Energy Efficient Products Program Evaluation, Measurement, and Verification Report 2014

Prepared for FirstEnergy Ohio Companies:

Ohio Edison Company
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The Toledo Edison Company

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1. Executive Summary

During 2014, the Ohio operating companies The Cleveland Electric Illuminating Company ("CEI"), Ohio Edison Company ("OE"), and The Toledo Edison Company ("TE") (collectively "Companies") continued to offer the Energy Efficient Products ("EEP") Program. Through this program, rebates are provided to residential customers to encourage the purchase and installation of energy efficient appliances, heating, ventilation and air conditioning (HVAC) services and equipment. In addition there is an upstream portion of the program where manufacturers are paid to reduce the price of energy efficient lighting and a mid-stream portion where retailers are incented to encourage the sale of energy efficient consumer electronics products. In 2014, the consumer electronics portion of the program expanded to include televisions, desktop computers, and monitors in addition to the previous year's single offering of controlled surge protectors (smart strips). The program was administered by Honeywell, which worked with lighting manufacturers, retailers and HVAC contractors to implement the program.

Table 1-1 shows participation by measure category for each of the companies. For the Appliances and HVAC subprograms, the count shown is unique project numbers. For the Consumer Electronics subprogram, the count shown is the number of products rebated. For the Lighting subprogram, the count shown is individual bulbs or fixtures distributed.

Table 1-1. Participants by Subprogram for 2014 EE Products Program

Measure Type	*CEI*	*OE*	*TE*	*Total*
Appliances	6,375	9,769	2,154	18,298
HVAC	1,121	1,473	438	3,032
Consumer Electronics	19,887	16,168	6,800	42,855
Lighting (total bulbs/fixtures)	599,678	1,127,507	291,034	2,018,219

Estimates of the gross energy savings (kWh) and peak demand reductions (kW) for the program in the three service territories are reported in Table 1-2.

Table 1-2. Impact Evaluation Results for 2014 EE Products Program

Utility	*Ex Ante Expected Savings*		*Ex Post Verified Total Savings*		*Realization Rates*	
	kWh	*kW*	*kWh*	*kW*	*kWh*	*kW*
CEI	35,609,404	4,571	36,193,507	4,929	102%	108%
OE	64,600,134	7,733	65,838,619	8,583	102%	111%
TE	16,550,073	2,036	16,753,918	2,209	101%	109%
Total	116,759,611	14,340	118,786,045	15,721	102%	110%

The results in Table 1-2 show a realization rate for kWh savings of approximately 102%, as determined by the ratio of verified total kWh savings to expected kWh savings. The realization rate for kW reductions was approximately 110%. The realization rates are slightly greater than 100% because of use of blended *ex ante* values in the HVAC subprogram and LED portion of the lighting subprogram, the difference in the date field chosen determine PA TRM[1] version savings for the consumer electronics subprogram, and a conservative ex ante assumption of dehumidifier capacity in the appliance subprogram.

The *ex ante* and *ex post* kWh savings and realization rates for each measure category are presented in Table 1-3.

Table 1-3. Overall Evaluation Results by Measure Type

Measure Type	*Ex Ante Expected Savings*		*Ex Post Verified Savings*		*kWh RR*	*kW RR*
	kWh	*kW*	*Total kWh*	*Total kW*		
Appliances	10,352,477	1,736	10,412,518	1,767	101%	102%
HVAC	2,861,751	1,229	3,725,273	1,181	130%	96%
Consumer Electronics	5,947,081	909	7,753,022	1,185	130%	130%
Lighting	97,598,302	10,467	96,895,231	11,589	99%	111%
Total	116,759,611	14,340	118,786,045	15,721	102%	110%

Key findings from the process evaluation of the 2014 Energy Efficient Products program include:

- **Overall program satisfaction was high.** HVAC contractors were asked to rate how satisfied they were overall with the program using a scale from one (very dissatisfied) to five (very satisfied). Nine out of ten HVAC contractors provided a four or five rating and the average rating was 4.9 on the five-point scale. Similarly, retail partners rated the program highly, with 15 out of 19 interviewees giving a rating of either 4 or 5.

[1] Pennsylvania Public Utility Commission, *Technical Reference Manual,* June 2013

- **Retailers believe that incentives lead customers to consider energy efficiency more closely.** Retail interviewees noted that the prospect of a monetary incentive spurred their customers to think more closely about the benefits associated with efficient products, which in turn led to more sales of these products. Several retailers also noted that the simplicity of the program was among its strengths, and that understanding the structure of the program was not a barrier to participation for customers.

2. Introduction and Purpose of Study

Under contract with the Companies, ADM performed evaluation, measurement, and verification (EM&V) services to determine and verify the savings being realized through the EEP Program during 2014. The evaluation of the program included both impact and process evaluations. ADM conducted the impact evaluation, and NMR Group conducted the process evaluation (under subcontract with ADM). This document is the final report on the EM&V for the program. The choice of procedures that was used to perform the EM&V activities has been formed by the State of Ohio Energy Efficiency Technical Reference Manual[2] ("TRM") and ADM's experience in evaluating the prior Program years. In addition, the procedures chosen build on information collected from ongoing discussions with the Companies' staff.

The impact evaluation component of this report estimates annual gross energy savings and peak demand reduction as framed by the following four research questions:

- How many products and services were sold?
- What is the average annual kWh savings per incentivized product or service?
- What is the average kW reduction per incentivized product or service?
- What fraction of incentivized products or services did not meet program standards?

The goal of the process evaluation component was to determine how effective the program is in terms of customer satisfaction, customer awareness, and stakeholder interaction. The process evaluation was framed by the following research questions.

Retailers and Contractors

- How satisfied they with the program in general?
- Do they think that there was enough effective signage and financial incentives to encourage customers to participate in the program?
- Do they feel that there was enough programmatic support?
- Do they have any recommendations for improvements in the design and/or delivery of the program?

Program Managers and Implementers

- How satisfied are they with the program in general?
- How satisfied are they with the managers monitoring the program?

[2] Vermont Energy Investment Corporation (VEIC), *State of Ohio Energy Efficiency Technical Reference Manual,* Prepared for Public Utilities Commission of Ohio, August 6, 2010.

- How satisfied are they with the implementers administering the program?
- Do they think that there was enough effective signage and financial incentives to encourage customers to participate in the program?
- Do they feel that there was enough programmatic support?
- Do they have any recommendations for improvements in the design and/or delivery of the program?
- Were previous issues and/or concerns resolved in 2014? Were there any lessons learned in resolving previous issues?

Industry Experts

- What is the current state of the market for each type of program?
- What is the future of the market for each type of program?
- Have they had any lessons learned from programs in different parts of the country?
- Are there other hurdles and barriers that other programs have experienced?
- What are the strengths and weaknesses of other programs?

3. Description of Program

The Companies began to offer the EEP Program to residential customers in 2011. In 2014, the program offered rebates, product markdowns and incentives through partnerships with lighting, electronics, and appliance retailers and HVAC contractors throughout the Companies' service area.

The EEP Program was designed to provide customer rebates for energy-efficient appliances, HVAC and water heater equipment, and HVAC system tune-ups. Additionally, the program provides incentives to manufactures in order to lower the retail price of lighting and to retailers to promote energy efficient consumer electronics products. Honeywell implements the program on behalf of the Companies.

The EEP Program issued rebates to customers purchasing energy efficient products and services. Appliance rebate customers filled out a paper or online rebate form and sent it to Honeywell, the program's implementation contractor, in exchange for the rebate. HVAC rebate customers worked with their contractor to fill out a paper rebate form, and then mailed the form to Honeywell. The consumer electronics and lighting subprograms were designed using a retailer upstream structure, wherein retailers were compensated in exchange for marking down the prices of qualified products on the shelves.

