



An Exelon Company

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November 15, 2013

Rosemary Chiavetta, Secretary  
Pennsylvania Public Utility Commission  
Commonwealth Keystone Building  
400 North Street  
Second Floor  
Harrisburg, Pennsylvania 17120

**Re: PUC Docket No. M-2008-2069887  
Energy Efficiency and Conservation Program Final Annual Report  
June 1, 2012 through May 31, 2013**

Dear Secretary Chiavetta:

In accordance with the Commission's Secretarial Letter dated May 25, 2011, enclosed is PECO's 2013 Final Annual Energy Efficiency & Conservation Report for the program year of June 1, 2012 through May 31, 2013.

PECO is providing a copy of the report to the Act 129 Statewide Evaluator (GDS Associates, Inc.) and is also posting the report on the PECO website.

Please acknowledge receipt of the foregoing on the enclosed copy of this letter.

If you have any further questions regarding this matter, please call me at 215-841-5777.

Sincerely,

A handwritten signature in black ink, appearing to read "R. Webster".

cc: C. Walker-Davis, Director, Office of Special Assistants  
P. T. Diskin, Director, Bureau of Technical Utility Services  
D. P. Hosler, Director, Bureau of Audits  
J. E. Simms, Director, Bureau of Investigation & Enforcement  
Office of Consumer Advocate  
Office of Small Business Advocate  
McNees, Wallace & Nurick

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SECRETARY'S BUREAU

enclosures

# **Final Annual Report for the Pennsylvania Public Utility Commission**

**For the Period  
June 2012 through May 2013  
Program Year 4**

For Pennsylvania Act 129 of 2008  
Energy Efficiency and Conservation Plan

Prepared by Navigant Consulting, Inc.

For

PECO Energy Company

November 15, 2013

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## Acronyms

AMY	Actual Meteorological Year
BAS	Building Automation System
BEopt	Building Energy Optimization
C&I	Commercial and Industrial
CATI	Computer-Aided Telephone Interview
CF	Coincidence Factor
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
CPITD	Cumulative Program/Portfolio Inception to Date
CPITD-Q	Cumulative Program/Portfolio Inception through Current Quarter
CSP	Conservation Service Provider or Curtailment Service Provider
CVR	Conservation Voltage Reduction
CVRf	Conservation Voltage Reduction factor
DCU	Digital Cycling Units
DEER	Database for Energy-Efficient Resources
DER	Distributed Energy Resources
DLC	Direct Load Control
DR	Demand Response
DRA	Demand Response Aggregator
EDC	Electric Distribution Company
EE&C	Energy Efficiency and Conservation
EFLH	Effective Full-Load Hours
EISA	Energy Independence and Security Act
EM&V	Evaluation, Measurement, and Verification
EMS	Energy Management System
ETO	Energy Trust of Oregon
FCM	Forward Capacity Market
FPL	Federal Poverty Level
GNI	Government, Nonprofit, Institutional
GNI NC	GNI New Construction
HOU	Hours of Use

HVAC	Heating, Ventilating, and Air Conditioning
IEF	Interactive Effects Factor
IMP	Interim Measure Protocol
IQ	Incremental Quarter
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
LEEP	Low-Income Energy Efficiency Program
LIURP	Low-Income Usage Reduction Program
M&V	Measurement and Verification
MW	Megawatt
MWh	Megawatt-hour
NERC	North American Electric Reliability Corporation
NTG	Net-to-Gross
PA PUC	Pennsylvania Public Utility Commission
PCT	Programmable Communicating Thermostats
PEG	Program Evaluation Group
PLR	Permanent Load Reduction
POP	Point of Purchase
PY1	Program Year 2009, from June 1, 2009 to May 31, 2010
PY2	Program Year 2010, from June 1, 2010 to May 31, 2011
PY3	Program Year 2011, from June 1, 2011 to May 31, 2012
PY4	Program Year 2012, from June 1, 2012 to May 31, 2013
PYX QX	Program Year X, Quarter X
PYTD	Program Year to Date
SAA	Symmetric Additive Adjustment
SAE	Statistically Adjusted Engineering
SAR	Smart Appliance Recycling
SEER	Seasonal Energy Efficiency Rating
SCI	Smart Construction Incentive
SEI	Smart Equipment Incentives
SHR	Smart Home Rebates
SLD	Smart Lighting Discounts
SSMVP	Site-Specific M&V Plan

SWE	Statewide Evaluator
T&D	Transmission and Distribution
TMY	Typical Meteorological Year
TRC	Total Resource Cost
TRM	Technical Reference Manual
WTA	Willingness to Accept

## Report Definitions

*Note: Definitions provided in this section are limited to terms critical to understanding values presented in this report.*

### REPORTING PERIODS

#### **Cumulative Program Inception to Date (CPITD)**

Refers to the period of time since the start of the Act 129 programs. CPITD is calculated by totaling all program year results, including the current program year to date results. For example, CPTID results for PY4 Q3 is the sum of PY1, PY2, PY3, PY4 Q1, PY4 Q2, and PY4 Q3 results.

