Assessment** includes a visual inspection of the home and an interview with the homeowner about his or her lifestyle and energy use. The auditor can identify approximately 80 percent of the energy-saving opportunities (especially quick to install measures) available in the home and can recommend retrofit measures to reduce energy use. While in the home, the contractor installs up to 12 CFLs, an LED night light and, if electric water heating, low flow shower heads and faucet aerators. There is a $25 fee for the one-hour In-Home Energy Assessment, which the customer pays directly to the assessor. Customers who have an assessment and install at least $1,000 worth of measures within six months are eligible for a performance bonus rebate of $25.

The **In-Home Energy Audit** is available only to all-electric customers and targeted high electric use customers and is patterned after a Building Performance Institute (BPI) audit and includes a thorough inspection of the home, an interview with the homeowner, and diagnostic testing for air leakage and combustion safety. The auditor utilizes a computer software program to generate a prioritized list of energy-saving measures and the calculated energy savings, estimated installed costs and simple payback. While in the home, the contractor installs up to 12 CFLs, an LED night light and, if electric water heating, low flow shower heads and faucet aerators. There is a $50 fee for an In-Home Energy Audit. Customers who have an audit and install at least $1,000 worth of measures within six months are eligible for a performance bonus rebate of $50.

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The **Multifamily Direct Install** component achieves energy savings by installing energy efficiency measures in apartment units at no cost to the tenant or building owner. AEP Ohio's direct installation team conducts a walk-through energy assessment and direct installation of efficient equipment, which include CFLs, showerheads, faucet aerators and LED nightlights. Multifamily units were not eligible for additional equipment rebates in 2013.

1.2 Implementation Strategy

1.2.1 Program Marketing Strategy

The program marketing strategy focuses on residential customers in existing homes and multifamily housing. To maximize savings impacts and the percentage of customers who implement improvements, the program targets promotion to customers with above average consumption.

1.2.2 Role of AEP Ohio Staff

The AEP Ohio staff member most involved in the administration of In-Home Energy Program is the Consumer Programs Coordinator. The AEP Ohio Consumer Programs Coordinator is responsible for day-to-day program management responsibilities for the utility, including weekly communication with the program implementer, program tracking and reporting, and assisting with development of program marketing materials. The Coordinator's role did not changed significantly in 2013.

1.2.3 Roles of the Implementation Contractor

The program is delivered and managed primarily by the staff of Ecova, an implementation contractor. Ecova works on marketing jointly with AEP Ohio and is directly responsible for communicating with customers, scheduling appointments with participants, and coordinating auditors and contractors who are responsible for assessing participant homes, installing measures, and providing participants with energy surveys that include recommendations for further energy saving actions. Ecova also provides AEP Ohio with reporting, which includes progress toward goals, and participant and measure-level databases. The role of Ecova did not change significantly over the course of 2013.

1.2.4 Measures and Incentives

The In-Home Energy Program provides direct installation services for the following measures:

- Compact fluorescent lamps (CFLs)
- Low-flow showerhead for homes with electric water heating
- Faucet aerators (kitchen and bathrooms) for homes with electric water heating
- Pipe insulation, R-4 rated for homes with electric water heating
- LED nightlight

In addition to the direct installation service, the program offers two levels of the in-home energy service: an "Assessment" and an "Audit." Both services seek to identify recommendations for equipment upgrades along with rebates for installation of recommended energy efficiency upgrades.

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Customers are eligible for rebates for a list of measures identified during audits or assessments. Table 1-1 shows incentives offered through the In-Home Energy Program in 2013. Incentives were revised in November 2013 to improve cost-effectiveness.

Table 1-1. AEP Ohio In-Home Energy Measure Incentives

In-home Energy Rebates	All Electric or Electric Heat Only	Central AC w/Gas or Other
PIN Based CFL Indoor Fixture	$20	same
PIN Based CFL-Outdoor Fixture	$35	same
CFL Torchieres	$20	same
Wall Insulation	$200	$35
Floor Insulation	$150	$25
Air Sealing	$200	$25
Window Film	$0	$45
ENERGY STAR® Window Replacement	$25/window	same
Attic Insulation	$200	$25
Shower Start/Stop	$25	same
Electric Water Heater	$50	same
ENERGY STAR® Ceiling Fan	$20	same
Heat Pump Programmable Thermostat	$50	$25
Programmable Thermostat	$20	same
Duct Sealing	$150	$25
Refrigerant Charge and Air-flow (RCA) Tune Up	$50	same
Furnace Replacement w/ Electrically-Commutated Motor (ECM)	$150	$100
ENERGY STAR® Central Air Conditioning Replacement	$100	same
ENERGY STAR® Air Source Heat Pump Replacement	$350-$700	$100
ENERGY STAR® Ground Source Heat Pump Replacement	$400-$800	$200
Ductless Heat Pump	$350-$800	$100
Complete System Bonus	$150	same
Performance Bonus (Assessment / Audit)	$25 / $50	same

1.3 *Program Theory*

The program theory for the AEP Ohio In-Home Energy Program is to produce long-term electric energy savings in the consumer sector by helping customers analyze their energy use and providing incentives

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for the installation of high-efficiency HVAC, lighting and shell measures. Since the program theory and logic have not changed since 2012, a new logic model was not created for 2013. The reader is instead referred to the 2012 evaluation report[1].

1.4 *Evaluation Questions*

The evaluation sought to answer the following key research questions. Each of these questions is addressed in the remainder of the evaluation report.

1.4.1 Impact Questions

1. What is the level of gross annual energy (kWh) and peak demand (kW) savings induced by the program?
2. What were the realization rates for each participation path and for the program as a whole? (Defined as evaluation-verified (*ex post*) savings divided by program-reported (*ex ante*) savings.)
3. What are the benefits and costs and cost effectiveness of this program?

1.4.2 Process Questions

1.4.2.1 Marketing and Participation

1. Is the marketing effort sufficient to meet current and future program participation goals?
2. How do participating customers and contractors become aware of the program? What marketing strategies could be used to boost program awareness?
3. Is the program outreach to customers and contractors effective in increasing awareness of the program opportunities?

1.4.2.2 Program Characteristics and Barriers

1. How do participating customers and contractors perceive the incentives and costs related to this program?
    a. Are customers and contractors sufficiently satisfied with the program incentives to sustain participation goals?
    b. Should the budget allocation between incentive spending and marketing spending be adjusted to meet participation and savings goals?
    c. Are there particular program characteristics that could be changed to improve customer and/or contractor satisfaction while maintaining program effectiveness?
2. What are key barriers to participation in the program for eligible customers and contractors who do not participate, and how can these be addressed by the program?

1.4.2.3 Administration and Delivery

1. How has program administration and delivery changed over the course of 2013?

[1] Appendix E Docket 13-1182 AEP Ohio Portfolio Status Report for 2012

2. Is program administration being documented and program tracking being conducted in a way that makes the program evaluable?
3. Is the program efficient and well managed? How are problems resolved?
4. What are the verification procedures for the program? Have these been implemented in a manner consistent with program design? Do these procedures present their own implementation barrier?
5. What are the opportunities for program improvement?

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2 Evaluation Methods

This section describes the analytic methods and data collection activities implemented as part of the 2013 impact and process evaluation of the In-Home Energy Program, including the data sources and sample designs used as the foundation for the data collection activities and analysis.

2.1 Overview of Approach

To meet the objectives of this evaluation, Navigant undertook the following activities:

1. **Development of Evaluation Questions.** Key evaluation questions were established from the development of the 2013 evaluation plan with AEP Ohio staff and a review of the key outcomes of the 2012 program evaluation.
2. **Tracking Data Review.** The program tracking data collected by Ecova were reviewed.
3. **Review of New Program Documentation**. Reviewed any program documentation that differed from 2012 (e.g., new marketing materials).
4. **Primary Data Collection.** Four primary data collection efforts were conducted in support of this evaluation: 1) in-depth interviews with program staff, 2) a participant telephone survey, 3) on-site field verification surveys, and 4) installation contractor telephone surveys.
5. **Methods Used to Analyze Impact Data.** Reviewed algorithms and tracking system to verify measure eligibility and correct application of energy and demand savings.
6. **Methods Used to Analyze Process Data.** The effectiveness of the program processes was assessed by analyzing program tracking data, in-depth interview data, and participant survey data.

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Table 2-1 summarizes data collection activities, along with the details regarding the sampling and timing.

Table 2-1. Summary of Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
Tracking Data Analysis	All Program Participants	Tracking Database	-	All	February 2014
In-depth Telephone Interview	AEP Ohio Program Coordinator	Contact from AEP Ohio	Program Coordinator	1	August 2013
In-depth Telephone Interview	Implementation Contractor	Contact from Ecova	Program Implementer	1	August 2013
Computer-Assisted Telephone Interviewing (CATI) Telephone Surveys	Program Participants	Tracking Database	Random Sample of Program Participants	182	March 2014
On-Site Field Surveys	Program Participants	Tracking Database	Random Sample of Program Participants	65	February 2014
Installation Contractor Telephone Surveys	Program Participants	Tracking Database	Random Sample of Program Participants	14	March 2014

2.2 *On-Site Surveys*

Navigant conducted on-site field verification visits in a sample of 65 projects during February 2014. Navigant field engineers conducted a brief survey with the customers to gather and/or validate information from the project files on building type, occupancy, floor area, and other parameters relevant to the estimation of savings.

The on-site survey sample is a stratified random sample from the population of program participants in the 2013 tracking database at the site-level. The sample targets confidence and precision of 90/10 and was stratified to ensure that the sample properly reflects the true population's impacts and installation rates. The Navigant team bundled the measures that are likely to have the same range of verification rates, which effectively results in stratification primarily based on measure type. Ultimately, the team identified four strata, as seen in Table 2-2. The Multifamily Strata was included because this data could not be obtained through participant phone surveys, because participant data was not recorded in the tracking system in 2013. The HVAC and Shell Strata were included to supplement installation data received through participant self-report surveys.

In order to derive target sample sizes, the evaluation team started by estimating the number of participants for the year, which was based on a mid-year data extract provided by AEP Ohio. Based on

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this information, to attain 90/10 at the program level, a minimum sample size of 52 completed participant surveys was determined to be appropriate.

Table 2-2 shows the actual population of multifamily direct install and retrofit (HVAC and shell measures) participants in 2013, the number of on-site surveys completed, and the resulting sampling error. Overall, at the program level, sampling efforts resulted in +/- 8.7 percent precision at a 90 percent level of confidence.

Table 2-2. 2013 On-Site Survey Completes and Population-Level Sampling Error

Strata	2013 Strata Population Size (N)	Survey Target Completes	Survey Completes (n)	Sampling Error (95% CI)
Multifamily Direct Install CFLs	6,181	19	23	17.4%
Multifamily Direct Install CFL & DHW	5,851	9	12	24.3%
HVAC Measures	4,006	18	18	14.1%
Shell Measures	1,070	8	12	17.9%
Total	17,108	52	65	8.7%

2.3 *Tracking System Review*

Navigant conducted a review of program data in the AEP Ohio In-Home Energy Audit tracking system to assess its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. This data review included an assessment of the rebate processing timeframes, a review of the project data for outliers and missing information, and an assessment of the data collected on rebate applications and recorded in the tracking systems.

2.4 *Audited Savings Evaluation*

Navigant conducted a review of measure savings algorithms and underlying assumptions for each measure compared to Draft Ohio TRM algorithms. Navigant also recalculated energy and demand savings for each measure in the tracking database to ensure that algorithms were applied correctly.

2.5 *Adjusted Savings Evaluation*

For high-impact measures not included in the TRM (ECM motor and programmable thermostat), the evaluation team examined AEP Ohio's calculation methods and evaluated them against calculation methods identified from secondary sources (recent TRMs from nearby states). Adjusted savings estimates for these measures were then used to calculate *ex post* energy and demand savings for each measure.

2.6 *Program Staff Interviews*

In-depth interviews with program staff members were conducted by telephone in August 2013. Each interview lasted between one and two hours and covered program design and implementation;

marketing and promotion; and perceived barriers to participation. Regular communications were also maintained with the AEP Program Coordinator on a monthly basis through brief check-in calls from July, 2013 to March, 2014. Table 2-3 provides a summary of the data collection activities conducted to support the process evaluation.

Table 2-3. Data Collection Activities

Data Collection Type	Targeted Population	Sample Frame	Sample Design	Sample Size	Timing
In-Depth Telephone Interviews	AEP Ohio Program Staff	Contacts from AEP Ohio	In-Home Energy Program Coordinator	1	August 2013
	Staff of Program Implementer	Contacts from Ecova	Program Manager	1	August 2013
Monthly Check-In Calls	AEP Ohio Program Staff	Contacts from AEP Ohio	New Homes Program Coordinator	9	July 2012 - Mar 2014

Interview guides were developed based on the research issues and metrics identified in the background review for the program. The purpose of the guides was to solicit information from those who implement the program. The questions in the guides were primarily focused on these topics:

» Program Contact and Roles
» Program Goals and Objectives
» Program Design and Participation
» Marketing and Outreach
» Program Tracking
» Quality Assurance and Quality Control (QA/QC)
» Staffing and Communication

Separate interviews were conducted with AEP Ohio staff and the implementation contractor to encourage candor and help identify any potential issues regarding the relationships between the two parties. Consistent with standard market research procedure, the confidentiality of each person interviewed was guaranteed, and comments are not attributed to any one individual; rather the evaluation focuses on trends and issues that arose from a variety of perspectives.

2.7 *Participant Telephone Survey*

A telephone survey of 182 program participants was conducted during February and March 2014. Two distinct telephone surveys were developed and fielded to assist in the evaluation of the In-Home Energy Program. One survey was delivered to participants who received an energy audit/assessment and rebates for retrofit measures. A similar survey was delivered to participants of the Online Energy Checkup who received a free energy kit. The surveys were completed by 182 program participants and were designed to serve several purposes:

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- To verify and/or update the assumptions that feed into engineering algorithms of measure level savings
- To obtain information on participant satisfaction with the program design and implementation
- To identify any steps in the participation process that customers found difficult or confusing
- To gain insight into customer motivations and the effectiveness of existing and potential communication channels
- To elicit customer suggestions on opportunities for program improvement

In order to derive target sample sizes, the evaluation team started by estimating the number of participants for the year, which was based on a mid-year data extract provided by AEP Ohio. Based on this information, to attain 95/5 statistical confidence and precisions at the program level, a minimum sample size of 182 completed participant surveys was determined to be appropriate.

Table 2-4 shows the actual population of energy kit and retrofit rebate recipients in 2013, the number of participant surveys completed, and the resulting sampling error. Overall, at the program level, sampling efforts resulted in +/- 4.4 percent precision at a 95 percent level of confidence.

Table 2-4. 2013 Survey Completes and Population-Level Sampling Error

Strata	2013 Strata Population Size (N)	Survey Target Completes	Survey Completes (n)	Sampling Error (95% CI)
Energy Kit Lighting Only	800	50	50	8.0%
Energy Kit Lighting & DHW	356	31	31	13.8%
HVAC & Shell	5,076	101	101	2.4%
Total	6,232	182	182	4.4%

2.8 Installation Contractor Interviews

In-depth interviews were conducted with fourteen participating contractors to engage in conversation with those firms that are most intimately involved with the delivery of the In-Home Energy Program. The final list of interview candidates was developed based on a review of the program database. In designing the interview guide, key objectives were to develop an understanding of contractor perspectives on the market in which the program operates and to gather feedback on the program structure and processes. Interviews were conducted via telephone surveys, with in-depth interview instruments guiding the discussions. The majority of questions were opened ended to facilitate open discussion of the topics, but some information was captured as discrete values to facilitate analysis and comparison.

2.9 Program Material Review

Navigant has reviewed all program materials provided by AEP Ohio to date and conducted a review of best practices for implementing residential energy audit programs. A summary list of program materials reviewed to date for this report follows.

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» Program tracking data
» Program impact algorithms and assumptions
» Program marketing materials/collateral
» Program implementation plans

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3 Program Level Results

This section presents detailed findings of the evaluation of the In-Home Energy Program.

3.1 *Impact Evaluation Findings*

3.1.1 Program Activity

Program data from all direct install and retrofit measures installed during 2013 were analyzed to summarize program activity. This section is divided into two sub-sections: 1) direct install, and 2) retrofit. Table 3-1 summarizes program activity across all measure types.