The program covered the following 19 product categories, split into four subprograms:

Appliances

- ENERGY STAR® clothes washers
- ENERGY STAR® dehumidifiers
- ENERGY STAR® refrigerators and freezers

HVAC & Water Heating

- ENERGY STAR® whole house fans
- Air source heat pumps with SEER ≥ 15
- Central air conditioners with SEER ≥ 15
- ENERGY STAR® ground source heat pumps
- ENERGY STAR® ductless mini-split air conditioners and heat pumps
- ENERGY STAR® heat pump water heaters
- Electric resistance water heaters with EF ≥ 0.93
- Residential HVAC tune-ups

- ENERGY STAR® room air conditioners

Consumer Electronics

- Smart power strips
- ENERGY STAR® televisions
- ENERGY STAR® desktop computers
- ENERGY STAR® computer monitors

Lighting

- CFL bulbs
- LED bulbs
- Ceiling fans with ENERGY STAR® CFL light fixtures
- Torchiere floor lamps

During 2014, there were 161 retailers who participated in the EEP Program. Of these retailers 142 participated in the appliance subprogram and 17 participated through the lighting subprogram and 2 participated through the consumer electronics subprogram. There were 304 HVAC contractors who participated in the program during 2014. The retail and HVAC partners were distributed throughout the Companies' service territory.

4. Methodology

The evaluation of the 2014 Energy Efficient Products Program consisted of both an impact evaluation and a process evaluation. The impact evaluation methodology is described in sections 4.1 through 4.4, and the process evaluation methodology is described in section 4.2 of this chapter.

4.1 Impact Evaluation Methodology

The impact evaluation objectives for each sub program are described below.

Appliances

- Quantify the number of:
  - Customers who applied for ENERGY STAR® rebates
  - ENERGY STAR® Rebates provided
  - Participating ENERGY STAR® retailers
  - Participating ENERGY STAR® contractors
- Calculate the energy savings (kWh)
- Calculate the peak demand savings (kW)

HVAC & Water Heating

- Quantify the number of:
  - Customers who applied for rebates
  - Rebates provided
  - Participating retailers
  - Participating contractors
- Calculate the energy savings (kWh)
- Calculate the peak demand savings (kW)

Consumer Electronics

- Quantify the number of:
  - Customers who purchased consumer electronics
  - Distributed consumer electronics
  - Consumer electronics transactions
  - Participating retailers

- Calculate the energy savings (kWh)
- Calculate the peak demand savings (kW)

Lighting

- Quantify the number of:
  - Customers who purchased lighting products
  - Distributed lighting products
  - Lighting product transactions
  - Participating retailers
- Calculate the energy savings (kWh)
- Calculate the peak demand savings (kW)

4.1.1 Verification of Measures Rebated

ADM's impact analysis was based on data files provided by Honeywell and the Companies' database. The files provided by the Companies database contained model numbers, efficiency ratings, unit specifications, and claimed kW and kWh savings for all sub programs. Data provided by Honeywell includes manufacturer invoices and retailer sales data for the consumer electronics and lighting subprograms.

ADM reviewed a census of invoices and sales data for the lighting and consumer electronics sub programs in 2014. ADMs review showed that all quantities and dates from the invoices were 100% accurate. ADM also reviewed a census of model numbers to endure that all products met program criteria

4.1.2 Ex-Ante Review

ADM conducted an *ex ante* review of the Program's final 2014 database. In this review, ADM carried out the necessary data cleaning and data editing steps in preparing the data for analysis, including:

- Verification of rebate status as completed
- Verification of measure rebate requirements (e.g., ENERGY STAR® qualified status and high efficiency level) for completed rebates for applicable measures in the appliance and consumer electronics portions.
- Elimination of duplicate data entries
- Elimination of cases with incomplete data (e.g., no model number provided)

Measures verified as passing ADM's rebate screening process were analyzed further for energy and demand savings using the procedures described below. ADM requested some additional information that was provided by Honeywell, such as invoices and tracking databases. After a thorough review of the documentation provided, ADM verified all measures as passing the above requirements.

The tables below presents the *ex ante* savings per measure:

Table 4-1. Ex Ante Estimates of per unit Annual kWh & kW Savings for Qualified Energy Efficient Products by Type of Measure

Measure	*kWh*	*kW*	*Source*
Energy Efficiency Measures: Appliances			
Dehumidifiers (>25 to 35)	120	0.03	
Dehumidifiers (>35 to 45)	149	0.03	TRM
Dehumidifiers (>45 to 54)	266	0.06	TRM
Dehumidifiers (>54 to 75)	249	0.06	TRM
Freezers	1,131	0.18	TRM Refrigerator Savings modified for Freezers
Refrigerators, bottom freezer	1,219	0.21	TRM
Refrigerators, side by side	1,132	0.20	TRM
Refrigerators, top freezer	1,299	0.23	TRM
Clothes Washers	202	0.02	TRM
Energy Efficiency Measures: HVAC			
Air Source Heat Pumps	1,645	0.58	Blended Value Based on TRM
Central Air Conditioning	595	0.59	Blended Value Based on TRM
Ductless Mini Split Air Conditioner	307	0.25	Blended Value Based on TRM
Ductless Mini Split Heat Pump	1,305	0.37	Blended Value Based on TRM
Electric Water Heater	47	0.04	TRM Algorithm Modified for Electric Savings
Ground Source Heat Pumps	4,047	0.80	Blended Value Based on TRM
Heat Pump Water Heater	1,297	0.18	TRM
HVAC Tune Ups*	162	0.04	TRM
Room Air Conditioners*	86.9	0.11	Blended Value Based on TRM
Energy Efficiency Measures: Consumer Electronics			
Desktops*	122	0.017	Pennsylvania TRM
Monitors*	15	0.002	Pennsylvania TRM
Smart Strips	57	0.006	TRM
Television <40*	54	0.008	Pennsylvania TRM
Television >40*	188	0.029	Pennsylvania TRM
Energy Efficiency Measures: Lighting			
CFLs	52.85	0.01	TRM
LEDs	48.03	0.01	Mid Atlantic TRM
Ceiling Fans	192.00	0.02	TRM
* Starred measures show the average claimed savings per unit. The savings for these measures differ based several variables.			

4.2 Sampling Strategy

ADM completed a census review of all measures listed in the tracking system to ensure appropriate use of deemed savings values, and a census review of all retailer invoices associated with upstream buy-downs (LEDs, CFLs, Televisions, Computers, Monitors, Smart Strips).

4.3 Calculating Gross Annual kWh and kW Savings

Engineering and Deemed savings calculations were performed for a census of program measures. Detailed methodology descriptions are outlined for each subprogram in the sections below.

Senate Bill 310 (SB 310), passed in 2014, states that the following is countable toward compliance requirements:

> Energy efficiency savings and peak demand reduction achieved on and after the effective date of S.B. 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method.

The incremental savings resulting from using the existing equipment as the baseline were calculated for the 2014 program year. The existing equipment baselines were taken from the Ohio TRM. Some measure baselines have been adjusted as applicable based on the savings provisions of Ohio Senate Bill 310 and are reflected in the sections below.

4.3.1 Analysis of Savings for Appliance Measures

A "deem and count" approach was used to analyze the energy savings and demand reductions for the following ENERGY STAR®-rated measures:

- Dehumidifiers
- Refrigerators
- Freezers
- Clothes Washers

ENERGY STAR® Dehumidifiers

Annual kWh savings per unit and average peak kW savings per unit are deemed based on the unit's capacity range in pints per day. Capacity was determined for each ENERGY STAR® qualified dehumidifier based on the model listed in the Honeywell appliance database. Table 4-2 lists the deemed savings values specified in the TRM (p. 64), and updated by ADM to account for changes made to the ENERGY STAR® assumptions of use, for the purchase of an ENERGY STAR® Dehumidifiers.