#### **Incremental Quarter (IQ)**

Refers to the current reporting quarter only. Activities occurring during previous quarters are not included. For example, IQ results for PY4 Q3 will only include results that occurred during PY4 Q3 and not PY4 Q2.

#### **Program Year to Date (PYTD)**

Refers to the current reporting program year only. Activities occurring during previous program years are not included. For example, PYTD results for PY4 Q3 will only include results that occurred during PY4 Q1, PY4 Q2, and PY4 Q3. It will not include results from PY1, PY2, and PY3.

### SAVINGS TYPES

#### **Preliminary**

Qualifier used in all reports except the final annual report to signify that evaluations are still in progress and that results have not been finalized. Most often used with “realization rate” or “verified gross savings”.

#### **Reported Gross**

Refers to results of the program or portfolio determined by the program administrator (e.g., the EDC or the program implementer). Also known as ex ante, or “before the fact” (using the annual evaluation activities as the reference point).

#### **Verified Gross**

Refers to results of the program or portfolio determined by the evaluation activities. Also known as ex post, or “after the fact” (using the annual evaluation activities as the reference point).

# 1 Overview of Portfolio

Pennsylvania Act 129, signed on October 15, 2008, mandated energy savings and coincident peak demand reduction goals for the largest electric distribution companies (EDCs) in Pennsylvania. Each EDC submitted energy efficiency and conservation (EE&C) plans—which were approved by the Pennsylvania Public Utility Commission (PA PUC)—pursuant to these goals. This report documents the progress and effectiveness of the EE&C accomplishments for PECO in Program Year four (PY4), defined as June 1, 2012 through May 31, 2013, as well as the cumulative accomplishments of the programs since inception.

Navigant Consulting, Inc. (Navigant) has evaluated the programs, which included measurement and verification of the savings. The final verified savings for PY4 and the cumulative verified savings since inception of the programs are included in this final annual report.

The next section of this report provides an overview of activities for the entire portfolio. This includes summary information and portfolio-level details regarding the progress towards compliance goals, energy and demand impacts, net-to-gross (NTG) ratios, finances, and cost-effectiveness. The following sections include program-specific details, including program updates, impact evaluation findings, and process evaluation findings.

Navigant has followed the Technical Reference Manual (TRM) in almost all respects. Navigant applied two types of alternate parameters in estimating savings from residential compact fluorescent lamps (CFLs), because it has found these to more accurately reflect actual savings. Throughout this report, savings from residential CFLs will be presented in two ways. Navigant has calculated “TRM Verified” savings from residential CFLs precisely as dictated by the TRM. In calculating “Evaluation Verified” savings from residential CFLs, Navigant has used an alternate coincidence factor and has applied interactive effects factors (IEFs) for both energy and demand, as presented in Table 1-1. Navigant has used these factors in calculating Evaluation Verified savings for PECO’s Smart Lighting Discounts (SLD) and Low-Income Energy Efficiency Program (LEEP). In all cases, Navigant also presents TRM Verified savings for these programs.

**Table 1-1. Alternate Parameters Used in "Evaluation Verified" Savings**

	Pennsylvania TRM	Evaluation Verified
Coincidence Factor	0.05	0.117
Interactive Effects Factor for Energy (IEFe)	1.00	1.02
Interactive Effects Factor for Demand (IEFd)	1.00	1.19