Table 3-1. Measure Activity Summary – *Ex Ante*

Measure	Number of Units	MWh Savings	MW Savings
Direct Install Measures	202,999	7,871	0.9
Energy Kit Measures	54,111	1,375	0.3
Retrofit Measures	11,067	2,801	0.9
Total	268,177	12,046	2.1

Table 3-2 shows the distribution of single-family and multifamily direct install measures installed in 2013. CFLs accounted for 80 percent of the direct install measure *ex ante* energy savings, and 53 percent of the total *ex ante* program energy savings.

Table 3-2. Direct Install (DI) Measure Activity – *Ex Ante*

Measure	Number of Units	MWh Savings	MW Savings
Single Family (SF)			
SF DI CFL	42,607	1,664	0.20
SF DI Pipe Insulation	578	74	0.01
SF DI LED Night Light	4,500	95	0.01
SF DI Faucet Aerator	635	16	0.00
SF DI Shower Heads	739	175	0.02
Multifamily (MF)			
MF DI CFL	129,762	4,660	0.56
MF DI LED Night Light	12,440	261	0.03
MF DI Shower Heads	3,387	735	0.09
MF DI Faucet Aerator	8,351	192	0.02
Direct Install Total	202,999	7,871	0.95

Table 3-3 shows the distribution of energy kit measures sent to customers in 2013. Energy Kit measure savings accounted for approximately 11 percent of total *ex ante* program energy savings in 2013.

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Table 3-3. Energy Kit Measure Activity – *Ex Ante*

Measure	Number of Units	MWh Savings	MW Savings
Energy Kit CFLs	16,790	793	0.09
Energy Kit LED Night Light	3,357	71	0.01
Energy Kit Pipe Insulation	1,332	148	0.02
Energy Kit Faucet Aerator	2,662	31	0.00
Energy Kit Shower Heads	1,331	255	0.03
Energy Kit Draft Stoppers	26,436	44	0.06
Energy Kit Weatherstripping	2,203	33	0.06
Energy Kit Total	54,111	1,375	0.27

Table 3-4 shows the distribution of retrofit measures installed in 2013. Retrofit measures accounted for only 23 percent of the total *ex ante* program MWh savings, with 90 percent of those energy savings coming from HVAC measures.

Table 3-4. Retrofit Measure Activity – *Ex Ante*

Measure	Number of Units	MWh Savings	MW Savings
Insulation	1,259	120	0.01
Air Sealing	806	109	0.01
Windows	366	15	0.00
Duct Sealing	16	19	0.00
Thermostats	1,116	452	0.00
Heat Pumps	835	910	0.19
Central AC Replacement	2,534	627	0.53
Furnace with ECM Motor or ECM Motor Replacement	3,849	515	0.13
RCA Tune up	236	29	0.01
PIN Based CFL Fixture (Indoor)	18	1	0.00
CFL Torchieres	5	0	0.00
Energy Star Ceiling Fan	27	5	0.00
Retrofit Measure Total	11,067	2,801	0.89

3.1.2 Measure In-Service Rates

The in-service rate for each measure installed through the program was determined through both on-site audits as well as participant telephone surveys. During the on-site audits, Navigant verified that the number of measures installed in the home matched the number listed in the program database. This information was verified both visually during on-site field visits and through telephone surveys to understand any discrepancies between the number of measures reported in the database and the observed number of measures installed. Participants who were surveyed by telephone, responded to several questions about the number and types of measures installed through the program. In cases

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where the number of measures listed in the database differed from the number of measures reported, participants were asked to indicate what happened to the additional measures (such as whether these were thrown away, given away, in storage, etc.). The ratio of the number of measures still installed (as reported or verified) was compared to the number of measures in the program database to determine the installation rate. Table 3-5 illustrates that installation rates for direct install measures ranged from 24% (multifamily nightlights) to 91% (single family CFLs). .

Table 3-5. In-Home Energy Program Direct Install Measure In-Service Rates

DI Measures	Telephone Survey		On Sites		Overall	
	Percent Installation	Number of Respondents	Percent Installation	Number of Respondents	Percent Installation	Number of Respondents
Single Family						
CFLs	93%	72	82%	18	91%	90
Showerheads	67%	7	100%	2	74%	9
Aerators	50%	2	100%	1	67%	3
Pipe Insulation	80%	5	67%	3	75%	8
LED Nightlight	87%	74	63%	19	82%	93
Programmable Thermostat	50%	2	94%	8	85%	10
Multifamily						
CFLs	N/A	N/A	93%	50	93%	50
Showerheads	N/A	N/A	83%	12	83%	12
Aerators	N/A	N/A	63%	16	63%	16
LED Nightlight	N/A	N/A	24%	33	24%	33

The realization rate found for multifamily LED nightlights was notably lower than expected, especially in light of high realization rates found for single-family nightlights. However, a recent evaluation (2013) of a similar program for a nearby utility found a 28% realization rate for nightlights in multifamily units. It is possible that tenants are taking the LED nightlights with them when they move out of the apartment. The low realization rate found for programmable thermostats during through telephone surveys is due to participant reports that the thermostat set-back is no longer programmed.

Realization rates for retrofit measures were also calculated based on survey data and on-site data. Table 3-6 shows installation rates for retrofit measures.

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Table 3-6. In-Home Energy Program Retrofit Measure In-Service Rates

Retrofit Measures	Telephone Survey		On Sites		Overall	
	Percent Installation	Number of Respondents	Percent Installation	Number of Respondents	Percent Installation	Number of Respondents
ECM Motor	100%	33	100%	19	100%	52
Central AC Replacement	100%	23	100%	6	100%	29
Heat Pump Replacement	100%	5	100%	7	100%	12
Attic Insulation	100%	43	100%	10	100%	53
Air Sealing	100%	57	100%	4	100%	61
Wall Insulation	100%	30	100%	4	100%	34
Programmable Thermostat	100%	1	N/A	N/A	100%	1

Navigant conducted a telephone survey of Online Energy Checkup participants and collected data on installation rates for energy kit measures mailed to participants. Table 3-7 shows installation rates for energy kit measures.

Table 3-7. In-Home Energy Program Energy Kit In-Service Rates

Kit Measures	Telephone Survey	
	Percent Installation	Number of Respondents
CFLs	64%	79
Showerheads	22%	31
Aerators	20%	31
Pipe Insulation	41%	31
LED Nightlight	75%	79

When participants were asked the reason for not installing a particular kit measure, their answers varied depending on the measure. For showerheads, pipe insulation, CFLs and faucet aerators, the most common reason for not installing a measure was already having that measure or just haven't gotten around to installing it yet. For nightlights, the most common reason was that the customers didn't need nightlights.

3.1.3 Tracking System Review

Navigant conducted a review of program data in the AEP Ohio In-Home Energy Program tracking system to verity its accuracy and effectiveness for use in recording, tracking, and reporting the processes and impacts of the program. This review included an assessment of the rebate processing timeframes and a review of the project data for outliers and missing information.

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Two final program tracking databases were provided in support of this evaluation by AEP Ohio in March of 2014. A final summary database was prepared by AEP Ohio, compiling data extracts provided by Ecova. Navigant conducted a review of the tracking data and documented any issues that were discovered.

The Ecova tracking data extract contained separate databases for single-family and multifamily measures. The single-family dataset contained 154 data fields and over 58,000 records. The multifamily dataset contained 141 data fields and 45,152 records. Following is a summary of missing data or data entry errors identified during this review.

Table 3-8. Tracking System Review Findings

Measure	Issue
General	• Audit data was entered inconsistently. Some projects have no data entered about existing conditions. • Numerous projects were missing measure attributes like heating type, so Navigant was unable to verify that correct savings were assigned (19 ECM furnace measures)
Energy Kits	All energy kit measures were incorrectly labeled as direct install measures.
DHW Direct Install Measures	Many direct install water-savings measures were installed in homes with gas water heating, though savings were not counted.
Refrigerant, Charge and Air-flow (RCA) Tune-up	• Information verifying that the system was cleaned and the filter replaced for RCA tune-up measures was not recorded for every project. This needs to be recorded to verify rebate eligibility • RCA tune-ups conducted on ground-source heat pumps did not include heating system efficiency, so heating savings were not calculated. This was correctly accounted for in *ex ante* savings.
Central Air-conditioning (CAC) Replacement	One CAC Replacement was ineligible based on SEER levels. Ex-ante savings were negated in the tracking system after the rebate had been paid.
Heat Pump	• Base measure SEER was left blank for 59 measures, unable to verify eligibility. • Four incentives were paid for ineligible heat pumps (SEER <14.5) but savings were negated, • Six rebates paid for ineligible heat pumps (HSPF < 8.5) and savings were not negated. • New system HSPF not recorded for 8 measures.
Ground Source Heat Pump (GSHP)	• GSHP system type (open loop, closed loop, etc.) not recorded but needed to verify eligibility. • Four GSHP replaced old GSHP units. Savings were based on an assumed baseline of 13 SEER and 7.7 HSPF, corresponding to an ASHP (as per the OH TRM), which results in inflated savings estimates.
Attic Insulation	• One project had R-40 existing insulation before retrofit though maximum is R-30. • 58 projects did not add the minimum R-19 insulation. Several incentives were paid for attic insulation of less than R-5. • Four incentives were paid for projects with less than 400 SF of insulation installed.
Duct Leakage	Contractors appear to be reporting envelope leakage, not duct leakage.

Navigant found some improvement in the quality of the data in the tracking system compared to 2012. The database contains fewer data entry errors and most data needed for evaluation is being recorded,

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although not always completely. The QA/QC process is finding errors, as evident by the number of projects negated in the tracking system, though it appears that these are not being caught until after the rebate has been paid.

Many of the tracking system issues identified were due to contractor errors that weren't caught in the application review process. Contractors are submitting rebate applications for some projects that do not meet minimum eligibility requirements, though this only happened on 0.5% of projects. Rebates were often paid for these projects, though savings are reduced and sometimes eliminated once they are caught later on in the QA/QC process. This is a quality control issue and also a cost-effectiveness issue because these projects incur full incremental measure costs but do not achieve the full energy savings for each measure. However, due to the low frequency of these occurrences, this issue does not present a major immediate concern.

3.1.4 Audited Savings Evaluation

Navigant conducted a review of measure savings recorded in the tracking system to verify that the energy savings algorithms matched those in the Ohio Technical Reference Manual (TRM) and were correctly applied for each project. The evaluation team independently calculated energy savings for each measure in the database using the *ex ante* calculation methods based on the Draft Ohio TRM. Navigant's algorithm review found that, with only a few exceptions that were corrected in subsequent versions of the database, the energy and demand savings algorithms have been constructed and applied properly.

3.1.5 Adjusted Savings Evaluation

For high-impact measures not included in the Draft Ohio TRM (for ECM motors and programmable thermostats), the evaluation team examined AEP Ohio's calculation methods and evaluated these against calculation methods identified from secondary sources (recent TRMs from nearby states). *Ex post* savings estimates were then used to calculate adjusted energy and demand savings for each measure. Table 3-9 shows a summary of the total *ex ante* and *ex post* savings for each measure. The following sections detail the savings adjustments made to each measure.

Table 3-9. Total Savings for ECM Motors and Programmable Thermostats

Measure	*Ex-Ante* Savings (MWh)	*Ex-Ante* Savings (MW)	*Ex-Post* Savings (MWh)	*Ex-Post* Savings (MW)	Realization Rates	
					kWh	kW
ECM Motor	514.7	0.1	1,264.1	0.3	2.5	2.6
Programmable Thermostat	453.2	0.0	232.5	0.0	0.5	1.0

3.1.5.1 ECM Motor

The *ex ante* savings calculations for ECM motors use deemed savings based on the home's heating and cooling system type, cited in the AEP Ohio DSM Plan. The evaluation team reviewed algorithms in recent drafts of the Illinois, Vermont and Pennsylvania TRMs, which are based on adaptations of a study

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conducted by the Energy Center of Wisconsin[2]. Based on this methodology, the average heating-mode savings of 400 kWh identified in the study is multiplied by the ratio of average heating degrees in Columbus, OH (4,100) compared to Madison, WI (7,172), where the study was conducted. Similarly, the average cooling-mode savings of 88 kWh identified in the study are multiplied by the ratio of average EFLH in Columbus, OH (552) compared to Madison, WI (487). Table 3-10 below shows the *ex ante* savings compared to the *ex post* savings calculated from this method.

Table 3-10. ECM Motor Algorithm Review Findings

Heat Type	*Ex-Ante* Savings (kWh/1000 SF)	*Ex-Ante* Savings (kW/1000 SF)	*Ex-Post* Savings (kWh/ton)	*Ex-Post* Savings (kW/ton)
Electric Forced-Air Furnace	167.9	0.0497	328.4	0.09
Gas Furnace with Central AC	104.7	0.031	328.4	0.09
Air Source Heat Pump	239.7	0.0473	328.4	0.09

3.1.5.2 *Programmable Thermostat*

The *ex ante* savings calculations for programmable thermostats use deemed savings based on the heating and cooling system type for the home, cited in the AEP Ohio DSM Plan. The evaluation team review TRM algorithms for nearby states and applied the following algorithm found in the 2013 Pennsylvania TRM.

$\Delta kWh = \Delta kWh_{COOL} + \Delta kWh_{HEAT}$

$\Delta kWh_{COOL} = CAP_{COOL}/1000 \text{ X } (1/(SEER \text{ x } Eff_{duct})) \text{ X } EFLH_{COOL} \text{ X } ESF_{COOL}$

$\Delta kWh_{HEAT} = CAP_{HEAT}/1000 \text{ X } (1/(HSPF \text{ X } Eff_{duct})) \text{ X } EFLH_{HEAT} \text{ X } ESF_{HEAT}$

$\Delta kW_{peak} = 0$

Where:

CAP_{COOL} = *Capacity of the air conditioning unit in BTUh, based on nameplate capacity.*

CAP_{HEAT} = *Nominal heating capacity of the electric furnace in BTUh*

Eff_{duct} = *Duct system efficiency*

SEER = *Seasonal energy efficiency ratio of the cooling unit.*

[2] Scott Pigg (Energy Center of Wisconsin), "Electricity Use by New Furnaces: A Wisconsin Field Study", Technical Report 230-1, October 2003, page 20.

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HSPF	*= Heating seasonal performance factor of the heating unit.*
$ESF_{COOL,HEAT}$	*= Energy savings factor for cooling and heating, respectively*
$EFLH_{COOL, HEAT}$	*= Equivalent full load hours for cooling and heating, respectively*

Table 3-11. Key Impact Parameters for Thermostats

Parameter Description	Parameter Value	Source
CAP_{cool}	Actual	Program data gathering
CAP_{heat}	Actual	Program data gathering
Eff_{duct}	0.85	OH TRM 2010
SEER	Actual	Program data gathering. Default 13 SEER
HSPF	Actual	Program data gathering. Default 7.7 HSPF
$EFLH_{heat}$	1272	OH TRM 2010
$EFLH_{cool}$	552	OH TRM 2010
ESF_{heat}	3.6%	"Programmable Thermostats. Report to KeySpan Energy Delivery on Energy Savings and Cost Effectiveness", GDS Associates, Marietta, GA. 2002. 3.6% factor includes 56% realization rate.
ESF_{cool}	2.0%	DEER 2005 cooling savings for climate zone 16, assumes a variety of thermostat usage patterns.

Table 3-12 shows the *ex ante* savings compared to the *ex post* savings calculated from this method. Note that the *ex ante* savings are calculated per 1,000 square feet of conditioned floor area, while the *ex post* savings are calculated according to the capacity of the heating/cooling system (tons).

Table 3-12. Programmable Thermostat Algorithm Review Findings

Heat Type	*Ex-Ante* Savings (kWh/1000 SF)	*Ex-Ante* Savings (kW/1000 SF)	*Ex-Post* Savings (kWh/ton)	*Ex-Post* Savings (kW/ton)
Electric Forced-Air Furnace	678.2	0.0	201.4	0.0
Gas Furnace with Central AC	50.2	0.0	12.7	0.0
Air Source Heat Pump	276.6	0.0	101.9	0.0

3.1.6 *Ex Post* Adjusted Savings

Navigant developed independent estimates of *ex post* energy and demand savings for the program by verifying measure savings calculations, adjusting savings calculations for high-impact non-Draft Ohio

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TRM measures and applying realization rates derived from the telephone and field surveys. Table 3-13 presents *ex ante* program savings and Navigant's independent estimates.