Table 4-2. Deemed Savings Values for ENERGY STAR® Dehumidifiers

Capacity Range (pints per day)	*Annual kWh Savings per unit*	*Demand kW Reductions per unit*
<25	130	0.03
>25 to 35	120	0.03
>35 to 45	149	0.03
>45 to 54	266	0.06
>54 to 75	249	0.06
>75 to 185	179	0.04

ENERGY STAR® Refrigerators

Annual kWh savings and kW demand reduction are deemed based on the refrigerator door configuration, which is recorded in the Honeywell appliance database. Table 4-3 shows the deemed savings values for ENERGY STAR® qualified refrigerators specified in the TRM (p. 53) with applicable baseline included for the purchase of ENERGY STAR® Refrigerators.

Table 4-3. Deemed Savings Values for ENERGY STAR® Refrigerators

Refrigerator Configuration	*Total Annual kWh Savings per Unit*	*Base Peak kW Reductions per Unit*
Bottom Freezer	1,219	0.21
Top Freezer	1,299	0.23
Side by Side	1,132	0.20

ENERGY STAR® Clothes Washers

ADM verified that the rebated clothes washers were ENERGY STAR® qualified ADM used the deemed calculations for kWh and kW demand reduction cited in the TRM for ENERGY STAR® qualified clothes washers. The listed savings values for ENERGY STAR® clothes washer are 202 kWh per unit and 0.021 kW per unit.

4.3.2 Analysis of Savings for HVAC Measures

The impact methods used to analyze the HVAC measures utilize the formulas specified in the TRM to calculate energy and demand savings. Estimates of savings were calculated for the following HVAC measures that were rebated through the EEP Program in 2014.

- Residential HVAC Maintenance/Tune Up
- Central air conditioning (CAC)
- Air Source Heat Pump (ASHP)

- Ground Source Heat Pump (GSHP)
- Ductless Mini Split Air Conditioner
- Ductless Mini Split Heat Pump
- Electric Water Heater
- Heat Pump Water Heater
- Room Air Conditioners

For each HVAC measure, total kWh savings and total peak demand savings for that measure are determined as a product of the number of measures verified as qualifying for a rebate under the EEP Program and the savings per measure. The methods used to verify rebate qualifications and the per-unit kWh and peak demand savings for the HVAC measures are described in this section.

Residential HVAC Maintenance/Tune Ups

ADM performed an engineering desk review of available data to determine if the savings claims for tune-ups were rational. It was determined that the savings claimed for tune-ups was reasonable and conservative.

Central Air Conditioning

The TRM algorithms for estimating annual energy and demand savings from the purchase of a new central air conditioning ducted split system meeting ENERGY STAR® efficiency standards were used for calculating energy and demand savings in the 2014 evaluation. As specified in the TRM, the formula for calculating annual energy savings for a new ENERGY STAR® central air conditioning system is:

$$kWh\ Savings = (FLH_{cool} * BtuH * (1/SEER_{base} – 1/SEER_{ee}))/1000$$

where:

FLH_{cool}	=	Full load cooling hours, which depend on location
BtuH	=	Size of the replaced AC unit in tons (1 ton = 12,000 BtuH) $SEER_{base}$
	=	SEER efficiency of the baseline AC unit = 10[3]
$SEER_{ee}$	=	SEER efficiency rating of the ENERGY STAR® AC unit installed

The formula for calculating demand savings for the purchase of a central air conditioning unit meeting ENERGY STAR® standards is specified as follows in the TRM:

[3] Ohio TRM Early Replacement Assumption

$$\text{kW Savings} = (\text{BtuH} * (1/\text{EER}_{base} - 1/\text{EER}_{ee}))/1000 * \text{CF}$$

where:

BtuH	=	Size of the new AC unit in tons (1 ton = 12,000 BtuH)
EER_{base}	=	EER efficiency rating of the baseline AC unit = 9[4]
EER_{ee}	=	EER efficiency rating of the ENERGY STAR® AC unit installed
CF	=	Peak Coincidence Factor for a CAC measure = 0.5 (TRM specified)

Full load cooling hours were determined from the customer's zip code. The values for other variables in the equation (e.g., BtuH, SEER, and EER) were determined for a given central air conditioning system model by looking up the values for a given model number in the AHRI database.

Air Source Heat Pump

In the evaluation of the 2014 EEP Program, the annual energy and demand savings from the purchase of a new air source heat pump were calculated using the TRM algorithms. As specified in the TRM, the formula for calculating annual energy savings for a new air source heat pump meeting minimum ENERGY STAR® efficiency level standards is:

$$\text{kWh Savings}_{\text{AS Heat Pump}} = ((\text{FLH}_{cool} * \text{BtuH} * (1/\text{SEER}_{base} - 1/\text{SEER}_{ee}))/1000 + (\text{FLH}_{heat} * \text{BtuH} * (1/\text{HSPF}_{base} - 1/\text{HSPF}_{ee}))/1000$$

where:

FLH_{cool}	=	Full load cooling hours, which depend on location
FLH_{heat}	=	Full load heating hours, which depend on location
BtuH	=	Size of the HVAC equipment in tons (1 ton = 12,000 BtuH)
SEER_{base}	=	SEER efficiency rating of the baseline unit = 10[5]
SEER_{ee}	=	SEER efficiency rating of the new ASHP installed
HSPF_{base}	=	Heating Season Performance Factor for baseline unit = 7.7[6]
HSPF_{ee}	=	Heating Season Performance Factor for efficient unit installed

The formula for calculating demand savings for the purchase of a new air source heat pump meeting ENERGY STAR® standards is specified as follows in the TRM:

$$\text{kW Savings} = \text{BtuH} * (1/\text{EER}_{base} - 1/\text{EER}_{ee}))/1000 * \text{CF}$$

[4] Ohio TRM Early Replacement Assumption

[5] Ohio TRM Early Replacement Assumption

[6] Minimum Federal Standard

where:

BtuH	=	Size of the new ASHP unit in tons (1 ton = 12,000 BtuH)
EER_{base}	=	EER efficiency rating of the baseline ASHP unit = 9[7]
EER_{ee}	=	EER efficiency rating of the ENERGY STAR® ASHP unit installed
CF	=	Peak Coincidence Factor for measure (TRM specifies CF = 0.5)

Full load cooling and heating hours were determined from the customer's zip code. The values for other variables in the equation (e.g., BtuH, SEER, EER, and HSPF) were determined for a given air source heat pump model by looking up the model number in the AHRI database.