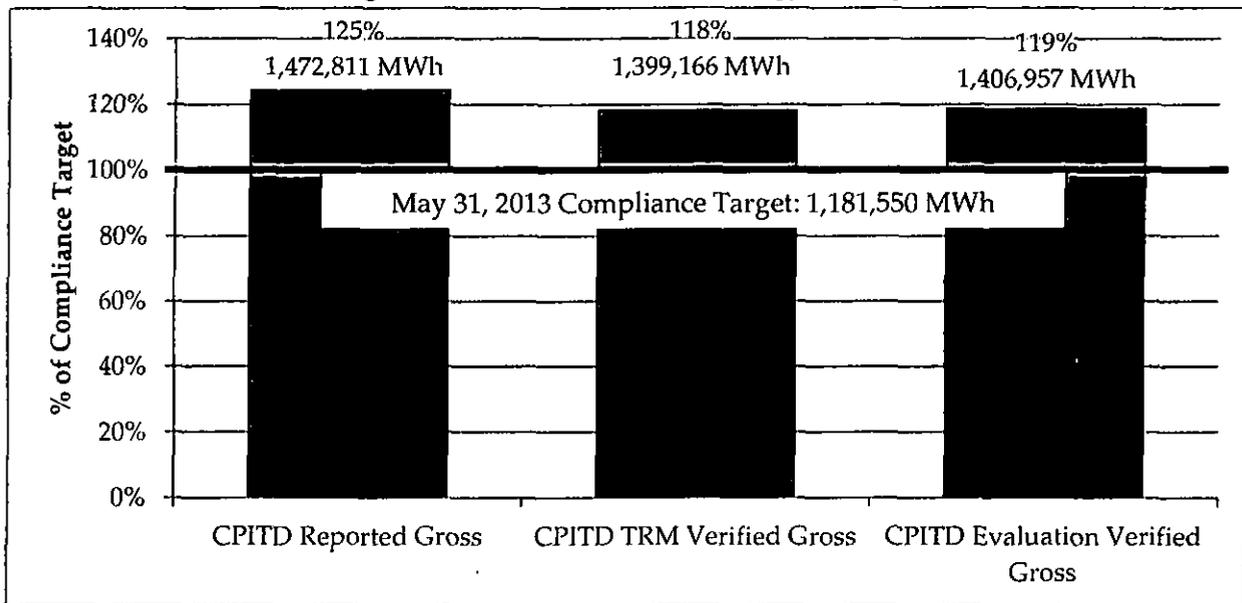
Source: Navigant analysis

The derivation of the higher coincidence factor and justification for its application are presented in Appendix A. Similar information is presented in Appendix B for the interactive effects factors.

### 1.1 Summary of Progress Toward Compliance Targets

The energy savings<sup>1</sup> compliance target for PECO was 1,181,550 megawatt-hours (MWh) and was required to be achieved by May 31, 2013 per Act 129. Based on Cumulative Program/Portfolio Inception to Date (CPITD) TRM Verified gross energy savings,<sup>2</sup> PECO has achieved 118 percent of the energy savings compliance target. Based on Evaluation Verified savings, PECO achieved 119 percent of its target. These figures are shown in Figure 1-1. The PUC will determine compliance using CPITD verified gross energy savings.

**Figure 1-1. Portfolio CPITD Energy Savings**



Source: Navigant analysis

<sup>1</sup> Herein, energy savings refers to annualized energy savings and is measured in kWh/year or MWh. Energy savings are reported at the meter.

<sup>2</sup> See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

Demand savings are reported at the system level. Table 1-2 shows the line loss adjustment factors that were used to gross up demand savings from the meter level to the system level.