Table 3-13. Tracking System (*Ex Ante*) and Verified (*Ex Post*) Savings Estimates

Measure	*Ex Ante* Savings (MWh)	*Ex Ante* Savings (MW)	*Ex Post* Savings (MWh)	*Ex Post* Savings (MW)	Realization Rates	
					kWh	kW
Energy Kit Measures	1,375	0.3	761	0.2	0.55	0.73
SF Direct Install	2,023	0.2	1,786	0.2	0.88	0.88
MF Direct Install	5,848	0.7	5,062	0.6	0.87	0.87
Retrofit Measures	2,801	0.9	3,325	1.1	1.19	1.24
Total Savings	12,047	2.1	10,933	2.1	0.91	1.01

Based on Navigant's engineering review of savings algorithms, which include measure installation rates, the program obtained a kWh realization rate of 91 percent, and 101 percent for kW savings.

3.2 *Process Evaluation Findings*

Data sources for the process evaluation included in-depth interviews with program staff, including the AEP Ohio Consumer Programs Coordinator and the Ecova Program Manager, as well as the CATI telephone surveys with a sample of program participants.

3.2.1 Participant Satisfaction

As shown in Table 3-14, respondents reported that their satisfaction with various elements of the In-Home Energy Program was quite high; the reported average satisfaction with the overall program was 8.71 on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied"). Satisfaction with the different aspects of the program did not vary substantially – all aspects scored above 8 (with the exception of low flow faucet aerators, 4.50, n=2; and the utility's contribution to towards the audit, 6.45, n=4). The highest ratings were provided for the programmable thermostat installation, the auditor who assessed home performance, the hot water tank pipe wrap installation, the length of time it took to complete the audit/assessment, the In-Home Energy Audit overall, and AEP Ohio overall, which is very similar to last year's findings. Notably, showerheads received a satisfaction of 10 after low-ratings in 2012 prompted a change in the showerhead model installed through the program.

Table 3-14. Mean Satisfaction Scores

Program Aspect	Satisfaction Rating, Scale of 1 to 10	
	Mean	N
The energy audit/assessment report	9.16	100
The CFL bulbs installed through the program	8.48	66

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Program Aspect	Satisfaction Rating, Scale of 1 to 10	
The low flow showerheads installed through the program	10.00	6
The hot water tank pipe wrap installed through the program	10.00	3
The programmable thermostat installed through the program	9.50	2
AEP Ohio's auditor that assessed your home's energy performance.	9.48	99
The In-Home Energy Audit program overall	9.32	87
The length of time it took to complete the audit/assessment in your home	9.29	100
AEP Ohio overall	9.20	101
The time it took to schedule the energy audit/assessment	9.18	99
The LED nightlight installed through the program	8.36	64
The utility contribution ($) toward your energy audit	6.75	4
The faucet aerators installed through the program	4.50	2

Participant satisfaction can also be gauged by examining how many participants recommended the program to others. Seventy-seven percent of participants indicated that they have already recommended the program to others (a 20% percentage point increase over 2012). When asked to indicate how likely they are on a scale of 1 to 10, where 1 – 'not at all likely' and 10 – 'very likely' to recommend the program to others, participants reported an average likelihood of 9.1. The high occurrence of reporting the program to others and the high likelihood of doing so in the future is a good indication of program satisfaction. Individuals who indicated they were unlikely to recommend the program to others (Likelihood < 4) were asked why they would not recommend the program. The majority of these individuals indicated they didn't have the time to educate others about the program, or that the program didn't have a specific set of appliances that qualify through the program.

3.2.2 Audit/Assessment Customer Enrollment Process

Eighteen percent of respondents indicated that they had contacted AEP Ohio during their participation in the program. When asked to indicate their satisfaction with this interaction, respondents reported an average satisfaction of 8.40 on a scale of 1 to 10 (n=30), which is a noticeable improvement over 2012 (7.86). This high level of satisfaction indicates that most respondents felt that the AEP Ohio representative was able to address their questions or concerns. Respondents who reported a satisfaction level less than six were asked why they were dissatisfied with the interaction. Three respondents indicated that the representative was not knowledgeable enough to answer their questions about the program; one respondent indicated that AEP Ohio did not call them back.

3.2.3 Home Audit/Assessment Process

As indicated earlier, participants reported a high level of satisfaction with the home audit/assessment process. On average, the auditor who assessed the home performance received a rating of 9.48 on a scale of 1 to 10 (n=99), the length of time it took to complete the audit/assessment received an average rating of 9.29 (n=100), and the time it took to schedule the audit/assessment received an average rating of 9.18 (n=99).

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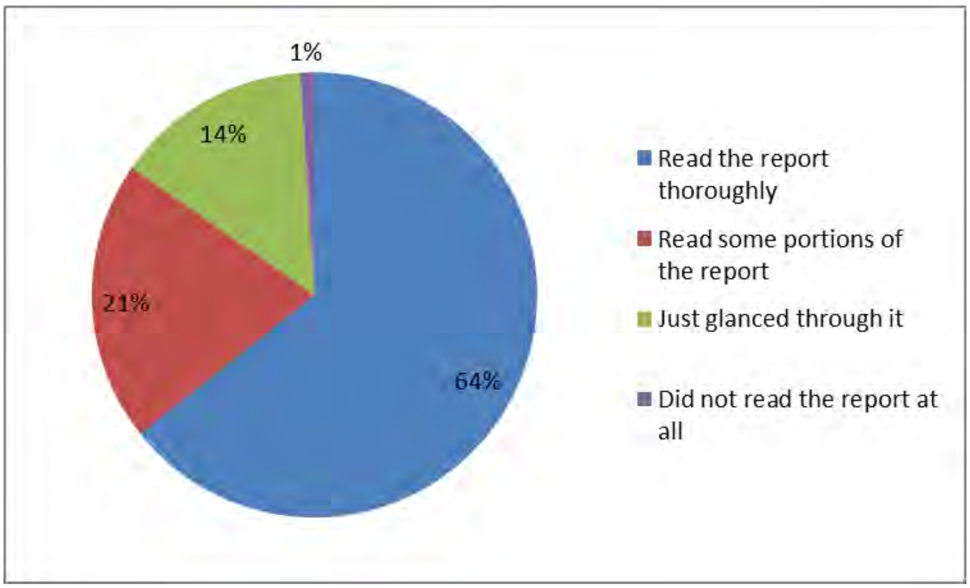
When asked to indicate the participants' primary goal in implementing the recommendations made by their auditors, 84 percent of the participants said that it was either to reduced energy costs or for energy conservation. Two percent of participants indicated that they would implement the recommendations to improve the retail value of their homes.

When asked about the Energy Audit report provided following the home audit/assessment, the majority of participants (64 percent) indicated that they had read the report thoroughly. Figure 3-1 illustrates that only one percent of participants indicated that they did not read the report at all.

Figure 3-1. Did Participants Read the Energy Audit Report?



Participants who indicated that they read the report thoroughly were asked how useful the report was on a scale of 1 to 10, where 1 – "not at all useful" and 10 – "very useful." The average rating was 8.96 (n=63), indicating a high level of satisfaction with the report.

3.2.4 Incentive Payment Process

Surveyed participants were asked to indicate if they had received their rebate. Eighty-seven percent of respondents (n=92) indicated that they had received their rebate, eight respondents indicated that they had not, and four did not know. Navigant verified the rebate status in the rebate tracking database for individuals who indicated they had not received their rebate or did not know if they had received their rebate. The database indicated all individuals received their rebate for all items though, in each case, the database indicated that the rebate had been paid to the contractor.

When asked about their satisfaction with the rebate amount received for participation in the program, an average score of 9.27 on a scale of 1 to 10 was reported (n=85), indicating a high level of satisfaction. Participants were also asked about their satisfaction with the timing of the rebate. This aspect received an average score of 8.34 on a scale of 1 to 10 (n=85), which was a noticeable increase over 2012 (7.76).

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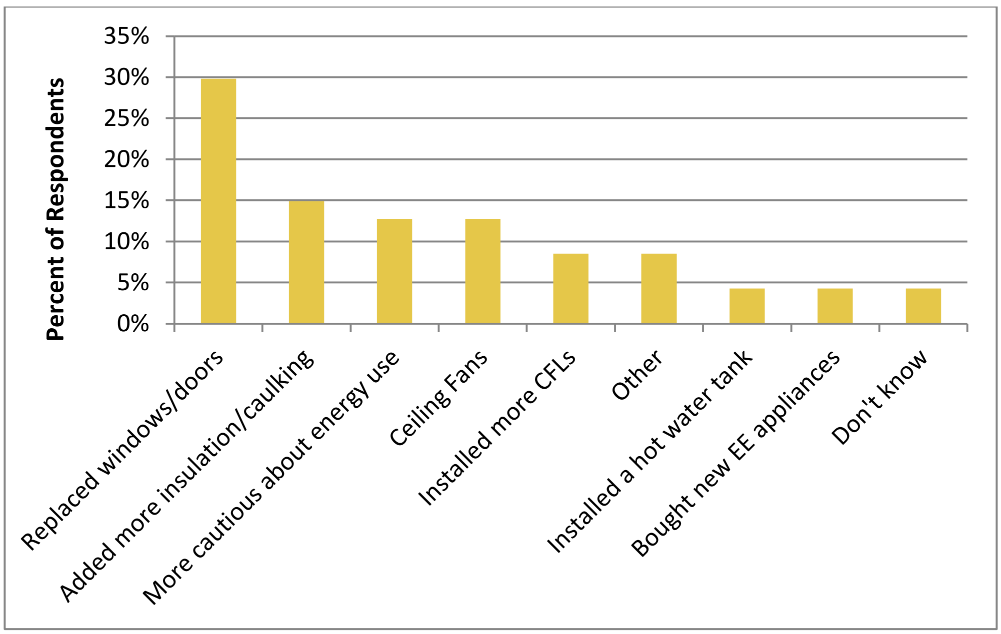
3.2.5 Additional Actions Taken

To evaluate if the program was effective in motivating participants to take additional energy savings actions outside of program participation, survey respondents were asked several questions. Forty percent of respondents (n=101) indicated having taking some additional energy savings action as a result of participation in the In-Home Energy Program. Figure 3-2 illustrates replacing doors and windows were reported by thirty percent of those who indicated taking additional action. Adding more insulation and being more conscious about energy use were also commonly reported additional energy savings actions.

Figure 3-2. Additional Energy Savings Actions Taken by Participants



Participants were also asked to indicate if they have participated in any other AEP Ohio programs. Ten percent of individuals (n=101) indicated that they had participated in another program, and 50 percent of those ten individuals (five respondents) indicated that their participation in the other, additional program occurred before participation in the In-Home Energy Program. Three individuals reported participating in the Refrigerator Rebate Program, which was the most frequent additional program listed by respondents.

3.2.6 Marketing and Program Awareness

The In-Home Energy Program is advertised through a number of marketing channels, including television, newspaper, bill inserts, community outreach events, participating contractors and direct mail to targeted customers. Figure 3-3 shows sources of program awareness among participant survey respondents. Respondents were first asked to report how they heard about the program, and were then asked which of these sources of program awareness was the most influential in their decision to participate.

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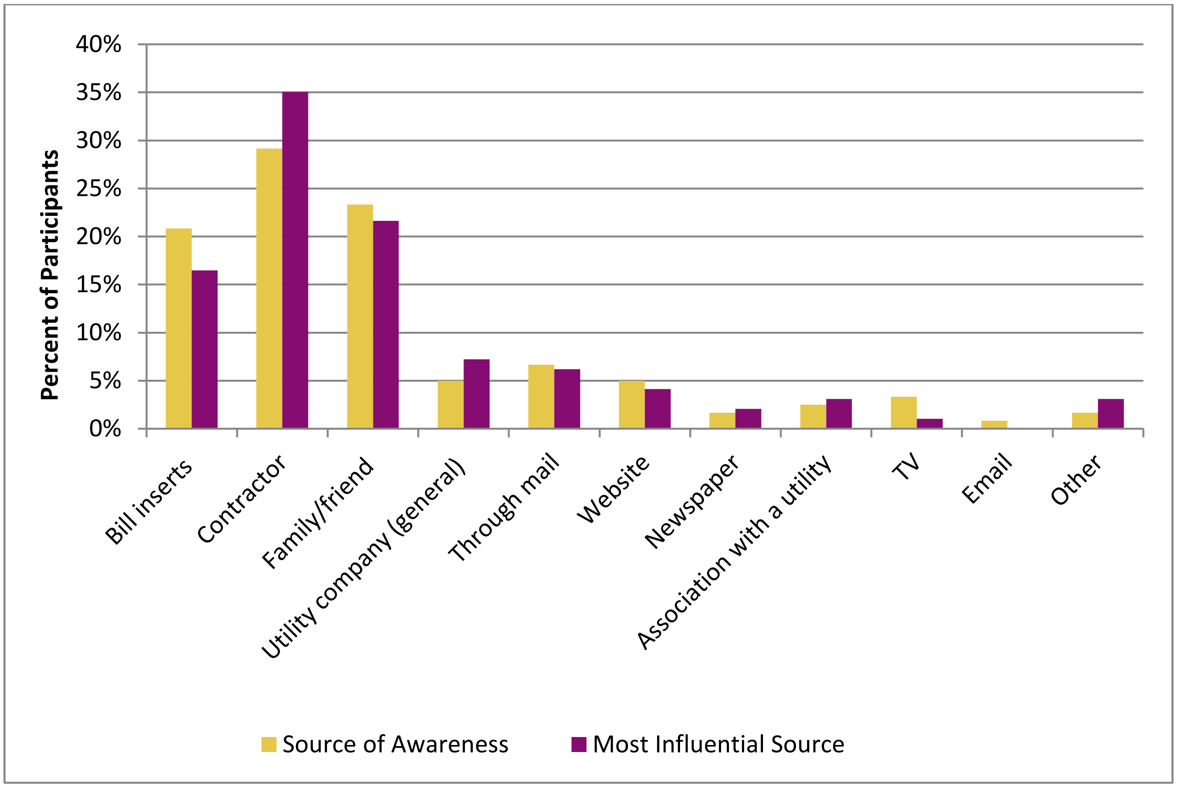
Figure 3-3. Sources of Program Awareness and Influence



Contractors, bill inserts, and family/friends were the most often cited sources of program knowledge among participants. When participants were asked to indicate which source of awareness was most influential in their decision, 35 percent of respondents reported that the contractor was the most influential source of the program. In total, 29 percent of respondents reported having heard of the program from a contractor, 23 percent recalled hearing about the program from a friend or family, and 20 percent from a bill insert (n=114).

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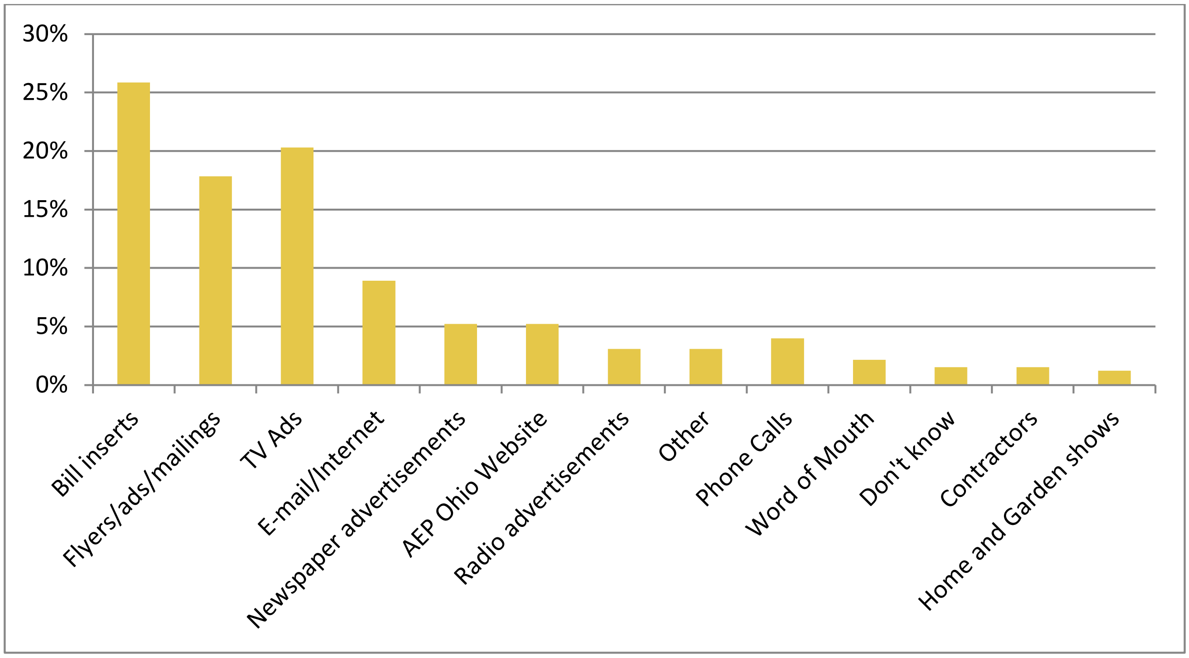
When asked to indicate how the program should be advertised in the future, the most commonly cited methods were bill inserts, TV Ads, and flyers/mailings, as seen in Figure 3-4.