Ground Source Heat Pump

The TRM algorithms for estimating annual energy and demand savings from the purchase of a new ground source heat pump were used for calculating energy and demand savings in the evaluation of the 2014 EEP Program. As specified in the TRM, the formula for calculating annual energy savings for a ground source heat pump meeting ENERGY STAR® efficiency level standards is:

$$\text{kWh Savings GS Heat Pump} = ((FLH_{cool} * BtuH * (1/SEER_{base} – 1/EER_{ee} * 1.02))/1000 + (FLHheat * BtuH * (1/HSPF_{base} – 1/COP_{ee} * 3.412))/1000$$

where:

FLH_{cool}	=	Full load cooling hours, which depend on location
FLH_{heat}	=	Full load heating hours, which depend on location
BtuH	=	Size of the HVAC equipment in tons (1 ton = 12,000 BtuH)
$SEER_{base}$	=	SEER efficiency rating of the baseline unit = 10[8]
EER_{ee}	=	EER efficiency rating of the new GSHP installed
1.02	=	Constant used to estimate SEER based on efficient unit's EER
$HSPF_{base}$	=	Heating Season Performance Factor for baseline unit = 7.7[9]
COP_{ee}	=	Coefficient of Performance for efficient unit installed
3.413	=	Constant to convert the COP of the unit to HSPF

The formula for calculating demand savings for the purchase of a ground source heat pump meeting ENERGY STAR® standards is specified as follows in the TRM:

[7] Ohio TRM Early Replacement Assumption

[8] Ohio TRM Early Replacement Assumption

[9] Minimum Federal Standard

kW Savings = BtuH * (1/EERbase – 1/(((EERee * 1.02) * 0.37) + 6.43))/1000 * CF

where:

BtuH	=	Size of the new GSHP unit in tons (1 ton = 12,000 BtuH)
EER_{base}	=	EER efficiency rating of the baseline GSHP unit = 9[10]
EER_{ee}	=	EER efficiency rating of the ENERGY STAR® GSHP unit installed
1.02	=	Constant used to estimate the unit's equivalent AC EER to enable comparisons to the baseline unit[11]
CF	=	Peak Coincidence Factor for measure = 0.5 (TRM specified)

Full load cooling and heating hours were determined from the customer's zip code. The values for other variables in the equation (e.g., BtuH, SEER, EER, and CF) were determined for a given ground source heat pump model by looking up the model number in the AHRI database.

ENERGY STAR® Room Air Conditioners

For base savings, ADM used a deemed energy savings value of 22 kWh per qualified ENERGY STAR® room air conditioner, per the approved VEIC replies to the Joint Utility Comments document which recommended adjusting the size of the average rebated unit from 8,500 BtuH to 10,000 BtuH. Base peak demand savings of 0.028 kW per unit was used, as specified in the TRM (p.67).

For total savings, ADM used a deemed energy savings value of 86.9 kWh per qualified ENERGY STAR® room air conditioner per the allowed early replacement baseline in the TRM. Base peak demand savings of 0.11 kW per unit was used, as specified in the TRM (p.70).

4.3.3 Analysis of Savings for Consumer Electronics Measures

Annual *ex post* savings was determined separately for each category of electronics that were eligible for retailer rebates under this program, but the methodology for calculating *ex post* energy savings is the same for each category. ADM reviewed program tracking data, invoices, and the ENERGY STAR® database to verify validity of deemed values used for purposes of determining energy savings and peak summer demand reduction per unit.

[10] Ohio TRM Early Replacement Assumption

[11] Using the algorithm EERac = (SEER * 0.37) + 6.43

Smart Strips

Energy and demand savings are deemed based on the plug size (5-plug or 7-plug) of the smart strip purchased. Table 4-4 shows the deemed savings values specified in the TRM (p. 76) for the purchase of Smart Strip.

Table 4-4. Deemed Savings Values for Smart Strips

Plug Size	*Annual kWh Savings per Unit*	*Peak Demand kW Reduction per Unit*
5-Plug	56.5	0.0063
7-Plug	102.8	0.012

Honeywell's appliance database uses the deemed savings values for 5-plug smart strips as the *ex ante* values. ADM similarly used the 5-plug values to determine *ex post* savings.

Televisions, Monitors, and Computers

ADM used the deemed values for energy savings and peak demand reduction Pennsylvania TRM. The Pennsylvania TRM was updated mid-year. ADM used the deemed pre-update deemed values for measures sold before June 1, 2014 and the post-update deemed values for measures sold after June 1, 2014. These deemed values are detailed in the tables below

Table 4-5: Deemed Savings Values for ENERGY STAR® Televisions

Diagonal Screen Size in Inches	Units Sold Before June (2013 PA TRM)		Units Sold After June (2014 PA TRM)	
	Annual kWh Savings per unit	*Peak Demand kW Reduction per Unit*	Annual kWh Savings per unit	*Peak Demand kW Reduction per Unit*
< 20	106	0.016	2	0.000
20 < 30	106	0.016	18	0.003
30 < 40	106	0.016	22	0.003
40 < 50	436	0.067	35	0.005
50 < 60	436	0.067	29	0.005
≥ 60	436	0.067	16	0.003

Table 4-6: Deemed Savings Values for ENERGY STAR® Computers and Monitors

Equipment Type	Units Sold Before June (2013 PA TRM)		Units Sold After June (2014 PA TRM)	
	Annual kWh Savings per unit	*Peak Demand kW Reduction per Unit*	Annual kWh Savings per unit	*Peak Demand kW Reduction per Unit*
Computer	77	0.010	133	0.018
Monitor	14	0.002	15	0.002

4.3.4 Analysis of Savings for Lighting Measures

As detailed in section 4.1.1, ADM analyzed data from invoices to verify quantities rebated. The verified quantities were multiplied by the per unit savings calculated as described below.

The following formula was used to calculate annual kWh *ex post* savings in accordance with the formula specified in the TRM and modified for LED bulbs as specified in the Mid-Atlantic[12] TRM. As set out in the TRM,

$$\text{kWh Savings} = (\Delta\text{Watt}*1{,}000)*\text{ISR}*\text{Hours}*\text{WHFe}$$

Where:

ΔWatts for CFLs	= CFL watts * delta watts multiplier;
	CFL watts = wattage of installed CFL, as verified
	Delta watts multiplier = factor to account for baseline Conditions = 3.25 (from TRM)
ΔWatts for LEDs	= Baseline Watts - LED watts;
	Baseline watts = wattage of baseline bulbs determined by lumen output using the guidelines set forth in the Mid-Atlantic TRM.
	LED watts = wattage of installed LED, as verified.
ISR	= In Service Rate = 0.86 (From TRM)
Hours	= Average hours of use per year = 1,040 (from TRM)
WHFe	= Waste Heat Factor for energy =1.07 (from TRM)

The formula for calculating demand (kW) savings for the purchase of efficient lighting is specified as follows in the TRM:

$$\Delta\text{kW} = ((\Delta\text{Watts})/1000) * \text{ISR} * \text{WHFd} * \text{CF}$$

Where:

ΔWatts for CFLs	= CFL watts * delta watts multiplier;
	CFL watts = wattage of installed CFL, as verified
	Delta watts multiplier = factor to account for baseline conditions = 3.25 (from TRM)

[12] Shelter Analytics, *Mid-Atlantic Technical Reference Manual Version 4.0,* Prepared for Northeast Energy Efficiency Partnerships (NEEP), June, 2014.

ΔWatts for LEDs	= Baseline Watts - LED watts;
	Baseline watts = wattage of baseline bulbs determined by lumen output using the guidelines set forth in the Mid-Atlantic TRM.
	LED watts = wattage of installed LED, as verified.
ISR	= In Service Rate = 0.86 (From TRM)
WHFd	= Waste Heat Factor for Demand = 1.21 (from TRM)
CF	= Peak Demand Coincidence Factor = 0.11(from TRM)

Ceiling Fans

Energy and demand savings for the purchase of efficient ceiling fans (with compact fluorescent lights) was calculated using a deemed savings approach, as specified in the Ohio TRM. Deemed energy savings per unit is 192 kWh and demand savings is 0.024 kW.

4.4 Calculation of Lifetime kWh Savings per Measure

Lifetime kWh savings for lighting, appliance and HVAC measures were calculated by multiplying annual kWh savings for each measure by the deemed effective useful life for each measure, as specified in the TRM.