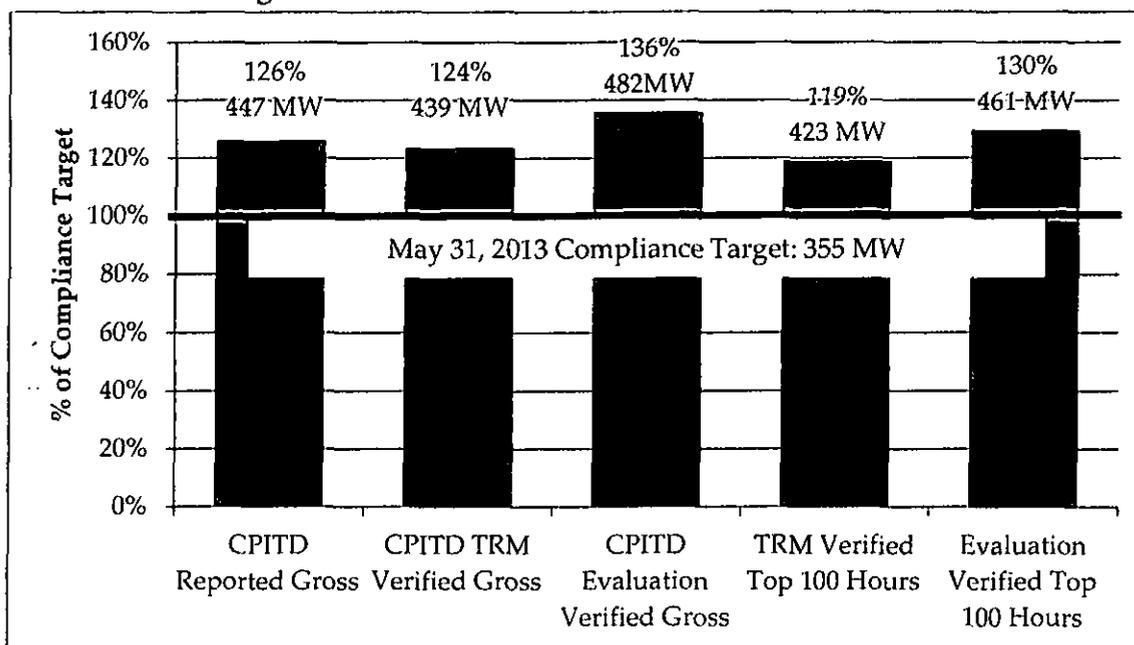
**Table 1-2. Line Loss Factors**

	Line Loss Factor Used
Smart Lighting Discounts Program	1.192
Smart Appliance Recycling Program	1.192
Smart Home Rebates Program	1.192
Low-Income Energy Efficiency Program	1.192
Smart Equipment Incentives - Retrofit	1.111
Smart Equipment Incentives - Multi-Tenant	1.111
Smart Equipment Incentives - Appliance Recycling	1.111
Smart Construction Incentives	1.111
Smart Equipment Incentives - Retrofit	1.117
Smart Equipment Incentives - Multi-Tenant	1.117
Smart Equipment Incentives - Appliance Recycling	1.117
Smart Equipment Incentives - New Construction	1.117
Residential Direct Load Control	1.192
Commercial Direct Load Control	1.192
Permanent Load Reduction	1.111
Demand Response Aggregators	Varies by participant: 1.070 to 1.192
Distributed Energy Resources	Varies by participant: 1.070 to 1.193

Source: PECO data

The system peak demand reduction<sup>3</sup> compliance target for PECO is 355 MW per Act 129 and was required to be achieved by May 31, 2013. PECO has achieved 119 percent of the demand reduction compliance target during the Top 100 Hours of 2012 based only on installations in place and generating demand reductions during those hours, based on TRM Verified demand reduction. Evaluation Verified demand reduction during PECO's Top 100 Hours was 130 percent of the target. Including demand reductions occurring after the Top 100 Hours, PECO achieved 124 percent and 136 percent of the demand reduction compliance target, respectively, for CPITD TRM Verified and CPITD Evaluation Verified gross demand reduction<sup>4</sup> achieved through the end of PY4, as shown in Figure 1-2. The PUC will determine compliance using CPITD verified gross demand reduction during the Top 100 Hours.

**Figure 1-2. Portfolio CPITD Peak Demand Reduction**



<sup>3</sup> Herein, demand reduction refers to the EDC's system peak demand reduction in the EDC's Top 100 Hours of highest demand, as defined by the PA PUC, and is measured in kW or MW.

<sup>4</sup> See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

### 1.1.1 Performance in the Low-Income Sector

Act 129 mandates that the number of measures offered to the low-income sector be proportionate to the low-income sector's share of total energy usage.<sup>5</sup> There are 17 measure groups targeted to the low-income sector, and another 27 measure groups offered by other programs in the residential sector (which are also available to low-income customers). These 44 measure groups offered to the low-income sector therefore comprise 35 percent of the total of 124 measure groups offered across PECO's portfolio. As required by Act 129, this exceeds the fraction of electric consumption of the utility's low-income households divided by the total electricity consumption in the PECO service area (3.1 percent). These values are shown in Table 1-3.

**Table 1-3. Low-Income Sector Compliance Metrics**

	<b>Low-Income Sector</b>	<b>All Sectors</b>	<b>% Low-Income</b>
Number of Measures Offered	17	124	14
Electric Consumption (MWh)	1,215,463	38,644,120	3.1%

*Source: Navigant analysis*

The CPITD reported gross energy savings for low-income sector programs (excluding low-income participation in non-low-income programs) is 108,916 MWh; this is 7.4 percent of the CPITD total portfolio reported gross energy savings.

Including low-income customer participation in non-low-income programs, the CPITD reported gross energy savings achieved is 112,072 MWh; this is 7.6 percent of the CPITD total portfolio reported gross energy savings.