Figure 3-4. Suggestions for Future Advertising Methods



Understanding energy efficiency was listed as the main benefit for participating in the program last year by 33 percent of respondents. This year, however, that number dropped down to two percent. Having a lower energy bill was indicated as the main benefit for participating in the program (n=179). The percentage of participants who reported that savings energy was the main benefit increased by ten percent over 2012. Figure 3-5 illustrates that saving energy and energy survey recommendations were also reported by many participants as benefits to participating. These benefits can be used to inform future advertising campaigns, as they reveal the most important program aspects from a participant perspective.

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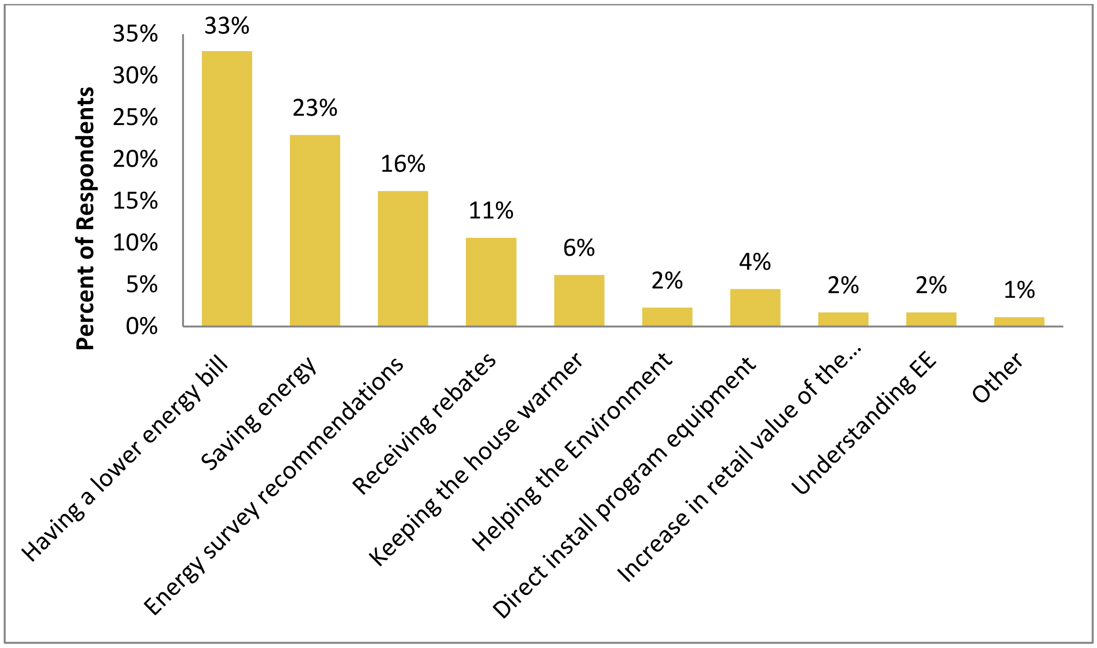
Figure 3-5. Main Benefits of Program Participation



3.2.7 Application and Payment Processing Time

Navigant completed a review of the rebate processing times entered into the rebate tracking dataset. Table 3-15 further breaks down the time period between measure installation to rebate payment for approximately 4,500 rebates. The overall average time from when the application is entered online to rebate payment was 50 days. This average rebate processing time was about the same as 2012 (47 days).

Table 3-15. Days for Rebate Processing Time

Project Type	Days Measure Installed to Application Entered	Application Entered to Invoice	Invoice to Rebate Paid	Application Entered to Rebate Paid
Assessment	34	19	26	45
Online Assessment	89	38	25	63
Audit	38	25	25	50
Overall	46	24	26	50

3.2.8 Online Energy Checkup Participant Satisfaction

As shown in Table 3-16, Mean Satisfaction Score respondents reported that their satisfaction with various elements of the Online Energy Checkup Program was high; the reported average satisfaction with the overall program was 7.9 on a scale of 1 to 10 (where 1 was “extremely dissatisfied” and 10 was “extremely satisfied”). The highest ratings were provided for the LED night light, hot water tank pipe wrap, CFL bulbs, energy savings kit as a whole, customized energy report, and length of time it took to complete the online checkup. Somewhat lower ratings were provided for the low flow showerheads and faucet aerators as a part of the energy savings kit received through the program.

Table 3-16. Mean Online Checkup Satisfaction Scores

Program Aspect	Satisfaction Rating (1-10)	
	Mean	N
Overall Online Energy Check program	7.9	70
Customized energy report with recommended ways to save energy	8.3	81
Energy Savings Kits	8.3	69
Information about eligible rebates for recommended energy efficiency improvements	8.2	81
The length of time it took to complete the online checkup	8.5	81
CFL bulbs received in the kit	8.3	81
Faucet aerators received in the kit	5.5	50
Low flow showerhead received in the kit	5.7	50
Hot water tank pipe wrap received in the kit	8.5	50
LED nightlight received in the kit	9.3	50
AEP Ohio overall	7.8	81

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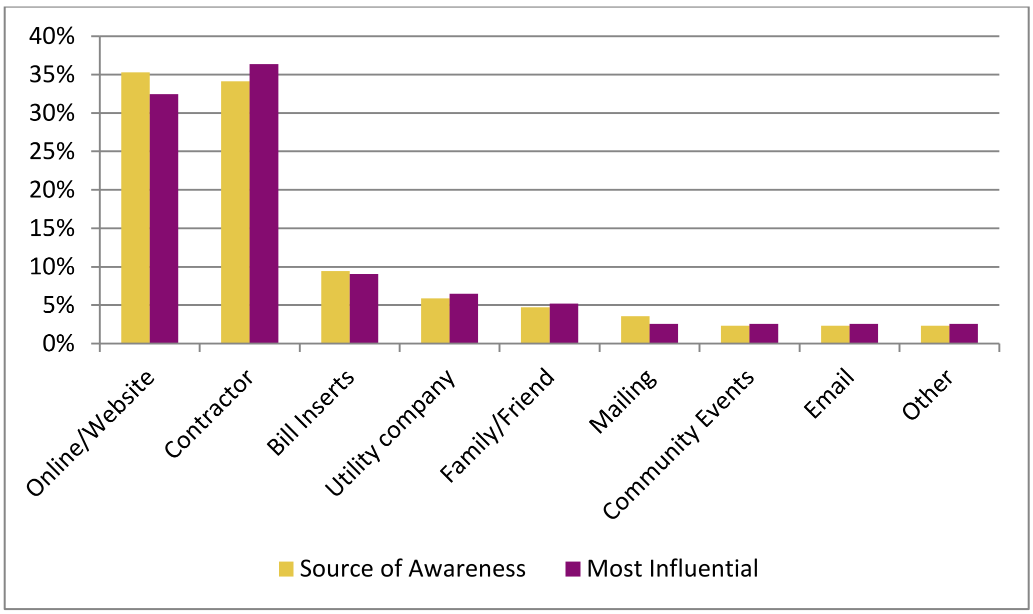
3.2.9 Online Energy Check-up Process

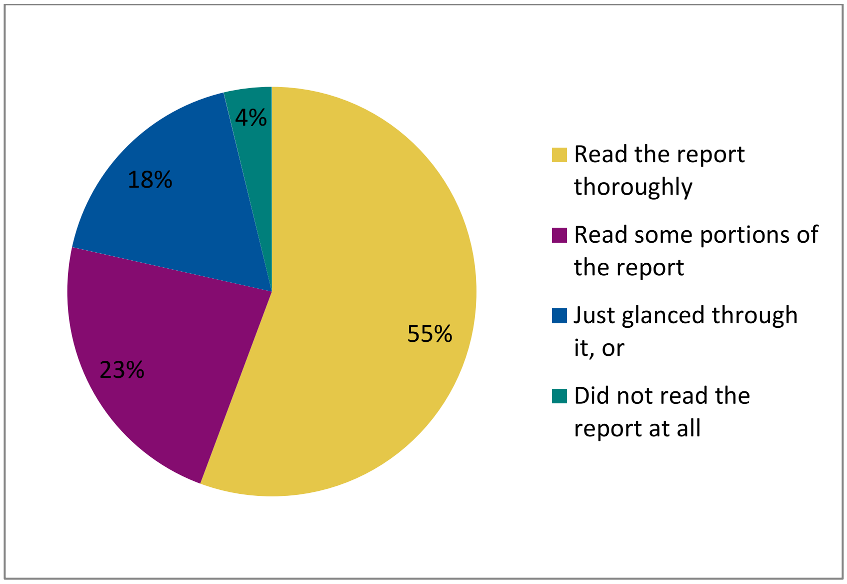
Contractors and the internet (online/websites) were the most often cited sources of program knowledge among participants, as shown in Figure 3-6. When participants were asked to indicate which source of awareness was most influential in their decision, 36 percent of respondents reported that the contractor and 32 percent responded that the internet were the most influential source of the program. In total, 34 percent of respondents reported having heard of the program from a contractor, 32 percent recalled knowing about the program from a website or an online source, and 9 percent from a bill insert (n=85).

Figure 3-6. How Did You Hear About the Program?



When asked about the Energy report provided following the Online Checkup, the majority of participants (55 percent) indicated that they had read the report thoroughly. Figure 3-7 illustrates that only 4 percent of participants indicated that they did not read the report at all.

Figure 3-7. Did Participants Read the Energy Report after Online Checkup?



Participants who indicated that they read the report thoroughly were asked how useful the report was on a scale of 1 to 10, where 1 – "not at all useful" and 10 – "very useful." The average rating was 7.4 (n=44), indicating a fairly high level of satisfaction with the report.

Participants were also asked to indicate if they have participated in any other AEP Ohio programs. The survey found that 14 percent of individuals (n=81) indicated that they had participated in another program, mostly receiving appliance rebates. Of those individuals, 55 percent indicated that their participation occurred after the Online Energy Checkup Program, indicating that the Online Checkup is successful at channeling some customers to other programs.

About 41 percent participants (n=81) reported that they have recommended the program to other participants. Participants were asked how likely is it that they recommend this program to other on a scale of 1 to 10 where 1 – "not at all likely" and 10 – "very likely." The average rating was 7.2 (n=81), indicating a high likelihood of recommendation for this program. Participants indicated lower savings in energy use and bill and recommendations not being useful enough as the primary reasons for not recommending the program.

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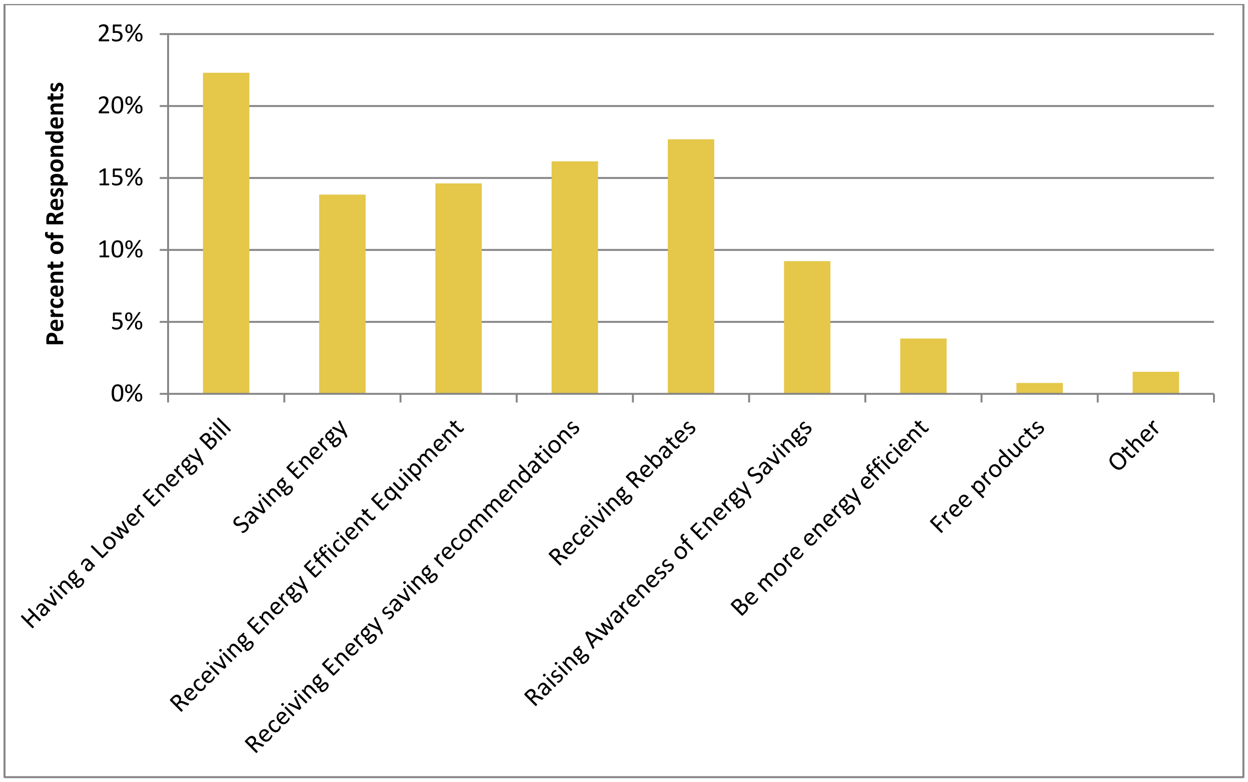
Having a lower energy bill was listed as the main benefit for participating in the program. Figure 3-8 illustrates that receiving rebates, energy savings recommendations and equipment, as well as savings energy, were also reported by many participants as a main benefit to participating. These benefits can be used to inform future advertising campaigns, as they reveal the most important program aspects from a participant perspective.

Figure 3-8. Benefits of Online Energy Checkup Participation



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3.2.10 Installation Contractor Satisfaction

Fourteen In-Home Energy Program installation contractors were interviewed to determine their satisfaction with various aspects of the program. Most interview participants were either owners or managers. The top three primary business activities for contractors were conducting energy audits (50%, n=14), HVAC replacement or tune-ups (29%), and roofing (14%). About 86% (n=14) of the contractors further noted that their primary service to participants of the AEP Ohio In-Home Energy program was providing energy audits. The remaining 14 percent primarily conducted HVAC replacement.

Table 3-17. Installation Contractor Interviewee Characteristics

	(average, n=14)
Experience with program measure (years)	6
Full-time employees	19
Time with the program (years)	3
AEP Ohio percent of total company projects	41%

Interviewees had on average six years of experience with the program measures they were involved in, their companies on average had 19 full-time employees, and they have been participating with the program on average for three years. Survey results indicate that the program accounts for between 25 to 57 percent of total participating contractor projects in most cases, indicating that the program is an important part of interviewee business.

About 15 percent of contractors (n=13) reported that their work decreased since last year, whereas, 38 percent reported work levels are the same, and 38 percent reported that they have more work with the program compared to last year. Firms that have experienced growth since last year attributed it to a variety of factors including better advertising by Ecova, more awareness by sales staff as to what is available in the program and company growth.

Contractor Satisfaction and Program Improvement Suggestions

Participants were asked to rate their overall satisfaction with AEP Ohio and their overall satisfaction with various key program components on a scale of 1 to 10, where 1 – "Not at all satisfied" and 10 – "Extremely satisfied." Table 3-18 indicates that contractors were on average "satisfied" with the program in 2013; however the mean program satisfaction rating has decreased somewhat since 2012. The evaluation team presents some sources of contractor dissatisfaction and provides suggestions for program improvements below.