4.5 Process Evaluation Methodology

The process evaluation component of the study addressed the following research questions:

Retailers and Contractors

- How satisfied they with the program in general?
- Do they think that there was enough effective signage and financial incentives to encourage customers to participate in the program?
- Do they feel that there was enough programmatic support?
- Do they have any recommendations for improvements in the design and/or delivery of the program?

Program Managers and Implementers

- How satisfied are they with the program in general?
- How satisfied are they with the managers monitoring the program?
- How satisfied are they with the implementers administering the program?

- Do they think that there was enough effective signage and financial incentives to encourage customers to participate in the program?
- Do they feel that there was enough programmatic support?
- Do they have any recommendations for improvements in the design and/or delivery of the program?
- Were previous issues and/or concerns resolved in 2014? Were there any lessons learned in resolving previous issues?

Industry Experts

- What is the current state of the market for each type of program?
- What is the future of the market for each type of program?
- Have they had any lessons learned from programs in different parts of the country?
- Are there other hurdles and barriers that other programs have experienced?

What are the strengths and weaknesses of other programs? The process evaluation component was completed by NMR Group Inc., (NMR).

4.5.1 In-Depth Interviews

NMR conducted 31 in-depth interviews with individuals who served various roles in the program. The interviews focused on the identification of implementation issues and concerns related to the 2014 EEP Program.

NMR conducted interviews with program staff, implementation staff, participating HVAC contractors, participating retail locations, and the corporate office of the retailer responsible for over 80% of the program consumer electronic sales.

For the 2014 evaluation NMR focused on retail partner interviews on the lighting and appliance components of the EEP program. For the HVAC component of the program NMR focused its efforts on learning about industry trends and developments by speaking with participating HVAC contractors.

4.5.2 Program Management and Implementation Contractors

NMR conducted two interviews with the individuals that are responsible for the program design and implementation. The individuals that were interviewed are:

- The Companies Program Manager
- Honeywell Program Manager

4.5.3 Retail Partners

In addition to program staff, NMR conducted eighteen in-depth interviews with participating retail locations and one in-depth interview with the corporate office of the retailer responsible for over 80% of the program consumer electronics sales.

The selection of retailers included in the interviews was based on a review of a list of participating stores. Attempts were made to get feedback for every product that is supported through the program.

5. Detailed Evaluation Findings

The findings from the impact and process evaluation efforts are presented in this chapter.

5.1 Impact Evaluation Findings

The number of energy efficient products that were qualified to receive a rebate from the EEP Program in 2014 is shown in Table 5-1 for each utility service territory and for the total program.

Table 5-1. Number of Rebates for Qualified Measures in the Energy Efficient Products Program during 2014

Measure Type	*CEI*	*OE*	*TE*	*Total*
Appliances	6,375	9,769	2,154	18,298
HVAC	1,174	1,540	449	3,163
Consumer Electronics	19,887	16,168	6,800	42,855
Lighting (total bulbs/fixtures)	599,678	1,127,507	291,034	2,018,219

Table 5-2 shows the quantities of energy efficient products for which rebates were paid per operating company and for the total EEP Program in 2014. Applying the methods described in Chapter 4 produced estimates of savings per unit on a measure-by-measure basis. Multiplying the quantities in Table 5-2 by the per-measure savings estimates produced the program-level estimates of kWh energy savings, which are reported in Table 5-3, and peak kW demand reductions, which are reported in Table 5-4.

Table 5-2. Quantities of Qualified Energy Efficient Products Rebated through EE Products Program in 2014 by Type of Measure and Operating Company

Measure Type	*CEI*	*OE*	*TE*	*Total*
Energy Efficiency Measures: Appliances				
Dehumidifiers (>25 to 35)	57	171	43	271
Dehumidifiers (>35 to 45)	14	44	5	63
Dehumidifiers (>45 to 54)	685	1,069	107	1,861
Dehumidifiers (>54 to 75)	667	1,204	137	2,008
Freezers	149	342	97	588
Refrigerators, bottom freezer	1,083	1,595	362	3,040
Refrigerators, side by side	442	710	159	1,311
Refrigerators, top freezer	612	810	164	1,586
Clothes Washers	2,666	3,824	1,080	7,570
Total Rebated Products, Appliances	6,375	9,769	2,154	18,298
Energy Efficiency Measures: HVAC				
Air Source Heat Pumps	138	260	31	429
Central Air Conditioning	487	398	196	1,081
Ductless Mini Split Air Conditioner	5	12	2	19
Ductless Mini Split Heat Pump	48	39	25	112
Electric Water Heater	12	47	6	65
Ground Source Heat Pumps	52	186	38	276
Heat Pump Water Heater	15	40	4	59
HVAC Tune Ups	320	425	131	876
Room Air Conditioners	93	132	15	240
Whole House Fan	4	1	1	6
Total Rebated Products, HVAC	1,174	1,540	449	3,163
Energy Efficiency Measures: Consumer Electronics				
Desktops	256	250	87	593
Monitors	505	438	191	1,134
Smart Strips	256	218	80	554
Television <40	8,366	6,712	2,976	18,054
Television >40	10,504	8,550	3,466	22,520
Total Rebated Products, Consumer	19,887	16,168	6,800	42,855
Energy Efficiency Measures: Lighting				
CFLs	517,123	1,107,267	268,952	1,893,342
LEDs	82,461	20,133	22,066	124,660
Ceiling Fans	94	107	16	217
Total Rebated Products, Lighting	599,678	1,127,507	291,034	2,018,219
Program Level				
Total Rebated Products	627,114	1,154,984	300,437	2,082,535

Table 5-3. Estimates of Annual kWh Savings for Qualified Energy Efficient Products by Type of Measure

Measure Type	*Ex Ante kWh*	*Ex Post kWh*	*Realization Rate*
Energy Efficiency Measures: Appliances			
Dehumidifiers (>25 to 35)	33,887	32,455	96%
Dehumidifiers (>35 to 45)	8,098	9,373	116%
Dehumidifiers (>45 to 54)	410,069	494,280	121%
Dehumidifiers (>54 to 75)	456,229	500,801	110%
Freezers	665,028	601,717	90%
Refrigerators, bottom freezer	3,705,760	3,703,322	100%
Refrigerators, side by side	1,484,052	1,482,920	100%
Refrigerators, top freezer	2,060,214	2,058,915	100%
Clothes Washers	1,529,140	1,528,736	100%
Total kWh Savings, Appliances	10,352,477	10,412,518	101%
Energy Efficiency Measures: HVAC			
Air Source Heat Pumps	705,877	640,863	91%
Central Air Conditioning	643,411	562,585	87%
Ductless Mini Split Air Conditioner	5,816	6,590	113%
Ductless Mini Split Heat Pump	144,844	101,879	70%
Electric Water Heater	3,055	3,055	100%
Ground Source Heat Pumps	1,116,972	2,169,835	194%
Heat Pump Water Heater	76,523	76,528	100%
HVAC Tune Ups	141,856	141,856	100%
Room Air Conditioners	20,856	20,846	100%
Whole House Fan	1,236	1,236	100%
Total kWh Savings, HVAC	2,860,446	3,725,273	130%
Energy Efficiency Measures: Consumer Electronics			
Desktops	76,013	75,173	99%
Monitors	16,836	16,679	99%
Smart Strips	31,188	31,301	100%
Television <40	1,070,444	1,333,156	125%
Television >40	4,752,600	6,296,713	132%
Total kWh Savings, Consumer Elec.	5,947,081	7,753,022	130%
Energy Efficiency Measures: Lighting			
CFLs	91,404,109	91,467,787	100%
LEDs	6,152,529	5,385,854	88%
Ceiling Fans	41,664	41,590	100%
Total kWh Savings, Lighting	97,598,302	96,895,231	99%
Program Level			
Total Program kWh Savings	116,758,306	118,786,045	102%