The CPITD verified gross energy savings achieved for low-income programs (excluding low-income participation in non-low-income programs) is 104,558 MWh; this is 7.5 percent of the CPITD total portfolio TRM Verified gross energy savings.<sup>6</sup>

---

<sup>5</sup> Act 129 includes a provision requiring electric distribution companies to offer a number of energy conservation measures to low-income households that are "proportionate to those households' share of the total energy usage in the service territory." 66 Pa.C.S. §2806.1(b)(i)(C). The legislation contains no provisions regarding targets for participation, or energy or demand savings.

<sup>6</sup> See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

Including low-income customer participation in non-low-income programs, the CPITD reported verified energy savings achieved is 107,665 MWh; this is 7.7 percent of the CPITD total portfolio TRM Verified energy savings.<sup>78</sup>

### **1.1.2 Performance in the Government, Nonprofit, and Institutional Sector**

Act 129 mandates that a minimum of 10 percent of the required energy and demand targets be obtained from units of federal, state, and local governments, including municipalities, school districts, institutions of higher education, and nonprofit entities. Herein, this group is referred to as the government, nonprofit, and institutional (GNI) sector.

The energy savings compliance target for the GNI sector for PECO is 181,155 MWh, which was required to be obtained by May 31, 2013. Based on CPITD TRM verified gross energy savings,<sup>9</sup> PECO achieved 164 percent of the target. These values are shown in Figure 1-3.

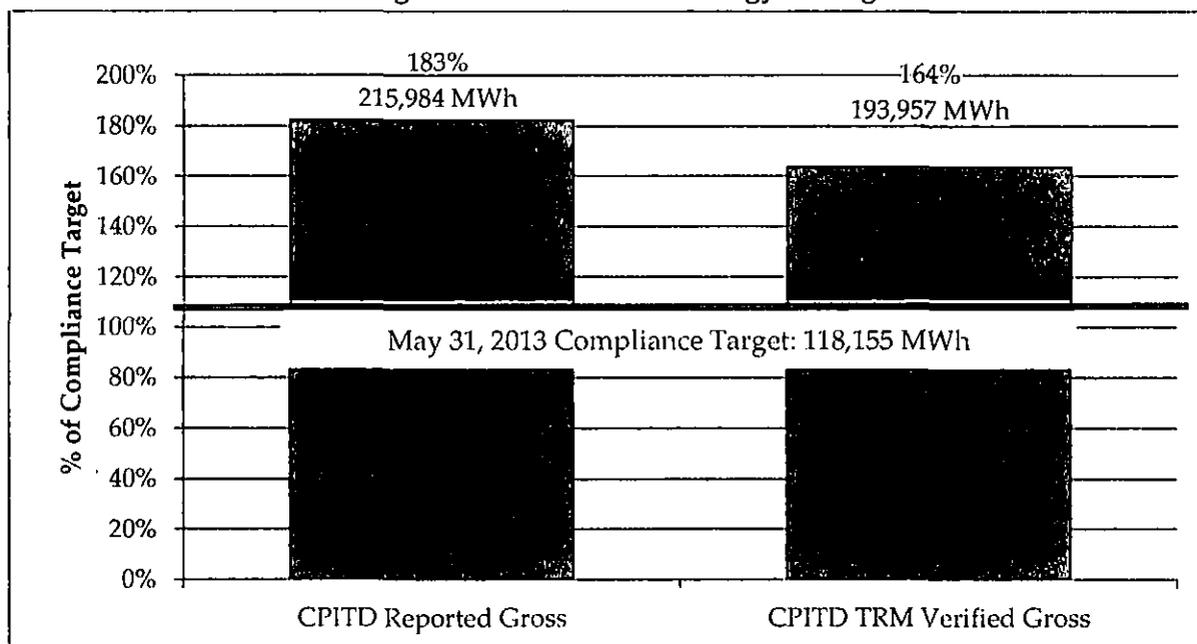
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<sup>7</sup> Low-income participation in non-low income programs was estimated by surveys conducted for PECO's Smart Lighting Discounts, Smart Appliance Recycling, and Smart Home Rebates (SHR) programs. Evaluators asked respondents to provide number of residents in the household, and then asked if household income exceeded the low-income threshold based on household size.

<sup>8</sup> The estimated cost of low-income savings from non-low-income programs is \$568,508 in PY4. This value was calculated by applying program-specific low-income participation percentages to PY4 Total EDC Costs for each program.