Table 3-18. Contractor Satisfaction with Program Overall

	Overall Program 2012	Overall Program 2013
Mean	7.9	7.3
Median	8.0	7.5
Mode	8.0	8.0

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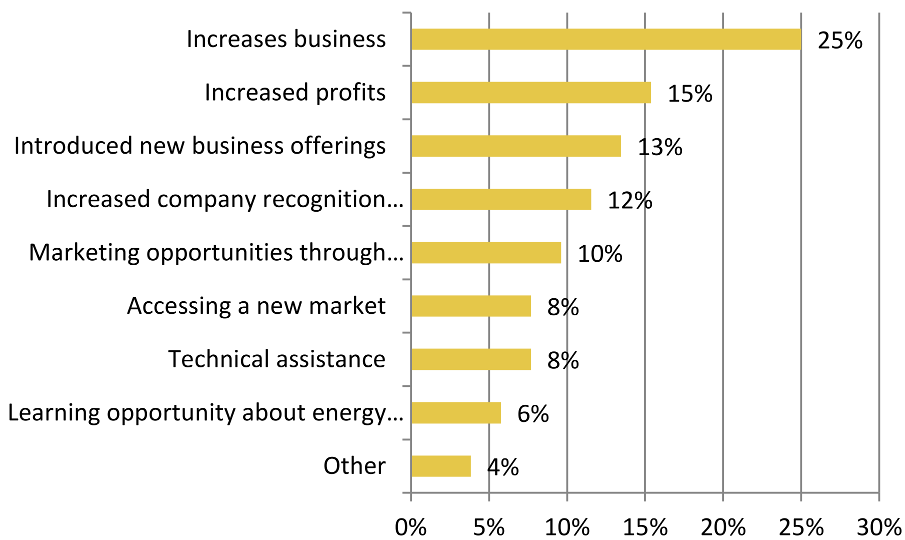
Navigant asked contractors to identify all of the benefits participating in the program provides their company. As seen in Figure 3-9, the top responses were that the program increases business (25%, n=52), it increases profits (15%), and that it allowed their company to introduce new business offerings (13%).

Figure 3-9. Contractor Benefits to Participation



The above results indicate that the program has had a general positive impact on the contractor market since inception. Contractors are seeing more business, profits, and business offering opportunities due to the program.

Contractors were also asked to identify drawbacks to participation. Twelve of fourteen contractors identified drawbacks. The most common drawback was extra administrative burdens (50%, n=14). Other issues identified were "constant changes in the rebate form and the company that's running the program seem like they're shorthanded," not enough pay for the effort required to participate because the projects take longer than promised, not enough leads, , and long wait times for customers to receive rebates.

Contractors were asked to provide feedback on what changes could be made to improve the program, shown in Figure 3-10. Suggestions included rebate or rebate process related changes, more marketing and simplifying administrative requirements. Other suggestions included allowing propane-heated homes in the program, using an online entry form for customers to fill out to speed up processes, and having more knowledgeable call center staff who can give accurate information about the program.

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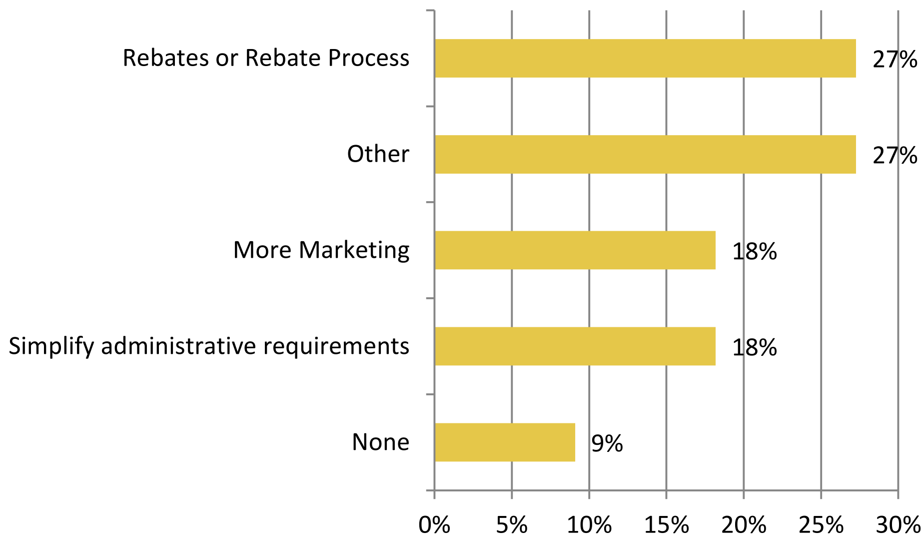
Figure 3-10. Contractor Suggested Program Improvements



In order to get a more detailed understanding of satisfaction with key program processes, Navigant asked contractors to rate their satisfaction with various key program components on a 1-10 scale, where 1 means "very dissatisfied." Contractors were generally satisfied with the rebate amounts offered for HVAC measures, the interactions and communications with program staff, and the In-Home Energy program in general. However, lower satisfaction was reported for the rebate amounts offered for shell measures, the level of marketing and promotion of the program to customers, the process for submitting a rebate application, and the amount of time it takes to receive a rebate.

Table 3-19. Contractor Program Satisfaction Scores

Process Component	Rating
Rebate amounts offered for HVAC measures	7.67
Your interactions and communications with program staff	7.43
The In-Home Energy program in general	7.29
Training opportunities you've received through the program	5.38
Rebate amounts offered for air sealing, insulation and windows	5.09
The level of marketing and promotion of the program to customers	4.86
The process for submitting a rebate application	4.25
The amount of time it takes to receive a rebate	4.23

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Furthermore, 71 percent of contractors indicated they have had administrative issues dealing with AEP Ohio or Ecova since becoming involved with the program. Contractors identified that most issues were either with paperwork (40%, n=10) or billing (30%). About half of the contractors that indicated having administrative issues had their problem solved or partially solved. Issues that were not solved include homeowners being denied rebates, lack of lead follow-up and scheduling issues, and having to wait for a customer to be entered into the database before a contractor can submit paperwork.

Navigant conducted an additional level of analysis to identify linear correlations between contractors' process component ratings. The data suggests that there is notable positive correlation between contractors' positive ratings for the time it takes to receive a rebate and positively scoring other rebate-related processes such as incentive amounts and the process for submitting a rebate. Thus, if the program focuses on improving rebate processing times, it may see contractors rate their satisfaction with program rebate amounts higher in the future, all other variables kept constant.

Contractor Opinions on Program Marketing

About 43 percent (n=14) of contractors indicate that the program's marketing efforts have not been successful at reaching the right audience. Contractors gave similar feedback during research conducted for 2012. Furthermore, about 86 percent of contractors in 2013 believe that additional marketing support would help them sell their services to customers. The most prominent suggestion from contractors for improving marketing was focusing on improving marketing material messaging so that claims being made are accurate for all customers (such as savings potential), accessible to the layman, and include more clear program messaging. Other contractors noted focusing on establishing contractor credibility with customers with utility branded shirts or other material, marketing in rural areas, making rebates available through certified contractors for AEP Ohio, and TV and radio advertising.

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4 Conclusions and Recommendations

This section highlights the findings from the process evaluation of the In-Home Energy Program for 2013.

4.1 Key Impact Findings

Navigant used engineering algorithms to verify energy and demand savings for the In-Home Energy Program. The In-Home Energy Program reported 12,047 MWh of energy savings and 2.1 MW of demand savings in 2013. The verified (*ex post*) energy and demand savings for 2013 were 10,933 MWh and 2.1 MW. *Ex post* energy savings (MWh) savings achieved the program energy savings goals of 10,776 MWh, as shown in Table ES-1. The realization rates were 91 percent for MWh and 101 percent for peak kW, indicating that both the *ex ante* energy savings and the *ex ante* demand savings reported by AEP Ohio were close to the evaluation-calculated savings.

Table ES-2. 2013 Overall Evaluation Results

	2013 Program Goals	*Ex Ante* Savings (a)	Audited Savings (b)	Realization Rate RR = (b) / (a)	Percent of Goal
Energy Savings (MWh)	10,776	12,047	10,933	0.91	101%
Demand Savings (MW)	0.7	2.1	2.1	1.01	305%

[1]Source: 2012-2014 Plan.

Geothermal Heat Pump Rebate Eligibility. The program is current paying rebates for new geothermal heat pumps replacing existing geothermal heat pumps at end-of-life. However, the baseline equipment against which savings are estimated is assumed to be an air-source heat pump (as per the Draft Ohio TRM). It is unlikely though that a customer would replace an existing geothermal heat pump with a new, lower efficiency, air-source heat pump, especially with existing geothermal infrastructure in place. For this reason, the baseline should be designated as a new geothermal heat pump and savings calculations should be adjusted accordingly.

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4.2 *Cost-Effectiveness Review*

This section addresses the cost effectiveness of the In-Home Energy Program. Cost effectiveness is assessed through the use of the Total Resource Cost (TRC) test. Table 4-1. summarizes the unique inputs used in the TRC test.

Table 4-1. Inputs to Cost-Effectiveness Model for In-Home Energy Program

Item	
Average Measure Life	11
Residences	10,678
Annual Energy Savings (kWh)	10,460,000
Coincident Peak Savings (kW)	1,900
Third Party Implementation Costs	$2,334,626
Utility Administration Costs	$514,877
Utility Incentive Costs	$2,201,869
Participant Contribution to Incremental Measure Costs	$4,653,247

Based on these inputs, the TRC ratio is 0.5. Therefore, the program does not pass the TRC test. Table 4-2 summarizes the results of the cost-effectiveness tests. Results are presented for the Total Resource Cost test, the Participant Cost Test, the Ratepayer Impact Measure Test, and the Utility Cost Test.

Table 4-2. Cost Effectiveness Results for the In-Home Energy Program

Test Results	
Total Resource Cost	0.5
Participant Cost Test	1.5
Ratepayer Impact Measure	0.3
Utility Cost Test	1.0

At this time, additional benefits related to reduction of greenhouse gas emissions have not been quantified in the calculation of the TRC. These additional benefits would increase the given TRC benefit/cost ratio.

4.3 *Key Process Findings and Recommendations*

The process evaluation component of the In-Home Energy Program assessed the effectiveness of the program operations, delivery for the energy audits/assessments, and rebates for retrofit measures. Navigant's process evaluation included in-depth interviews with program staff, participating customers and installation contractors, and a review of program tracking systems, reports and marketing materials. Findings follow along with recommendations.

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1. **Participants are satisfied with most aspects of the program.** Respondents reported that their satisfaction with various elements of the In-Home Energy Program was quite high; the reported average satisfaction with the overall program was 8.71 on a scale of 1 to 10 (where 1 was "extremely dissatisfied" and 10 was "extremely satisfied"). Satisfaction with the different aspects of the program did not vary substantially – all aspects scored above 8 (with the exception of low flow faucet aerators, 4.50, n=2; and the utility's contribution to towards the audit cost, 6.45, n=4). Additionally, 77 percent of participants indicated that they have already recommended the program to others (a 20% percentage point increase over 2012). Notably, showerheads received a satisfaction rating of 10 from single-family direct install customers after low-ratings in 2012 prompted a change in the showerhead models installed through the program. However, energy kit customers still gave low-flow showerheads a rating of 5.7. The low satisfaction rating for faucet aerators (4.5 for direct install measures and 5.5 for energy kit measures) corresponds to low realization rates (50%) for this measure.

   Recommendation #1: Add literature to the energy kit that explains the benefits and installation procedures for self-install measures, which may increase installation rates. It is possible that single-family direct install customers do not understand that faucet aerators have been installed during assessments. Encourage auditors/assessors to discuss the direct install measures with customers to ensure customer awareness and potentially increase customer-reported installation rates.

2. **Participant Perception of Incentive Payments.** Satisfaction with rebate amounts was quite high (9.27), though only 84 percent of respondents (n=101) indicated that they had received their rebate; twelve respondents indicated that they had not, and four did not know. Navigant verified rebate processing status for the rebate applications for individuals who indicated they had not received their rebate or did not know if they had received their rebate. The application review indicated all individuals received their rebate for all items though, in each case, the database indicated that the rebate had been paid to the contractor.

   Recommendation #2: Contractors should make it clear that customers are receiving a rebate for selecting high-efficiency equipment from AEP Ohio. Customer awareness of rebates will aid in their word-of-mouth promotion of the program.

3. **Data tracking**. Navigant found some improvement in the quality of the data in the tracking system compared to 2012. The database contains fewer data entry errors and data needed for evaluation is being recorded, although not always completely. The implementation contractor's internal QA/QC process is finding errors, as evidenced by the number of projects negated in the tracking system due to non-compliance with rebate requirements, though it appears that some of these errors are not being caught until after the rebate has been paid.

   Many of the tracking system issues identified were due to installation contractor errors that appear to have not been caught in the initial application review process. Contractors are submitting rebate

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applications for some projects that do not meet minimum eligibility requirements. Rebates were often paid for these projects, though savings are reduced and sometimes eliminated once these issues are identified later on in the QA/QC process. This is a quality control issue and also a cost-effectiveness issue because these projects incur full incremental measure costs but do not achieve the full energy savings for each measure. However, due to the low frequency of these occurrences (0.5% of projects), this issue does not present a major immediate concern. Participating contractors also reported dissatisfaction with the rebate application process, citing administrative burdens and being denied rebates.

Recommendation #3: Consider improvements to the frequency or rigor of the rebate application QA/QC processes. Every rebate claim should be reviewed upon receipt for compliance with measure rebate requirements. However, additional QA/QC processes could be decreased for high-performing contractors with a demonstrated history of compliance to decrease rebate processing times. Participating contractors should clearly be made aware of reasons for rebate denial and should be the focus of additional training and outreach.

4. **Installation Contractor Satisfaction.** Survey results indicate that the program is having an impact on the installation contractor market and is an important part of participating contractor business. Contractors are seeing more business, profits, and business offering opportunities due to the program. Furthermore, contractors on average, are satisfied with the program overall (giving the program a rating of 7.3 out of 10). However, several areas of contractor dissatisfaction and improvement were thematic in contractor feedback. These issues include dissatisfaction with rebate processing times and application procedures, rebate amounts offered for shell measures, and the level of marketing and promotion of the program to customers. In addition, about 21 percent of contractors identified skepticism about utility intentions as a barrier to customer participation, and some indicated customer skepticism towards their credibility as representatives of AEP Ohio.

   Recommendation #4a: consider changing the rebate structure for weatherization measures. Contractors identified air sealing, insulation, and windows rebates as being too low. Consider implementing a tiered incentive structure for shell measures to award higher incentives to projects that save more energy. For instance, air sealing rebates could be awarded at tiers such as 20 percent reduction, 30 percent reduction, or 40 percent reduction. Lower satisfaction for incentive amounts may reflect the end-of-year decrease in incentives for gas measures, for cost-effectiveness reasons. The 2014 contractor survey should differentiate between gas and electric incentive amounts.

   Recommendation #4b: address customer skepticism about program intentions and contractor affiliation. The program might benefit from directly addressing customer skepticism and addressing these in marketing and outreach material messaging. .

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Appendix A Data Collection Instruments

The following guides were used to conduct the in-depth surveys.

A.1 AEP Ohio In-Home Energy Program Participant Survey (Audit/Assessment Recipients)

Hello, my name is __________ and I'm calling on behalf of AEP Ohio, your electric utility. I'm calling recent participants in AEP Ohio's In-Home Energy Program to learn about their experience and satisfaction with the program. This is not a sales call, and all responses will be kept anonymous. May I please speak with [INSERT NAME] or someone in your household who was involved with your recent decision to purchase energy efficiency measures for your home (IF NEEDED: such as high-efficiency furnace, air sealing, insulation, etc.)? [IF THE DECISION-MAKER IS NO LONGER THERE, THANK AND TERMINATE].

READ IF ASKED:

- Depending on your responses, the survey will take about **15** minutes to complete.

Screeners

S1. Can you confirm you are an AEP Ohio customer?

1. YES – SKIP to S3
2. NO
98. DON'T KNOW
99. REFUSED

S2. Are you a Columbus Southern Power or Ohio Power Company customer?

1. YES
2. NO [TERMINATE]
88. (DON'T KNOW) [TERMINATE]
99. (REFUSED) [TERMINATE]

S3. Our records indicate that you received an energy <Job Type>and received a rebate for installing energy efficiency improvements in your home. Is that correct?

3. YES
4. NO [TERMINATE]
1. (DON'T KNOW) [TERMINATE]
99. (REFUSED) [TERMINATE]
    a.

S2. Were you home during the <Job Type>when the auditor was present and participating in the process?

a. YES **[CONTINUE TO NEXT SECTION]**

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b. NO **[CONTINUE TO S2A]**
c. DON'T KNOW **[THANK AND TERMINATE]**
d. REFUSED **[THANK AND TERMINATE]**

S2A. May I speak with someone who was home during the <Job Type>when the auditor was present, and who followed along the <Job Type>process?

b. YES **[CONTINUE]**
c. NO **[THANK AND TERMINATE]**
d. DON'T KNOW **[THANK AND TERMINATE]**
e. REFUSED **[THANK AND TERMINATE]**

Measure Verification

CFLs [If QTYCFL>0]
CFL1. Our records indicate that the auditor installed [QTYCFL] CFL(s) during the <Job Type>, is this correct?

a. YES [Skip to CFL2]
b. NO [Continue to CFL1A]
c. DON'T KNOW [Skip to next applicable section]
d. REFUSED [Skip to next applicable section]
f.