Table 5-4. Estimates of Demand (kW) Reductions for Qualified Energy Efficient Products by Type of Measure

Measure Type	*Ex Ante kWh*	*Ex Post kW*	*Realization Rate*
Energy Efficiency Measures: Appliances			
Dehumidifiers (>25 to 35)	8	7	96%
Dehumidifiers (>35 to 45)	2	2	116%
Dehumidifiers (>45 to 54)	93	112	121%
Dehumidifiers (>54 to 75)	104	114	109%
Freezers	103	105	102%
Refrigerators, bottom freezer	648	649	100%
Refrigerators, side by side	260	260	100%
Refrigerators, top freezer	360	361	100%
Clothes Washers	159	158	99%
Total kW Reduction, Appliances	1,736	1,767	102%
Energy Efficiency Measures: HVAC			
Air Source Heat Pumps	249	227	91%
Central Air Conditioning	638	559	88%
Ductless Mini Split Air Conditioner	5	5	104%
Ductless Mini Split Heat Pump	41	14	33%
Electric Water Heater	3	-	0%
Ground Source Heat Pumps	221	304	138%
Heat Pump Water Heater	11	10	98%
HVAC Tune Ups	35	35	100%
Room Air Conditioners	27	27	100%
Whole House Fan	-	-	-
Total kW Reduction, HVAC	1,228	1,181	96%
Energy Efficiency Measures: Consumer Electronics			
Desktops	10	10	99%
Monitors	2	2	95%
Smart Strips	3	3	100%
Television <40	162	202	124%
Television >40	731	967	132%
Total kW Reduction, Consumer Elec.	909	1,185	130%
Energy Efficiency Measures: Lighting			
CFLs	9,679	10,940	113%
LEDs	782	644	82%
Ceiling Fans	5	4	78%
Total kW Reduction, Lighting	10,467	11,589	111%
Program Level			
Total Program kW Reduction	14,340	15,721	110%

5.1.1 Appliances

The *ex post* savings are high for dehumidifiers due to a large amount of line items not including the capacity in the data set. The *ex ante* estimates defaulted to using the savings for a 35 to 45 capacity unit when the capacity was not included. ADM used the model numbers to verify the capacity for the units where it wasn't included. This increased the savings for many of the line items due to the capacity for those units being over 45. These variances give subprogram level realization rates of 101% and 102% for kWh and kW respectively.

5.1.2 HVAC

The *ex post* savings vary from the *ex ante* estimates for a number of the HVAC measures. Much of the variation is accounted for by the *ex ante* use of a blended savings value for each unit in a given measure without using the specific inputs that are provided in the participant data. Using a deemed value for each unit does not account for differences in variables such as unit tons or energy efficiency ratings. We see this variation in air source heat pumps, central air conditioners, ductless mini split air conditioners, ductless mini split heat pumps, and ground source heat pumps. The variance created by the different methodologies gives a realization rate of 130% for kWh and 96% for kW.

5.1.3 Consumer Electronics

The realization rates for the consumer electronics portion of the program is high because of a discrepancy in dates used to determine which deemed savings values to use. As detailed in section 4.1.4, due to a mid-year update to the Pennsylvania TRM different deemed savings were used for measures, with the exception of smart strips, sold before June 2014 than measures sold after. The *ex ante* savings used the "regulatory reporting date" to determine which deemed savings to apply. ADM analyzed monthly sales data as part of the invoice review. The dates from the invoices correlated to the "install date" and not the "regulatory reporting date". Thus, ADM used "install date" to determine which savings values were appropriate. The resulting discrepancy in savings had very little impact on desktops and monitors kWh savings, but greatly increased the television kWh savings giving a realization rate of 130%. For peak demand reductions, desktops and monitors saw a slight decrease in kW, but televisions saw a large increase giving a realization rate of 130%.

5.1.4 Lighting

Ex ante estimates in the lighting portion of the program were highly accurate. The only major discrepancy was in the LED calculation. ADM recommended using an alternative methodology as outlined in the Mid-Atlantic TRM because the delta watts multiplier method in the Ohio TRM is specific to CFLs. The *ex ante* estimates used the Mid-

Atlantic method, but used a blended value approach by assigning savings values to certain ranges of wattage instead of calculating each line individually. While this is an acceptable approach, it created a small discrepancy that gave a kWh realization rate of 88% to LED, which contributed to the 99% realization rate for the lighting portion of the program.

5.2 Process Evaluation Findings

For the process evaluation, NMR completed in-depth interviews regarding all aspects of the program, including: HVAC equipment, appliances, consumer electronics, and lighting. NMR completed in-depth interviews with the Companies program staff, Honeywell implementation contractor staff, participating HVAC contractors, and participating retail locations.

For the Appliance Program and the Lighting Markdown and Rebate Program, NMR conducted separate in-depth interviews with program management staff and participating retailers. The program management staff interviews were conducted with the Companies and the Honeywell (implementation contractor) program managers. The representatives interviewed from participating retailers represented retail outlets that ranged from large national chain "big box" stores to smaller "mom and pop" stores.[13]

For the Consumer Electronics subprogram, one retail chain that was by far most active asked that a corporate representative be interviewed instead of store personnel. That corporate representative spoke on behalf of all locations of that retailer, and provided interesting commentary that could not have been gleaned at the store level, given the predominance of upstream measure volume for the 2014 Energy Efficient Products Program.

For the HVAC Program, NMR conducted separate in-depth interviews with program management staff and HVAC contractors. The program management staff interviews were conducted with the Companies and the Honeywell (implementation contract) program managers. The HVAC contractors interviewed represented the participating contractors who conducted the HVAC installation and tune-up projects.

The feedback provided by program staff, HVAC contractors, and retailers are organized in the following sections by specific topic.

[13] Large residential retail stores in this review represent the national chains or *big box* stores. Smaller residential retail stores represent regional or local *mom and pop* stores, defined as a business that is privately owned and operated, with a small number of employees and relatively low volume of sales.

5.2.1 Program Tracking Data

The evaluation team examined program tracking data, provided by Honeywell, for the period beginning in January 2014, through November 2014. Conclusions pertaining to program tracking data include the following:

Upstream lighting incentives accounted for the vast majority of consumer products purchased with program support. According to program records, just over 1.7 million CFLs and slightly less than 97,000 LEDs were incentivized by the program in 2014. Together, this constitutes over 97% of all products sold through the program. Televisions were the next most oft-incentivized product, with over 36,000 rebates, or 2% of the total.

A few program partners accounted for most rebates. The top two most active retailer chains—Walmart and Home Depot—accounted for nearly 73% of all rebates in 2014. The top five chains accounted for over 97% of all rebates. This uneven distribution is attributable to the program's upstream lighting and consumer electronics components; appliance rebates were also concentrated at a few chains, but not to the same extent (55% at the top three chains). Similarly, 25 HVAC contractors (10%) accounted for nearly half (49%) of HVAC installation rebates, and 11 tune-up contractors (7%) accounted for over half (53%) of those rebates.

5.2.2 Program Background, Design and Objectives

Conclusions pertaining to program background, design and objectives include the following.

HVAC contractors generally had a firm understanding the EEP program's goals and objectives. When asked about their knowledge of the program's objectives, HVAC contractors' responses were consistent with the program's overall aim to provide incentives for high efficiency HVAC equipment and HVAC system tune-ups to residential customers.

The EEP program is well-aligned with HVAC contractors' existing business practices. All of the interviewed HVAC contractors indicated that the program fits well with the way that they sell and service equipment, and reported that the program customers benefited directly through the adoption of higher efficiency equipment; HVAC contractors felt that they also benefited indirectly by being able to sell or upsell such equipment.