<sup>9</sup> See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

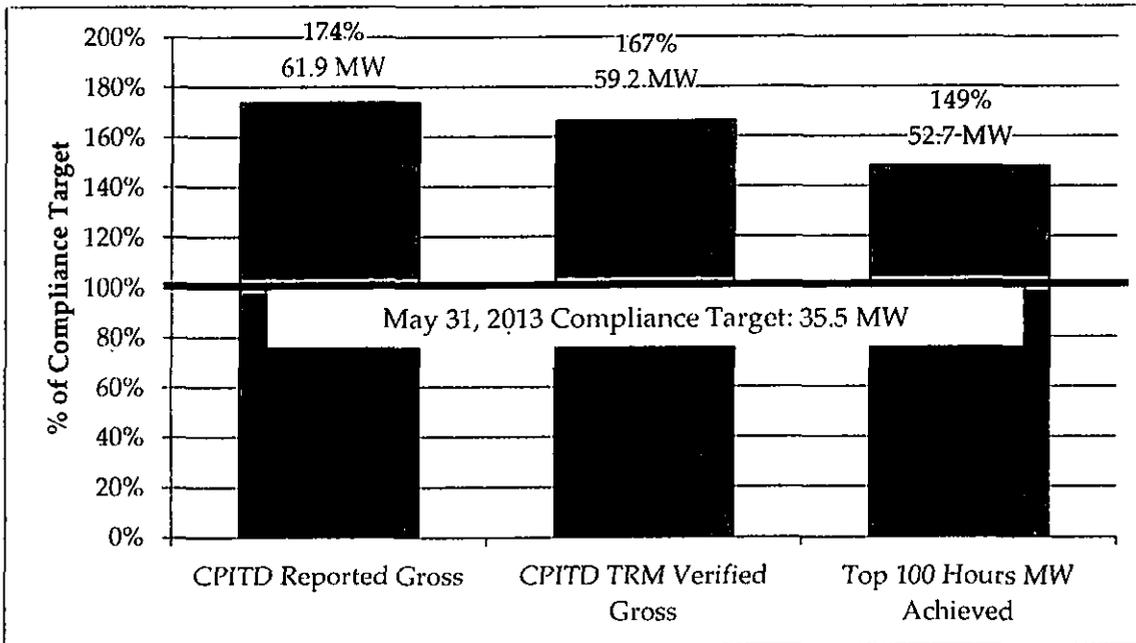
Figure 1-3. GNI CPITD Energy Savings



The peak demand reduction compliance target for the GNI sector for PECO is 35.5 MW. Based on CPITD TRM verified gross demand reduction,<sup>10</sup> PECO achieved 167 percent of the target. These values are shown in Figure 1-4. Note that the values shown include GNI participation in the DRA and DER programs.

<sup>10</sup> See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

**Figure 1-4. GNI CPITD Peak Demand Reduction**



### 1.1.3 Carry-Over Savings

According to the Phase II Implementation Order, PECO is allowed by the PUC to “carry over” MWh savings into Phase II of Act 129. Table 1-4 below shows how much savings from PY4 PECO will be carrying over into Phase II. Values in the “CPITD Unverified Savings” column are the gross reported savings from three combined heat and power projects that received rebates from the Smart Equipment Incentives program (one in the C&I sector, two in the GNI sector). These three projects have a “commercial date of operation” (CDO) prior to June 1, 2013, but they were completed too late in the program year to be fully verified by Navigant prior to this report. Per the SWE’s September 13, 2013 guidance memo on reporting unverified savings, PECO is presenting reported savings for these projects in this report, and will present their final verified savings in the PY5 Q2 report.<sup>11</sup> All verified savings values presented in this report exclude savings from these three projects.

<sup>11</sup> Statewide Evaluator, Guidance Memo GM-021, *Reporting Unverified Energy and Peak Demand Savings for Phase I Projects in the Act 129 Phase I Final Report* (September 13, 2013).