CFL1A. **[ASK IF CFL1=B]** How many CFLs did the auditor install during the <Job Type>?

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

IF RESPONDENT ANSWERS "0" SKIP TO NEXT APPLICABLE SECTION.

CFL2. How many CFLs were just handed to you during the <Job Type>? (If needed: "As opposed to actually being installed by the auditor")

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

CFL3. [If CFL2=1] "Is the CFL that was installed during the <Job Type>still in place?"
[If CFL2>1 or CFL2=98 or 99] "Are all the CFLs that were installed through the <Job Type>still in place?"

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

[If CFL2>1 and CFL3=b] CFL4. How many of the CFLs which were installed during the <Job Type>are still installed?

[NUMERIC OPEN-END]
98. DON'T KNOW

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99. REFUSED

[If CFL3=b] CFL5. What happened to the CFL(s) which are no longer installed **[ALLOW MULTIPLE RESPONSES]**?

a. THROWN AWAY
b. IN STORAGE
c. SOLD OR GIVEN AWAY
d. OTHER [SPECIFY]
e. DON'T KNOW
f. REFUSED

CFL6. Did you have specific plans to install CFLs before hearing about the program?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED
g.

CFL7. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed the same CFLs if you had not received (it/them) through the program?

_____________________- [RECORD RESPONSE 1-10]

CFL8. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to implement the installation of the CFLs?

_____________________- [RECORD RESPONSE 1-10]

Showerheads [if QTYSHOW>0]

SHOW1. Our records indicate that the auditor installed [QTY_SHOW] low flow showerhead(s) during the <Job Type>, is this correct?

1. YES [Skip to SHOW2]
2. NO [Continue to SHOW1A]

88. DON'T KNOW [Skip to next applicable section]
99. REFUSED [Skip to next applicable section]

SHOW1A. [Ask If SHOW1=b] How many low flow showerheads were installed during the <Job Type>?

[NUMERIC OPEN-END]
88. DON'T KNOW
99. REFUSED

IF RESPONDENT ANSWERS "0" SKIP TO NEXT APPLICABLE SECTION.

SHOW2. Was/were the showerhead(s) actually *installed* during the <Job Type>or just left behind?

1. All were installed
2. Some were installed
3. All were left behind

88. DON'T KNOW

NAVIGANT

99. REFUSED

(ASK IF SHOW2=1)
SHOW3. [If SHOW1A=1] “Is the low flow showerhead that was installed during the <Job Type>still in place?” [If SHOW1A>1] “Are all the low flow showerheads that were installed through the <Job Type>still in place?”

a. YES
b. NO
c. DON’T KNOW
d. REFUSED

[If SHOW1A>1 and SHOW3=b] SHOW4. How many of the showerheads are still installed?

[NUMERIC OPEN-END]
98. DON’T KNOW
99. REFUSED

[If SHOW3=b] SHOW5. What happened to the showerhead(s) which are no longer installed? **[ALLOW MULTIPLE RESPONSES]**

a. THROWN AWAY
b. IN STORAGE
c. SOLD OR GIVEN AWAY
d. OTHER [SPECIFY]
e. DON’T KNOW
f. REFUSED

SHOW6. Did you have specific plans to install low flow showerheads before hearing about the program?

a. YES
b. NO
c. DON’T KNOW
d. REFUSED
h.

SHOW7. On a scale of 1 to 10 where 1 is “not very likely” and 10 is “very likely”, how likely is it that you would have installed the same showerheads if you had not received (it/them) through the program?

______________________- [RECORD RESPONSE 1-10]
DON’T KNOW
REFUSED

SHOW8. On a scale of 1 to 10 where 1 is “not at all influential” and 10 is “very influential”, how influential was the program in your decision to implement the installation of the low flow showerheads?

______________________- [RECORD RESPONSE 1-10]
DON’T KNOW
REFUSED

NAVIGANT

AERATORS [if QTYAER>0]

AER1. Our records indicate that the auditor installed [QTYAER] low flow aerator(s) during the <Job Type>, is this correct?

a. YES [Skip to AER2]
b. NO [Continue to AER1A]
c. DON'T KNOW [Skip to next applicable section]
d. REFUSED [Skip to next applicable section]

AER1A. How many low flow aerators were installed during the <Job Type>?

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

IF RESPONDENT ANSWERS "0" SKIP TO NEXT APPLICABLE SECTION.

AER2. How many of those aerators were actually *installed* during the <Job Type>, as opposed to just being left behind?

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

AER3. [If AER2=1] "Is the low flow aerator that was installed during the <Job Type>still in place?" [If AER2>1 or AER2=98 or 99] "Are all the low flow aerators that were installed through the <Job Type>still in place?"

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

[If AER2>1 and AER3=b] AER4. How many of the aerators are still installed?

[NUMERIC OPEN-END]
98. DON'T KNOW
99. REFUSED

[If AER3=b] AER5. What happened to the aerator(s) which are no longer installed?

a. THROWN AWAY
b. IN STORAGE
c. SOLD OR GIVEN AWAY
d. OTHER [SPECIFY]
e. DON'T KNOW
f. REFUSED

AER6. Did you have specific plans to install low flow aerators before hearing about the program?

a. YES
b. NO

NAVIGANT

c. DON'T KNOW
d. REFUSED
i.

AER7. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed the same aerators if you had not received (it/them) through the program?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

AER8. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to implement the installation of the low flow aerators?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

Pipe [If QTY_PIns>0]

PINS1. Our records indicate that pipe insulation was installed on the pipe connected to your hot water heater during the <Job Type>, is this correct?

a. YES
b. NO [SKIP TO NEXT APPLICABLE SECTION]
c. DON'T KNOW [SKIP TO NEXT APPLICABLE SECTION]
d. REFUSED [SKIP TO NEXT APPLICABLE SECTION]

PINS2. Is the pipe insulation that was installed during the <Job Type>still in place?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

PINS3. Did you have specific plans to install pipe insulation on the pipe connected to your hot water heater before hearing about the program?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED
j.

PINS4. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed the same pipe insulation if you had not received it through the program?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

NAVIGANT

PINS5. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to implement the installation of the pipe insulation?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

LED Nightlight [if QTY_LEDNL>0]

LEDNL1. Our records indicate that an LED nightlight was installed during the <Job Type>, is this correct?

a. YES
b. NO [SKIP TO NEXT APPLICABLE SECTION]
c. DON'T KNOW [SKIP TO NEXT APPLICABLE SECTION]
d. REFUSED [SKIP TO NEXT APPLICABLE SECTION]

LEDNL2. Is the LED Nightlight that was installed during the <Job Type>still installed?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

[If LEDNL2=b] LED3. What happened to the LED nightlight that is no longer installed?

a. IT WAS THROWN AWAY
b. IT'S IN STORAGE
c. IT WAS SOLD OR GIVEN AWAY
d. OTHER [SPECIFY]
e. DON'T KNOW
f. REFUSED

k.

LEDNL4. Did you have specific plans to install an LED nightlight before hearing about the program?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

l.

LEDNL5. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed the same LED nightlight if you had not received it through the program?

____________________- [RECORD RESPONSE 1-10]

LEDNL6. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to implement the installation of the LED nightlight?

____________________- [RECORD RESPONSE 1-10]

NAVIGANT

Programmable Setback Thermostat [If QTY_PTherm>0]

PT1. Our records indicate that a programmable thermostat was installed during the <Job Type>, is this correct?

a. YES
b. NO [SKIP TO NEXT SECTION]
c. DON'T KNOW [SKIP TO NEXT SECTION]
d. REFUSED [SKIP TO NEXT SECTION]

PT2. Was the thermostat programmed during the <Job Type>?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

PT3. Is the programmable thermostat that was installed during the <Job Type>currently programmed?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED
m.

[If PTHERM3=b]

PT4. What happened to the programmable thermostat which is no longer installed?

a. THROWN AWAY
b. IN STORAGE
c. SOLD OR GIVEN AWAY
d. OTHER [SPECIFY]
e. DON'T KNOW
f. REFUSED

PT5. Did you have specific plans to install a programmable thermostat <u>before</u> hearing about the program?

e. YES
f. NO
g. DON'T KNOW
h. REFUSED
n.

PT6. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed a programmable thermostat if you had not received (it/them) through the program?

____________________- [RECORD RESPONSE 1-10]

DON'T KNOW
REFUSED

NAVIGANT

PT7. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to implement the installation and programming of the thermostat?

_____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

[ASK IF STRATA = HVAC and SHELL, otherwise skip to next section]

Retrofit Measure Verification

Ask Questions R1 through R9 for each retrofit measure installed using the table below:

Y	Furnace Replacement
N	Attic Insulation
Y	Central Air Conditioning Replacement(s)
Y	Heat Pump Replacement(s)
Y	Programmable Thermostat(s)
N	Air Conditioner Tune Up
N	Wall Insulation
N	Air Sealing
Y	Window Replacement(s)
Y	Ceiling Fan(s)
N	Duct Sealing

R1. Our records indicate that you purchased [if pluralization =Y, QTYMeasure] [Measure Name(s)] after the energy <Job Type>, is this correct? DO NOT PIPE IN THE QTYMEASURE IF PLURALIZATION =N. For pluralization=N and qtymeasure=1 or more than 1, ask: "Our records indicate that you purchased attic insulation after the energy" <JOB Type >, is this correct?"

Example – if on the sample file, there are 5 attic insulations, in this question we still say only 'attic insulation'. If the respondent says no, they will skip out of the section. This is because – in the case of attic insulation pluralization=N, so these people will not get R2.

For pluralization=Y and qtymeasure=1, "Our records indicate that you purchased one <measure name> after the energy" <JOB Type >, is this correct?"

Example – if on the sample file, there are 1 FURNACE REPLACMENTS, in this question we still say 1 FURNACE REPLACEMENT.

NAVIGANT

For pluralization=Y and qtymeasure>1, "Our records indicate that you purchased <qtymeasure> <measure name> after the energy" <JOB Type >, is this correct?"
Example – if on the sample file, there are 5 FURNACE REPLACMENTS, in this question we still say 5 FURNACE REPLACEMENTS.

a. YES
b. NO
c. DON'T KNOW [SKIP TO NEXT SECTION]
d. REFUSED [SKIP TO NEXT SECTION]
o.

IF pluralization=N, and R1=NO, skip out of section)
[If R1=b and Pluralization=Y] R2. How many [Measure Name(s)] did you purchase after the <Job Type>?

[NUMERIC OPEN-END]

98. DON'T KNOW [SKIP TO NEXT SECTION]
99. REFUSED [SKIP TO NEXT SECTION]

[For pluralization=Y, IF R1=NO, and R2=0, skip section]

[DO NOT ASK R3 IF R1= DON'T KNOW or REFUSED]
R3. [If QTYMeasure=1] Has the [Measure Name] purchased through the program been installed in your home? [If QTYMeasure>1] Have all the [Measure Name(s)] purchased through the program been installed in your home?

a. YES
b. NO
c. DON'T KNOW [SKIP TO NEXT SECTION]
d. REFUSED [SKIP TO NEXT SECTION]
p.

R4. [If R3=b and QTYMeasure>1] How many of the [Measure Name](s) have been installed in your home?

[NUMERIC OPEN-END]

98. DON'T KNOW
99. REFUSED

R5. [If R3=b] Why have you not installed the [Measure Name](s) purchased through the program? **[ALLOW MULTIPLE RESPONSES]**

a. HAVE NOT GOTTEN AROUND TO IT
b. NOT SATISFIED WITH THE [MEASURE NAME] PURCHASED
c. WAITING FOR THE EXISTING EQUIPMENT TO STOP WORKING
d. NOT THE RIGHT TYPE/WON'T FIT
e. OTHER (SPECIFY)
f. DON'T KNOW
g. REFUSED

R6. [If R3=b] When do you intend on installing the [Measure Name(s)] which have not yet been installed?

a. IN THE NEXT 3 MONTHS

NAVIGANT

b. IN THE NEXT 6 MONTHS
c. IN THE NEXT YEAR
d. MORE THAN A YEAR FROM NOW
e. NEVER
f. DON'T KNOW
g. REFUSED

R7. Did you have specific plans to install a [Measure Name](s) before hearing about the program?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

[DO NOT ASK R8 or R9 IF R3=DON'T KNOW or REFUSED]
R8. On a scale of 1 to 10 where 1 is "not very likely" and 10 is "very likely", how likely is it that you would have installed the same [Measure Name](s) if you had not received (it/them) through the program?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

R9. On a scale of 1 to 10 where 1 is "not at all influential" and 10 is "very influential", how influential was the program in your decision to purchase and install and the [Measure Name]?

____________________- [RECORD RESPONSE 1-10]
DON'T KNOW
REFUSED

q.

Process Questions

P1. How did you first find out about the In-Home Energy Program? **[DO NOT READ LIST. ENTER ALL THAT APPLY.]**

a. BILL INSERT
b. COMMUNITY EVENT/COUNTY/STATE FAIR
c. CONTRACTOR (SUCH AS A PLUMBER, ELECTRICIAN, OR GENERAL CONTRACTOR)
d. EMAIL
e. FAMILY/FRIEND
f. RESPONDENT WORKS IN THE INDUSTRY
g. UTILITY COMPANY (GENERAL)
h. WEBSITE
i. YARD SIGNS
j. SOME OTHER WAY (SPECIFY)
k. DON'T KNOW
l. REFUSED

NAVIGANT

[IF P1 HAS MORE THAN ONE ANSWER, ASK P2, OTHERWISE AUTO-FILL.]

P2. Which of these sources of information was most influential in your decision to participate in the program? [SHOW ANSWERS GIVEN IN P1.] **[ENTER ONE RESPONSE.]**

P3. How would you suggest AEP Ohio try to reach out to their customers in the future to get them to participate in this program? [DO NOT READ. ALLOW MULTIPLE RESPONSES]

a. BILL INSERTS
b. FLYERS/ADS/MAILINGS
c. HOMEOWNERS ASSOCIATION
d. NEWSPAPER ADVERTISEMENTS
e. RADIO ADVERTISEMENTS
f. TELEVISION ADVERTISEMENTS
g. WITH PHONE CALLS
h. OTHER (SPECIFY)
i. DON'T KNOW
j. REFUSED

P4. On a scale of 1 to 5, where 1 is extremely dissatisfied and 5 is extremely satisfied, how would you rate your satisfaction with… [SCALE 1-5; 96=not applicable, 98=Don't know, 99=Refused]

a. The energy <Job Type>REPORT you received that showed your home's energy usage and recommended ways to save energy.
b. [If QTY_CFL≥1] The CFL bulbs installed through the program
c. [If QTY_AER≥1] The faucet aerators installed through the program
d. [If QTY_SHOW≥1] The low flow showerheads installed through the program
e. [If QTY_PIns ≥1] The hot water tank pipe wrap installed through the program
f. [If QTY_PTherm1≥1] The programmable Thermostat installed through the program
g. [If QTY_LEDNL≥1] The LED nightlight installed through the program
h. The time it took to schedule the energy <Job Type>
i. The length of time it took to complete the <Job Type>in your home
j. AEP Ohio's auditor that assessed your home's energy performance.
k. [If JOB TYPE=1] The utility contribution ($) toward your energy assessment
l. [If JOB TYPE=2] The utility contribution ($) toward your energy audit
m. The *In-Home Energy* program overall
n. AEP Ohio overall

(SP TEAM: As this question for any of the P4a-n<4. Pipe in the response as shown below)
[If any P4a-n≤2] P5. You mentioned you were not satisfied with <P4a-n<4>. Why did you give this rating? **[OPEN-END. RECORD RESPONSE]**

NAVIGANT

98. DON'T KNOW
99. REFUSED

P6. What do you see as the main benefits to participating in the *program*? [DO NOT READ; MULTIPLE RESPONSE, UP TO 3]

a. HAVING A LOWER ENERGY BILL
b. SAVING ENERGY
c. RECEIVING THE DIRECT INSTALL PROGRAM EQUIPMENT
d. RECEIVING THE ENERGY SURVEY RECOMMENDATIONS
e. RECEIVING REBATES ON RETROFIT MEASURES
f. NO IMPROVEMENTS/FINE THE WAY IT IS
g. OTHER, SPECIFY
h. DON'T KNOW
i. REFUSED
r.