The program added incentives for several new measures in 2014. For the 2014 program year, the program added retailer upstream incentives for ENERGY STAR consumer electronics: desktop computers, computer monitors, smart power strips, and televisions. These products together accounted for only 2% of all EEP Program rebates but 10% of incentive dollars, with televisions accounting for the vast majority of incentivized sales within the consumer electronics category.

5.2.3 Marketing, Outreach and Education Efforts

Process evaluation findings pertaining to marketing, outreach, and education efforts include the following.

Retailers are not actively engaged in program promotion. Retailers relied on the Companies and Honeywell to provide in-store signage and brochures, which most respondents said were the primary way customers learned about the program. Because the vast majority of active retail participants in the EEP Program are national chains with marketing and advertising strategies that are national in scope, retailers do not tend to promote the program specifically in any of their marketing. For this reason, customers tended to learn about the program for the first time in the store.

Program representatives were largely unknown to the retailer's managers as program representatives often worked with department level employees. All retail respondents were in managerial positions at their stores, and when they were asked who their program point of contact was, five of 19 said that person did not exist to their knowledge and 12 said they simply did not know. Most of these respondents reported that a representative from the program had visited during the course of the year, however, indicated that program field staff provided retailers with forms and signage, but did not establish relationships with store management.

Most of the program took place away from the eyes of store personnel. Four retail interviewees reported having received any training, and just one knew the program field staff person assigned to their store by name. This is perhaps due to a largely upstream approach in 2014. Over 99% of individual rebates were distributed under a retailer upstream incentive structure, representing 81% of incentive dollars.

HVAC contractors were not very aware of the program's marketing, outreach and education efforts. Half of the HVAC contractors stated that they were not familiar with or had very limited knowledge of the Companies' efforts to market the program. Those who were familiar with promotional efforts most commonly referred to the website as well as fliers, brochures, and other materials that were developed for contractors to use to promote the program.

Despite limited knowledge of the program's promotional efforts, HVAC contractors actively marketed the program with customers. HVAC contractors reported that they explicitly marketed the Companies' rebates when specifying new HVAC equipment or HVAC tune-ups. They reported using formal marketing tools such as mailers, home shows, local magazines and coupon books, their company website, and social media. Most HVAC contractors also mentioned that they employed informal methods during sales calls, on-site visits, and building a solid customer base.

5.2.4 Financial Incentives and Rebate Processing

Process evaluation findings pertaining to financial incentives and rebate processing include the following.

Retail personnel were satisfied with the rebate amounts. Asked to rate the various rebate amounts, most respondents replied that they were appropriate for most products.

According to HVAC contractors, the rebate amounts were sufficient to encourage customer participation. HVAC contractors generally were satisfied with the rebate amounts and felt that the levels were appropriate.

5.2.5 Technical Assistance and Guidelines

Process evaluation findings pertaining to technical assistance and guidelines include the following.

HVAC contractors were more likely to adhere to internal technical guidelines for HVAC installations and tune-ups rather than industry standards. Nearly all of the HVAC contractors indicated that their company followed a set of in-house procedures. In addition to their internal procedures, HVAC contractors reported that they adhered to manufacturer specifications or recommendations, local code, and national code when applicable.

Few retail partners reported receiving technical assistance. The retail components of the EEP Program were largely incentivized upstream and promoted mainly through the use of Company-approved in-store signage. This program structure precluded any major effort to provide retail sales staff with formal technical assistance in 2014.

6. Conclusions and Recommendations

6.1 Conclusions from the Impact Evaluation

The number of qualifying products rebated in each service territory is detailed in Table 6-1.

Table 6-1. Rebates by Measure Category for 2014 EE Products Program

Measure Type	*CEI*	*OE*	*TE*	*Total*
Appliances	6,375	9,769	2,154	18,298
HVAC	1,174	1,540	449	3,163
Consumer Electronics	19,887	16,168	6,800	42,855
Lighting (total bulbs/fixtures)	599,678	1,127,507	291,034	2,018,219

The overall evaluation results for estimated gross energy savings and peak demand reductions for the program in the Companies' service territories are summarized in Table 6-2.

Table 6-2. Overall Evaluation Results for Gross kWh and kW Savings

Utility	*Ex Ante Expected Savings*		*Ex Post Verified Savings*		*Realization Rates*	
	kWh	*kW*	*kWh*	*kW*	*kWh*	*kW*
CEI	35,609,404	4,571	36,193,507	4,929	102%	108%
OE	64,600,134	7,733	65,838,619	8,583	102%	111%
TE	16,550,073	2,036	16,753,918	2,209	101%	109%
Total	116,759,611	14,340	118,786,045	15,721	102%	110%

The gross kWh savings total, shown in Table 6-2, give a realization rate for kWh savings of approximately 102%. This is determined by the ratio of verified gross kWh savings to expected gross kWh savings. The realization rate for kW reductions was approximately 110%. As discussed in section 5.1 above, the realization rates are slightly greater than 100% because of use of blended *ex ante* values in the HVAC subprogram and LED portion of the lighting subprogram, the difference and dates applied in the consumer electronics subprogram, and a conservative assumption of dehumidifier capacity in the appliance subprogram.

The *ex ante* and *ex post* kWh savings and realization rates for each measure category are presented in Table 6-3.

Table 6-3. Overall Evaluation Results by Measure Type

Measure Type	*Ex Ante Expected Savings*		*Ex Post Verified Savings*		*kWh RR*	*kW RR*
	kWh	*kW*	*kWh*	*kW*		
Appliances	10,352,477	1,736	10,412,518	1,767	101%	102%
HVAC	2,861,751	1,229	3,725,273	1,181	130%	96%
Consumer Electronics	5,947,081	909	7,753,022	1,185	130%	130%
Lighting	97,598,302	10,467	96,895,231	11,589	99%	111%
Total	116,759,611	14,340	118,786,045	15,721	102%	110%

6.2 Conclusions from the Process Evaluation

Several conclusions can be drawn from the process evaluation regarding the program.

- **Overall program satisfaction was high.** HVAC contractors were asked to rate how satisfied they were overall with the program using a scale from one (very dissatisfied) to five (very satisfied). Nine out of ten HVAC contractors provided a four or five rating and the average rating was 4.9 on the five-point scale. Similarly, retail partners rated the program highly, with 15 out of 19 interviewees giving a rating of either 4 or 5.
- **Retailers believe that incentives lead customers to consider energy efficiency more closely.** Retail interviewees noted that the prospect of a monetary incentive spurred their customers to think more closely about the benefits associated with efficient products, which in turn led to more sales of these products. Several retailers also noted that the simplicity of the program was among its strengths, and that understanding the structure of the program was not a barrier to participation for customers.

6.3 Recommendations

Overall, the program ran smoothly during the 2014 implementation year. While the program is currently suspended for 2015, the evaluation team offers the following

recommendations for program consideration in the event the program is reinstated in the future.

- **Encourage active participation from retailers in promoting future upstream incentive programs.** Retailer awareness of the EEP Program was high, but the program's level of engagement with these retailers was low; retailers tended to see the program as something that they were not involved in, leaving nearly all promotion of the program to signage. In the future, take steps to engage retailers in the process of promoting upstream incentive measures. For instance, offer training for sales staff on the benefits of energy efficient products. With a concerted effort at retail staff engagement, these measures could be even more successful in the future.

7. Appendix A: Required Savings Tables

Tables showing measure-level participation counts and savings for the 2014 EEP Program were provided in various locations throughout this report. This appendix provides additional tables summarizing savings results.