**Table 1-4. Savings from PY4 Carried into Phase II**

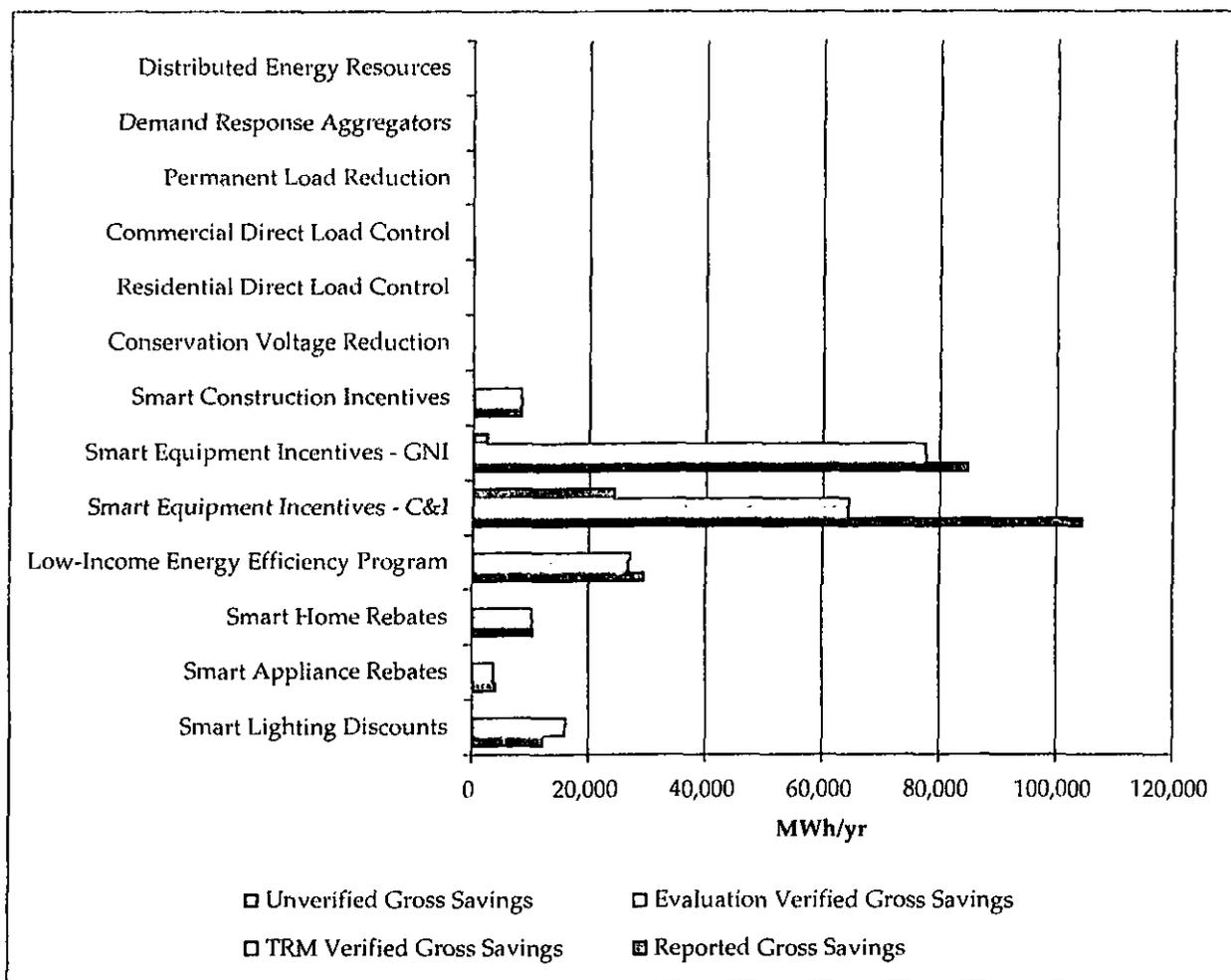
	<b>CPITD Verified Savings (MWh)</b>	<b>CPITD Unverified Savings (MWh)</b>	<b>Savings Carried into Phase II (MWh)</b>
TRM Verified Savings	217,616	27,063	244,679
Evaluation Verified Savings	225,407	27,063	252,470