P7. Have you noticed a reduction in the amount of your electric bill since participating in the program?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

P8. Would you say participating in this program has made you feel more favorable, less favorable, or no different about AEP Ohio?

a. MORE FAVORABLE ABOUT AEP OHIO
b. LESS FAVORABLE ABOUT AEP OHIO
c. NO DIFFERENT ABOUT AEP OHIO
d. DON'T KNOW
e. REFUSED
s.

P9. Have you recommended the AEP Ohio In-Home Energy Program to others since participating?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

P10. On a scale of 1 to 5, where 1 is "Not at All Likely", and 5 is "Extremely Likely", how likely are you to recommend this program to others in the future?

____________________- [RECORD RESPONSE 1-5]

DON'T KNOW
REFUSED

[If P10≤4] P11. Why might you <u>not</u> recommend the program to others? [DO NOT READ, MARK ALL THAT APPLY]

a. ENERGY USAGE SAVINGS WERE NOT HIGH ENOUGH

NAVIGANT

b. ENERGY BILL SAVINGS WEREN'T HIGH ENOUGH
c. TOO MUCH OF A HASSLE/TOO MUCH RED TAPE
d. IT TOOK TOO LONG TO RECEIVE THE REBATE
e. THE REBATE WASN'T WORTH IT/WAS TOO LOW
f. THE RECOMMENDATIONS WERE NOT HELPFUL
g. RESPONSE WAS NEUTRAL/NOT NEGATIVE
h. OTHER [SPECIFY]
i. DON'T KNOW
j. REFUSED

P12. At any point during your participation in the *In-Home Energy* program, did you contact a representative at AEP Ohio?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

[If P12=a] P13. On a scale of 1 to 5, where 1 is Extremely Dissatisfied, and 5 is Extremely Satisfied, please rate your satisfaction with your experience contacting AEP Ohio regarding the In-Home Energy program.

____________________- [RECORD RESPONSE 1-5]

DON'T KNOW
REFUSED

[If P13≤2] P14. Why are you dissatisfied with your experience contacting AEP Ohio regarding the In-Home Energy program? **[Record verbatim]**

DON'T KNOW
REFUSED

P15. Now I would like you to focus on the Report you received after the <Job Type>. After receiving the report that contained recommendations for ways to reduce your energy consumption and your utility bill, would you say that you….(Read list)

a. Read the report thoroughly
b. Read some portions of the report
c. Just glanced through it
d. Did not read the report at all
e. DON'T KNOW
t.

P16. [ASK IF P15=a] On a scale of 1 to 5 where 1 is "not useful at all" and 5 is "extremely useful", please rate the usefulness of the recommendations contained in the report.

____________________- [RECORD RESPONSE 1-5]

DON'T KNOW
REFUSED

NAVIGANT

[If P15=a] P17. Thinking about all of the suggestions made by the auditor, what is your primary goal in implementing the recommendations? (RECORD ONE ANSWER)

a. REDUCE ENERGY COSTS
b. MAKE MY HOME MORE COMFORTABLE
c. TO IMPROVE THE MARKET VALUE OF MY HOME
d. TO MAKE GENERAL IMPROVEMENTS TO MY HOME
e. TO BENEFIT THE ENVIRONMENT
f. OTHER SPECIFY ______________________
g. DON'T KNOW
h. REFUSED

[IF STRATA = HVAC and SHELL} ASK P18, AND SUBSEQUENTLY P19 FOR ANY DEVICE (COLUMN S-AC)>0.
P18. On a scale of 1 to 5 where 1 is extremely dissatisfied and 5 is extremely satisfied, Please rate your satisfaction with the [Measure Name] purchased through the program

______________________- [RECORD RESPONSE 1-5]

[If P18≤2] P19. Why are you dissatisfied with the energy efficiency improvements? **[Record verbatim]**

Ask questions P20 through P23 if "Rebate Recipient" = "Homeowner"

P20. Did you receive your rebate for the energy efficiency improvements that you purchased through the program?

a. YES
b. NO
c. DON'T KNOW [SKIP TO P24]
d. REFUSED [SKIP TO P24]

P21. About how long did it take for you to receive the rebate? [Numeric Open-End] **[Record in days]**

P22. On a scale of 1 to 5, where 1 is "Not at All Satisfied", and 5 is "Extremely Satisfied" How satisfied were you with the rebate for the efficiency improvements?

______________________- [RECORD RESPONSE 1-5]

DON'T KNOW
REFUSED

P23. On a scale of 1 to 5, where 1 is "Not at All Satisfied", and 5 is "Extremely Satisfied" How satisfied were you with the amount of time it took to receive the rebate?

______________________- [RECORD RESPONSE 1-5]

DON'T KNOW
REFUSED

NAVIGANT

P24. Based on your participation in AEP Ohio's In-Home Energy Program, have you taken any additional actions to save energy in your home which were not part of the program or part of the retrofit rebates?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

P25. [If P24=a] What additional energy savings actions have you taken? **[Record verbatim]**

P26. Have you participated in any other AEP Ohio energy efficiency programs for your home?

a. YES
b. NO
c. DON'T KNOW
d. REFUSED

P27. [If P26=a] Which other programs have you participated in? **[Record verbatim]**

P28. [If P26=a] Did you participate in this/these programs before or after your participation in the In-Home Energy program?

a. BEFORE THIS ONE
b. AFTER THIS ONE
c. BOTH BEFORE AND AFTER [NOTE TO INTERVIEWER: COULD BE PARTICIPATION IN MULTIPLE PROGRAMS OR PARTICIPATION COULD HAVE TAKEN A LONGER TIME]
d. DON'T KNOW
e. REFUSED
u.

Demographics

D1. How many people live in your household year-round? ## [**NUMERIC OPEN END]**

a. DON'T KNOW
b. REFUSED

D4. Do you own or rent your home? **[DO NOT READ LIST. ENTER ONE RESPONSE.]**

a. Own
b. Rent
c. DON'T KNOW
d. REFUSED

D5. How many years have you lived in your current residence?

________________________years
DON'T KNOW
REFUSED

D6. **[DO NOT READ: INTERVIEWER RECORD ANY INFORMATION RESPONDENT VOLUNTEERS ABOUT THE PROGRAM THAT WAS NOT CAPTURED DURING THE INTERVIEW HERE]**

Closing

That's all the questions that we have. On behalf of AEP Ohio, I'd like to thank you very much for taking the time to participate in this study.

NAVIGANT

A.2 AEP Ohio In-Home Energy Program Online Energy Checkup Participant Survey

Hello, my name is __________ from the Blackstone Group, and I'm calling on behalf of AEP Ohio, your electric utility. I'm contacting AEP Ohio customers who recently completed an "Online Energy Checkup" through AEP Ohio's website to learn about their experience and satisfaction with the service. This is not a sales call, and all responses will be kept anonymous. May I please speak with [INSERT NAME] or someone in your household who completed the Online Energy Checkup?

READ IF ASKED:

- Depending on your responses, the survey will take about **15** minutes to complete.
- Please be assured that this is a survey and in no way a sales call.
- All of your responses will be kept completely confidential.

Screeners

S1. Can you confirm you are an AEP Ohio customer? [SINGLE PUNCH]

1. YES [SKIP TO S3]
2. NO
98. DON'T KNOW
99. REFUSED

S2. Are you a Columbus Southern Power or Ohio Power Company customer? [SINGLE PUNCH]

1. YES
2. NO [TERMINATE]
98. DON'T KNOW [TERMINATE]
100.REFUSED [TERMINATE]

S3. Our records indicate that you completed an Online Energy Checkup on AEP Ohio's website at some point in 2012 and, as part of your participation, AEP Ohio mailed you an energy efficiency kit including products like a low-flow showerhead and LED nightlight. Is that correct? [SINGLE PUNCH]

1. YES
2. NO [TERMINATE]
98. DON'T KNOW [TERMINATE]
100.REFUSED [TERMINATE]

S4. Do you recall completing the "Online Energy Checkup" interactive tool that helps you evaluate how you use energy in your home and where you can save money?

1. YES
2. NO [SKIP TO CFL1]
98. DON'T KNOW [SKIP TO CFL1]

NAVIGANT

99. REFUSED [SKIP TO CFL1]

Online Energy Checkup Information Retention and Satisfaction

OS1. On a scale from 0 to 10 where 0 is "not at all knowledgeable" and 10 is "extremely knowledgeable" how would you rate your knowledge of energy efficiency **before** you participated in the Online Energy Checkup?

(DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. NOT AT ALL KNOWLEDGEABLE
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY KNOWLEDGEABLE
98. DON'T KNOW
99. REFUSED

OS2. How much did you learn about energy efficiency from the Online Checkup? Would you say you learned…? (READ LIST) [SINGLE PUNCH]

1. Nothing
2. Very Little
3. Some, or
4. A lot
97. OTHER, SPECIFY [OPEN END]
98. DON'T KNOW
99. REFUSED

OS3. On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the Online Energy Checkup overall? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.

NAVIGANT

05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

[ASK OS4 IF OS3 <= 5. ELSE SKIP TO OS5.]
OS4. Why did you rate it that way? [OPEN END]

98. DON'T KNOW
99. REFUSED

OS5. From your perspective, what, if anything, could be done to improve the Online Energy Checkup program?

97. [OPEN END]
98. DON'T KNOW
99. REFUSED

OS6. On a scale of 1-5 with 1 being "strongly disagree" and 5 being "strongly agree," please indicate how much you agree or disagree with the following statements. [FORMAT AS GRID WITH 1 – STRONGLY DISAGREE TO 5 – STRONGLY AGREE, INCLUDE 98 DON'T KNOW AND 99 REFUSED ACROSS THE TOP. LIST A-G DOWN THE LEFT SIDE. RANDOMIZE A-G. SINGLE PUNCH FOR EACH RESPONSE.]

A. The information provided was easy to understand
B. The online checkup helped me learn about other sources of energy efficiency information and AEP Ohio energy efficiency programs
C. I learned something new from the online checkup
D. The online checkup provided information that I needed in order to take action to save energy and money in my home
E. The online checkup gave me a better understanding of where I can save energy and money in my home
F. The time needed to complete the online checkup was reasonable
G. The online checkup was easy to complete

OS7. On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the <u>energy savings kit</u>? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED

NAVIGANT

01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

[ASK OS8 IF OS9 <= 5. ELSE SKIP TO OS9.]

OS8. Why did you rate it that way? [OPEN END]

98. DON'T KNOW
99. REFUSED

OS9. Would you recommend the Online Energy Checkup to a friend? [SINGLE PUNCH]

1. YES
2. NO
88. DON'T KNOW
99. REFUSED

OS10. Based on your overall experience as an AEP Ohio customer, how would you rate the company? Please use the same 0 to 10 scale, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied"? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED

NAVIGANT

98. DON'T KNOW
99. REFUSED

Measure Verification

CFL BATTERY

CFL1) The energy savings kit included five Compact Fluorescent Light bulbs also known as CFLs. How many of the CFLs that you received in did you install in your home?

1. ONE
2. TWO
3. THREE
4. FOUR
5. FIVE
6. NONE [GO TO SKIP BEFORE CFL8]

88. DON'T KNOW [SKIP TO LED1]
99. REFUSED [SKIP TO LED1]

[ASK IF CFL1= 1 to 5 OTHERWISE SKIP TO CFL5]

CFL2) Of those [INSERT RESPONSE FROM CFL1] CFL bulbs that you actually installed, how many of those replaced: (READ 1-3, RECORD ONE NUMBER FOR EACH OPTION. CONTINUE UNTIL YOU REACH [INSERT RESPONSE FROM CFL1])

1. Incandescent bulbs [NUMERICAL OPEN END. RANGE 0 - 5]
2. CFL bulbs [NUMERICAL OPEN END. RANGE 0 - 5]
3. Halogen bulbs [NUMERICAL OPEN END. RANGE 0 - 5]
4. (IF STILL NOT AT [INSERT RESPONSE FROM CFL1], ASK: "Did the CFLs replace any other type of bulb?" SPECIFY TYPE OF BULB. [OPEN END]

98. DON'T KNOW
99. REFUSED

[ASK CFL3 IF CFL1=1, 2, 3, 4. ELSE SKIP TO CFL5]

CFL3) What was your reasoning for not installing the other CFLs? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. ALREADY HAVE CFLS INSTALLED
2. DO NOT LIKE THE LIGHT THAT THE CFLS GIVE OFF
3. THE CFL WAS BROKEN
4. THE CFL DID NOT WORK

97. OTHER (RECORD REASON) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

NAVIGANT

99. REFUSED [EXCLUSIVE]

CFL4) What did you do with the CFL(s) you did not install? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. STORED IT/THEM FOR FUTURE USE
2. STORED IT/THEM TO GIVE TO SOMEONE ELSE LATER
3. STORED IT/THEM TO DISPOSE OF LATER
4. RECYCLED IT/THEM
5. THREW IT/THEM AWAY IN THE GARBAGE
6. GAVE IT/THEM TO SOMEONE ELSE

77. OTHER (RECORD RESPONSE) [OPEN END]
88. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

CFL5. How many of the CFLs that you originally installed are still installed? [INSERT SELECTION FROM CFL1 AND ALL LESSER OPTIONS. FOR EXAMPLE, IF CFL1=2 THE RESPONSE OPTIONS SHOULD INCLUDE 1 AND 2.]

98. DON'T KNOW
99. REFUSED

[ASK CFL6 IF CFL5 < CFL1. ELSE GO TO SKIP BEFORE CFL7.]

CFL5) Why did you remove those CFLs? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. DID NOT LIKE THE LIGHT THE CFL GIVES OFF
2. THE CFL WAS BROKEN
3. THE CFL DID NOT WORK
4. THE CFL STOPPED WORKING ALREADY

97. OTHER (RECORD REASON) [OPEN END]
88. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

CFL6) What happened to those CFL(s) that are no longer installed? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. THROWN AWAY
2. IN STORAGE
3. SOLD OR GIVEN AWAY

97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

NAVIGANT

99. REFUSED [EXCLUSIVE]

[ASK CFL7 IF CFL1 = 1 OR 2 OR 3 OR 4 OR 6, ELSE SKIP TO CFL8.]

CFL7) Do you plan on installing the [IF CFL1=1 OR 2 OR 3 OR 4 INSERT "additional"] CFLs? [SINGLE PUNCH]

1. YES
2. NO [SKIP TO CFL9]
98. DON'T KNOW [SKIP TO CFL9]
99. REFUSED [SKIP TO CFL9]

CFL8) When do you plan on installing the [IF CFL1=1 OR 2 OR 3 INSERT "additional"] CFLs? Would you say…? (READ LIST. RECORD ONE RESPONSE.)[SINGLE PUNCH]

1. In the next month or two
2. In 3 to 6 months
3. In 7 to 12 months
4. More than a year from now, or
5. As current CFLs burn out
98. DON'T KNOW
99. REFUSED

CFL9) On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the CFLs? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

[IF STRATA = KITS (ALL), ELSE SKIP TO P1]

NAVIGANT

LED NIGHTLIGHT BATTERY

LED1. Did you install the LED nightlight you received in the energy kit? [SINGLE PUNCH]

1. YES
2. NO [SKIP TO LED5]
88. DON'T KNOW [SKIP TO SH1]
99. REFUSED [SKIP TO SH1]

LED2. Is the LED nightlight still installed? [SINGLE PUNCH]

1. YES [SKIP TO LED4]
2. NO
88. DON'T KNOW [SKIP TO SH1]
99. REFUSED [SKIP TO SH1]

LED3. What was your reasoning for removing the LED nightlight?