- Table 7-1 reports the annual ex post kWh savings by utility and measure.
- Table 7-2 reports the average annual ex post on-peak kW reductions by utility and measure.
- Table 7-3 reports the lifetime ex post kWh savings by utility and measure.

Table 7-1: Annual Ex Post Energy Savings (kWh)

Measure Type	*CEI*	*OE*	*TE*	*Total*
Energy Efficiency Measures: Appliances				
Dehumidifiers (>25 to 35)	6,826	20,479	5,150	32,455
Dehumidifiers (>35 to 45)	2,083	6,546	744	9,373
Dehumidifiers (>45 to 54)	181,935	283,925	28,419	494,280
Dehumidifiers (>54 to 75)	166,352	300,281	34,168	500,801
Freezers	152,476	349,978	99,263	601,717
Refrigerators, bottom freezer	1,320,177	1,943,086	440,059	3,703,322
Refrigerators, side by side	500,344	802,588	179,988	1,482,920
Refrigerators, top freezer	794,988	1,052,190	211,737	2,058,915
Clothes Washers	538,532	772,246	217,958	1,528,736
Total kWh Savings (Appliances)	3,663,713	5,531,319	1,217,486	10,412,518
Energy Efficiency Measures: HVAC				
Air to Air Heat Pump	210,671	388,773	41,419	640,863
Central Air Conditioner	245,230	217,064	100,291	562,585
Ductless Minisplit AC	1,691	4,323	576	6,590
Ductless Minisplit HP	42,967	33,299	25,613	101,879
Electric Water Heater	564	2,209	282	3,055
Geothermal Heat Pump	439,027	1,461,567	269,240	2,169,835
Heat Pump Water Heater	19,456	51,883	5,188	76,528
Tune-up	56,372	74,296	11,188	141,856
Room AC	8,078	11,465	1,303	20,846
Whole House Fan	824	206	206	1,236
Total kWh Savings (HVAC)	1,024,881	2,245,085	455,307	3,725,273
Energy Efficiency Measures: Consumer Electronics				
Desktops	32,368	31,850	10,955	75,173
Monitors	7,437	6,433	2,809	16,679
Smart Strips	14,464	12,317	4,520	31,301
Television <40	600,900	498,760	233,496	1,333,156
Television >40	2,822,514	2,418,043	1,056,156	6,296,713
Total kWh Savings (Consumer Electronics)	3,477,683	2,967,403	1,307,936	7,753,022
Energy Efficiency Measures: Lighting				
CFLs	24,313,603	54,332,444	12,821,740	91,467,787
LEDs	3,695,611	741,860	948,383	5,385,854
Ceiling Fans	18,016	20,508	3,067	41,590
Total kWh Savings (Lighting)	28,027,230	55,094,812	13,773,190	96,895,231
Program Level				
Total kWh Savings	36,193,507	65,838,619	16,753,918	118,786,045

Table 7-2: Annual Ex Post On-Peak Demand Reductions (kW)

Measure Type	*CEI*	*OE*	*TE*	*Total*
Energy Efficiency Measures: Appliances				
Dehumidifiers (>25 to 35)	2	5	1	7
Dehumidifiers (>35 to 45)	0	1	0	2
Dehumidifiers (>45 to 54)	41	64	6	112
Dehumidifiers (>54 to 75)	38	68	8	114
Freezers	27	61	17	105
Refrigerators, bottom freezer	231	340	77	649
Refrigerators, side by side	88	141	32	260
Refrigerators, top freezer	139	184	37	361
Clothes Washers	56	80	22	158
Total kW Savings (Appliances)	621	944	201	1,767
Energy Efficiency Measures: HVAC				
Air to Air Heat Pump	74	138	15	227
Central Air Conditioner	259	201	99	559
Ductless Minisplit AC	1	3	0	5
Ductless Minisplit HP	6	5	3	14
Electric Water Heater	-	-	-	-
Geothermal Heat Pump	59	209	36	304
Heat Pump Water Heater	3	7	1	10
Tune-up	13	17	5	35
Room AC	10	15	2	27
Whole House Fan	-	-	-	-
Total kW Savings (HVAC)	425	595	161	1,181
Energy Efficiency Measures: Consumer Electronics				
Desktops	4	4	1	10
Monitors	1	1	0	2
Smart Strips	2	1	0	3
Television <40	91	75	35	202
Television >40	433	371	162	967
Total kW Savings (Consumer Electronics)	531	453	200	1,185
Energy Efficiency Measures: Lighting				
CFLs	2,908	6,499	1,534	10,940
LEDs	442	89	113	644
Ceiling Fans	2	2	2	6
Total kW Savings (Lighting)	3,352	6,589	1,649	11,590
Program Level				
Total kW Savings	4,929	8,583	2,209	15,721

Table 7-3: Lifetime Ex Post Energy Savings (kWh)

Measure Type	*EUL*	*CEI*	*OE*	*TE*	*Total*
Energy Efficiency Measures: Appliances					
Dehumidifiers (<25)	12	-	-	-	-
Dehumidifiers (>25 to 35)	12	81,916	245,747	61,796	389,458
Dehumidifiers (>35 to 45)	12	24,994	78,552	8,926	112,472
Dehumidifiers (>45 to 54)	12	2,183,223	3,407,103	341,029	5,931,355
Dehumidifiers (>54 to 75)	12	1,996,220	3,603,372	410,018	6,009,610
Freezers	17	2,592,090	5,949,629	1,687,468	10,229,187
Refrigerators, bottom freezer	17	22,443,009	33,032,462	7,481,003	62,956,474
Refrigerators, side by side	17	8,505,848	13,643,996	3,059,796	25,209,640
Refrigerators, top freezer	17	13,514,796	17,887,230	3,599,529	35,001,555
Clothes Washers	11	5,923,852	8,494,706	2,397,538	16,816,096
Total kWh Savings (Appliances)		57,265,948	86,342,797	19,047,103	162,655,847
Energy Efficiency Measures: HVAC					
Air to Air Heat Pump	18	3,792,087	6,997,911	745,541	11,535,538
Central Air Conditioner	18	4,414,148	3,907,150	1,805,241	10,126,539
Ductless Minisplit AC	15	25,369	64,839	8,642	98,849
Ductless Minisplit HP	15	644,499	499,490	384,200	1,528,189
Electric Water Heater	14	7,896	30,926	3,948	42,770
Geothermal Heat Pump	18	7,902,492	26,308,210	4,846,322	39,057,024
Heat Pump Water Heater	10	194,562	518,832	51,883	765,277
Tune-up	5	281,862	371,480	55,940	709,282
Room AC	12	96,932	137,581	15,634	250,147
Whole House Fan	20	16,480	4,120	4,120	24,720
Total kWh Savings (HVAC)		17,376,326	38,840,538	7,921,471	64,138,335
Energy Efficiency Measures: Consumer Electronics					
Desktops	4	129,472	127,400	43,820	300,692
Monitors	15	111,555	96,495	42,135	250,185
Smart Strips	4	57,856	49,268	18,080	125,204
Television <40	15	9,013,500	7,481,400	3,502,440	19,997,340
Television >40	15	42,337,710	36,270,645	15,842,340	94,450,695
Total kWh Savings (Consumer Electronics)		51,650,093	44,025,208	19,448,815	115,124,116
Energy Efficiency Measures: Lighting					
CFLs	6.8	111,419,483	244,927,567	57,589,022	413,936,072
LEDs	15	43,257,676	9,552,069	10,857,294	63,667,039
Ceiling Fans	6.8	122,510	139,452	20,853	282,815
Total kWh Savings (Lighting)		154,799,668	254,619,088	68,467,169	477,885,925
Program Level					
Total kWh Savings		281,092,035	423,827,631	114,884,558	819,804,223