1. DO NOT LIKE THE TYPE OF LIGHT IT PROVIDES
2. I DECIDED I DID NOT NEED A NIGHTLIGHT WHERE I PUT IT
3. NOT SATISFIED WITH THE NIGHTLIGHT
97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW
99. REFUSED

[AFTER ASKING LED3 SKIP TO SH1]

1. LED4. Which of the following best describes how you used the LED nightlight that you installed? Did it…? (READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]Replace a regular incandescent nightlight,
2. Replace an older efficient nightlight, or
3. Get placed it in a location that didn't previously have a nightlight?
98. DON'T KNOW
99. REFUSED

[AFTER ASKING LED4 SKIP TO LED7]

LED5. What was your main reason for not installing the LED nightlight? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. WAITING FOR EXISTING NIGHTLIGHT TO BURN OUT
2. HAVEN'T GOTTEN AROUND TO IT YET
3. NOT SATISFIED WITH THE NIGHTLIGHT
4. DO NOT LIKE THE TYPE OF LIGHT IT PROVIDES
5. DO NOT HAVE THE NEED FOR ANOTHER NIGHTLIGHT

NAVIGANT

6. DO NOT HAVE A NEED FOR NIGHTLIGHTS
97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

LED6. Do you plan on installing the nightlight in the future? [SINGLE PUNCH]

- o. 1. YES
- p. 2. NO [SKIP TO SH1]
- q. 98. DON'T KNOW [SKIP TO SH1]
- r. 99. REFUSED [SKIP TO SH1]

LED6A. When do you plan on installing the nightlight? Would you say…? (READ LIST. RECORD ONE RESPONSE.)[SINGLE PUNCH]

1. Within the next month or two
2. In 3 to 6 months
3. In 7 to 12 months
4. More than a year from now
5. When the current nightlight burns out
6. I don't plan on installing the nightlight

98. DON'T KNOW
99. REFUSED

LED7. On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied", how satisfied were you with the nightlight?

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

SHOWERHEAD BATTERY

SH1. Did you receive a water-saving showerhead in your energy kit?

NAVIGANT

1. YES
2. NO [SKIP TO FA1]
98. DON'T KNOW [SKIP TO FA1]
99. REFUSED [SKIP TO FA1]

SH2. Did you install the showerhead you received in the energy kit?
1. YES
2. NO [SKIP TO SH5]
88. DON'T KNOW [SKIP TO FA1]
99. REFUSED [SKIP TO FA1]

SH3. Is the showerhead still installed?
1. YES [SKIP TO SH7]
2. NO
88. DON'T KNOW [SKIP TO FA1]
99. REFUSED [SKIP TO FA1]

SH4. Why did you remove the showerhead? (DO NOT READ. RECORD ALL THAT APPLY) [MULTIPUNCH]
1. DID NOT LIKE THE SPRAY
2. DID NOT LIKE THE WATER FLOW (PRESSURE) OF THE SHOWERHEAD
3. IT STOPPED WORKING
97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

[AFTER ASKING SH4 SKIP TO FA1]

SH5. What was your main reason for not installing the showerhead? (DO NOT READ. RECORD ALL THAT APPLY.) [MULTIPUNCH]
1. ALREADY HAVE AN EFFICIENT SHOWERHEAD INSTALLED
2. I LIKE MY CURRENT SHOWERHEAD THAT IS NOT ENERGY EFFICIENT
3. TOO DIFFICULT TO INSTALL
4. WORRIED ABOUT THE POSSIBLE REDUCED PRESSURE OF THE SHOWERHEAD
97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

SH6. Do you plan on installing the showerhead in the future? **[READ LIST]**
1. YES

NAVIGANT

2. NO [SKIP TO FA1]
98. DON'T KNOW [SKIP TO FA1]
99. REFUSED [SKIP TO FA1]

SH7. When do you plan on installing the showerhead? Would you say…? (READ LIST. RECORD ONE RESPONSE.)[SINGLE PUNCH]
1. In the next month or two
2. In 3 to 6 months
3. In 7 to12 months
4. More than a year from now, or
5. As current showerhead stops working
98. DON'T KNOW
99. REFUSED

SH8. On a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied," how satisfied were you with the showerhead? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]
00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

FAUCET AERATORS BATTERY

FA1. Did you install both kitchen and bathroom faucet aerators you received in the energy kit? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

1. YES, INSTALLED BOTH
2. NO, JUST INSTALLED THE KITCHEN AERATOR
3. NO, JUST INSTALLED THE BATHROOM AERATOR [GO TO SKIP BEFORE FA2A]
4. NO, DID NOT INSTALL EITHER [GO TO SKIP BEFORE FA3]

NAVIGANT

98. DON'T KNOW [SKIP TO PI1]
99. REFUSED [SKIP TO PI1]

FA2. Is the kitchen faucet aerator still installed? [SINGLE PUNCH]

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK FA2A IF FA1=1 OR 3. ELSE GO TO SKIP BEFORE FA2B]

FA2A. Is the bathroom faucet aerator still installed? [SINGLE PUNCH]

1. YES
2. NO
98. DON'T KNOW
99. REFUSED

[ASK FA2B IF FA2=2 OR FA2A=2. ELSE GO TO SKIP BEFORE FA3]

FA2B. What was your reasoning for removing the faucet aerator(s)? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. I ALREADY HAVE A FAUCET AERATOR
2. DO NOT LIKE THE PRESSURE OF THE FAUCET AERATOR
97. OTHER (RECORD REASON) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

[ASK FA3 IF FA1 = 2 OR 3 OR 4. ELSE SKIP TO LED1.]

FA3. What was your main reason for not installing [IF FA1= 2 OR 3 INSERT "both". IF FA1=4 INSERT "either"] of the faucet aerator(s)? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. ALREADY HAVE (AN) EFFICIENT FAUCET AERATOR(S) INSTALLED
2. DO NOT LIKE THE PRESSURE OF THE FAUCET AERATOR
3. TOO DIFFICULT TO INSTALL
97. OTHER (RECORD REASON) [OPEN END]

NAVIGANT

98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

FA4. Do you plan on installing the faucet aerator(s) in the future? [SINGLE PUNCH]

1. YES
2. NO [SKIP TO LED1]
98. DON'T KNOW [SKIP TO LED1]
99. REFUSED [SKIP TO LED1]

FA4A. When do you plan on installing the faucet aerator(s)? Would you say…? (READ LIST. RECORD ONE RESPONSE.)[SINGLE PUNCH]

1. Within the next month or two
2. In 3 to 6 months
3. In 7 to 12 months
4. More than a year from now, or
5. As current faucet aerator stops working
98. DON'T KNOW

REFUSED

FA5. On a scale of 0 to 10, where 0 means you "extremely dissatisfied" and 10 means you "extremely satisfied", please tell me how satisfied were you with the faucet aerators?(DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

WATER HEATER PIPE INSULATION BATTERY

NAVIGANT

PI1. Did you install the hot water heater pipe insulation you received in the energy kit? [SINGLE PUNCH]

1. YES [SKIP TO PI4]
2. NO

88. DON'T KNOW [SKIP TO P1]
99. REFUSED [SKIP TO P1]

PI2. Why didn't you install the pipe insulation? [OPENEND]

PI3. What did you do with the pipe insulation you did not install? (DO NOT READ. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. GAVE IT TO SOMEONE ELSE
2. RECYCLED IT
3. STORED IT FOR FUTURE USE
4. STORED IT TO GIVE TO SOMEONE ELSE LATER
5. STORED IT TO DISPOSE OF LATER
6. THREW IT AWAY IN THE GARBAGE

97. OTHER (RECORD RESPONSE)[OPEN END]
98. DON'T KNO [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

[AFTER ASKING PI3 SKIP TO PI7]

PI4. Is the pipe insulation still installed?

1. YES [SKIP TO PI7]
2. NO

98. DON'T KNOW [SKIP TO PI7]
99. REFUSED [SKIP TO PI7]

PI5. Why did you remove the pipe insulation? [OPEN END]

PI6. What did you do with the pipe insulation that you removed? (DO NOT READ. RECORD ALL THAT APPLY.) [MULTIPUNCH]

1. THROWN AWAY
2. IN STORAGE
3. SOLD OR GIVEN AWAY

97. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW [EXCLUSIVE]

NAVIGANT

99. REFUSED [EXCLUSIVE]

PI7. On a scale of 0 to 10, where 0 means you "extremely dissatisfied" and 10 means you "extremely satisfied", please tell me how satisfied were you with the pipe insulation?
(DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. EXTREMELY DISSATISFIED
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY SATISFIED
98. DON'T KNOW
99. REFUSED

PI8. Do you have an electric or gas water heater? [DO NOT READ. RECORD ONE RESPONSE.) [SINGLE PUNCH]

1. ELECTRIC WATER HEATER
2. GAS WATER HEATER
3. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW
99. REFUSED

Process Questions

P1. How did you find out about the Online Energy Checkup? (DO NOT READ LIST. RECORD ALL THAT APPLY.) [MULTIPUNCH]

a. BILL INSERT
b. COMMUNITY EVENT/COUNTY/STATE FAIR
c. CONTRACTOR (SUCH AS A PLUMBER, ELECTRICIAN, OR GENERAL CONTRACTOR)
d. EMAIL
e. FAMILY/FRIEND
f. RESPONDENT WORKS IN THE INDUSTRY
g. UTILITY COMPANY (GENERAL)
h. WEBSITE

NAVIGANT

i. YARD SIGNS
j. SOME OTHER WAY (RECORD RESPONSE.) [OPEN END]
88. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

[IF P1 HAS MORE THAN ONE ANSWER, ASK P2, OTHERWISE AUTO-FILL.]

P2. Which of these sources of information was most influential in your decision to participate in the program? (PROMPT IF NECESSARY. RECORD ONE RESPONSE.) [SHOW ANSWERS GIVEN IN P1. SINGLE PUNCH.]

P3. How would you recommend AEP Ohio reach out to customers in the future to get them to participate in this program? (DO NOT READ. RECORD ALL THAT APPLY.) [MULTIPUNCH]

a. BILL INSERTS
b. FLYERS/ADS/MAILINGS
c. HOMEOWNERS ASSOCIATION
d. NEWSPAPER ADVERTISEMENTS
e. RADIO ADVERTISEMENTS
f. TELEVISION ADVERTISEMENTS
g. WITH PHONE CALLS
h. OTHER (RECORD RESPONSE) [OPEN END]
98. DON'T KNOW
99. REFUSED

P4. On a scale of 1 to 10, where 0 is extremely dissatisfied and 10 is extremely satisfied, how would you rate your satisfaction with… (READ LIST. RECORD ONE RESPONSE FOR EACH. REPEAT SCALE AS NECESSARY.) [FORMAT AS GRID WITH 0 EXTREMELY DISSATISFIED TO 10 EXTREMELY SATISFIED INCLUDE 98 DON'T KNOW AND 99 REFUSED ACROSS THE TOP. SHOW A-I DOWN LEFT SIDE. RANDOMIZE A-I.]

a. The customized energy report you received with recommended ways to save energy
b. The CFL bulbs you received in the kit
c. [IF STRATA = KITS (ALL)] The faucet aerators you received in the kit
d. [IF STRATA = KITS (ALL)] The low flow showerhead you received in the kit
e. [IF STRATA = KITS (ALL)] The hot water tank pipe wrap you received in the kit
f. [IF STRATA = KITS (ALL)] The LED nightlight you received in the kit
g. The length of time it took to complete the online checkup
h. The information you received about eligible rebates for recommended energy efficiency improvements
i. AEP Ohio overall

NAVIGANT

[ASK P5 IF ANY P4A-P4I IS $\leq$ 4. ELSE SKIP TO P6]
P5. You mentioned you were not satisfied with some aspect of the program. Why did you give this rating? [OPEN END]

98. DON'T KNOW
99. REFUSED

P6. What do you see as the main benefits to participating in the *program*? (DO NOT READ. RECORD ALL THAT APPLY, UP TO 3.) [MULTIPUNCH. MAX 3]

1. HAVING A LOWER ENERGY BILL
2. SAVING ENERGY
3. RECEIVING THE ENERGY EFFICIENCY EQUIPMENT
4. RECEIVING THE ENERGY SURVEY RECOMMENDATIONS
5. RECEIVING REBATES ON RETROFIT MEASURES
6. OTHER (RECORD RESPONSE) [OPEN END]
7. DON'T KNOW [EXCLUSIVE]
8. REFUSED [EXCLUSIVE]

P7. Have you noticed a reduction in the amount of your electric bill since participating in the program? [SINGLE PUNCH]

a. YES
b. NO
98. DON'T KNOW
99. REFUSED

P8. Would you say participating in this program has made you feel more favorable, less favorable, or no different about AEP Ohio? [SINGLE PUNCH]

f. MORE FAVORABLE ABOUT AEP OHIO
g. NO DIFFERENT ABOUT AEP OHIO
h. LESS FAVORABLE ABOUT AEP OHIO
88. (Don't know)
99. (Refused)

P9. Have you recommended the AEP Ohio Online Energy Checkup to others since participating? [SINGLE PUNCH]

a. YES
b. NO
98. DON'T KNOW
99. REFUSED

NAVIGANT

P10. On a scale of 0 to 10, where 0 is "Not at All Likely", and 10 is "Extremely Likely", how likely are you to recommend this program to others in the future?
(DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

00. NOT AT ALL LIKELY
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY LIKELY
98. DON'T KNOW
99. REFUSED

[ASK P11 IF P10 ≤ 4 ELSE SKIP TO P12.]
P11. Why might you not recommend the program to others? (DO NOT READ. RECORD ALL THAT APPLY.) [MULTIPUNCH]

a. ENERGY SAVINGS WERE NOT HIGH ENOUGH
b. ENERGY BILL SAVINGS WEREN'T HIGH ENOUGH
c. TOO MUCH OF A HASSLE/TOO MUCH RED TAPE
d. IT TOOK TOO LONG TO RECEIVE THE ENERGY KIT
e. THE RECOMMENDATIONS WERE NOT HELPFUL
f. RESPONSE WAS NEUTRAL/NOT NEGATIVE
g. OTHER [SPECIFY]
98. DON'T KNOW
99. REFUSED

P15. Now I would like you to focus on the Report you received after the online checkup. After receiving the report that contained recommendations for ways to reduce your energy consumption and your utility bill, would you say that you…? (READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

a. Read the report thoroughly
b. Read some portions of the report
c. Just glanced through it, or
d. Did not read the report at all
98. DON'T KNOW
99. REFUSED

NAVIGANT

j.

P16. [ASK P16 IF P15=1. ELSE SKIP TO P18] On a scale of 0 to 10 where 0 is "not useful at all" and 10 is "extremely useful", please rate the usefulness of the recommendations contained in the report.

00. NOT USEFUL AT ALL
01.
02.
03.
04.
05.
06.
07.
08.
09.
10. EXTREMELY USEFUL
98. DON'T KNOW
99. REFUSED

P17. Thinking about all of the recommendations in the report, what is your primary goal in implementing the recommendations? (DO NOT READ LIST. RECORD ONE RESPONSE.) [MULTIPUNCH]

a. REDUCE ENERGY COSTS
b. MAKE MY HOME MORE COMFORTABLE
c. TO MAKE GENERAL IMPROVEMENTS TO MY HOME
d. TO BENEFIT THE ENVIRONMENT

97. OTHER (RECORD RESPONSE) [OPEN END] ______________________
98. DON'T KNOW [EXCLUSIVE]
99. REFUSED [EXCLUSIVE]

P18. Have you participated in any <u>other</u> AEP Ohio energy efficiency programs for your home? [SINGLE PUNCH]

a. YES
b. NO

98. DON'T KNOW
99. REFUSED

P19. [ASK P19 IF P18=1. ELSE SKIP TO D1] Which other programs have you participated in? [OPENEND]

NAVIGANT

P20. Did you participate in this/these programs before or after you completed the Online Energy Checkup? [SINGLE PUNCH]

a. BEFORE THIS ONE
b. AFTER THIS ONE
c. BOTH BEFORE AND AFTER (NOTE TO INTERVIEWER: COULD BE PARTICIPATION IN MULTIPLE PROGRAMS OR PARTICIPATION COULD HAVE TAKEN A LONGER TIME)

98. DON'T KNOW
99. REFUSED

k.

Demographics

D1. How many people live in your household year-round? **[NUMERIC OPEN END. RANGE 1-10]**

98. DON'T KNOW
99. REFUSED

D4. Do you own or rent your home? (DO NOT READ LIST. RECORD ONE RESPONSE.) [SINGLE PUNCH]

a. OWN
b. RENT

98. DON'T KNOW
99. REFUSED

D5. How many years have you lived in your current residence? (RECORD IN YEARS) [NUMERICAL OPEN END. RANGE 000-100]

D6. [OPEN END] **(**DO NOT READ: INTERVIEWER RECORD ANY INFORMATION RESPONDENT VOLUNTEERS ABOUT THE PROGRAM THAT WAS NOT CAPTURED DURING THE INTERVIEW HERE**)**

END. That's all the questions that we have. On behalf of AEP Ohio, I'd like to thank you very much for taking the time to participate in this study.