*Source: Navigant analysis*

## 1.2 Summary of Energy Impacts

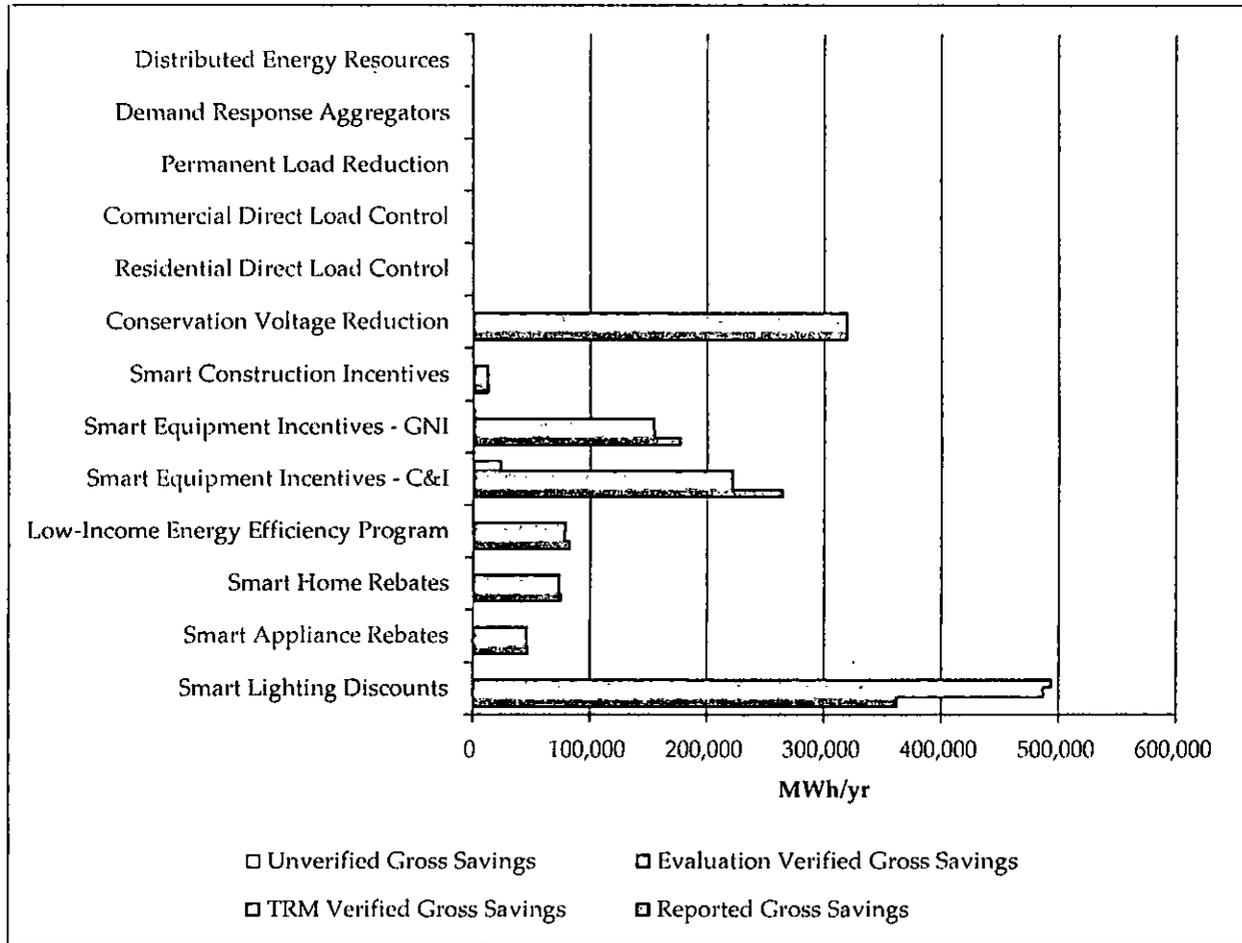
A summary of the reported, verified, and unverified energy savings by program for PY4 is presented in Figure 1-5. The “Unverified Gross Savings” values refer to projects that were reported in PY4, but have not been verified at the time of this report.

**Figure 1-5. PYTD Gross Energy Savings by Program**



A summary of the cumulative reported, verified, and unverified energy savings by program is presented in Figure 1-6.

**Figure 1-6. CPITD Gross Energy Savings by Program**



A summary of energy impacts by program through the fourth quarter of PY4 is presented in Table 1-5 through Table 1-7. Note that Table 1-6 applies an IEF<sub>e</sub> of 1.02 to lighting measures installed in the SLD and LEEP programs. Table 1-7 presents the same information, but adheres strictly to the TRM algorithm for residential lighting.

Table 1-5. EDC Reported Participation and Gross Energy Savings by Program

Program	Participants			Reported Gross Impact (MWh/Year)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
<b>Residential</b>	<b>3,242</b>	<b>12,344</b>	<b>322,501</b>	<b>6,899</b>	<b>26,202</b>	<b>563,856</b>
Smart Lighting Discounts Program <sup>1</sup>	61,485	259,187	7,675,726	2,994	12,440	363,480
Reduction due to Non-residential Participation	-4,734	-19,957	-591,031	-231	-958	-27,988
Smart Appliance Recycling Program	517	2,830	30,573	756	4,138	47,431
Smart Home Rebates Program <sup>2</sup>	2,725	9,514	291,928	3,379	10,582	75,210
Residential Conservation Voltage Reduction	N/A	N/A	N/A	0	0	105,723
<b>Low-Income Energy Efficiency Program Total<sup>3</sup></b>	<b>2,844</b>	<b>10,106</b>	<b>32,240</b>	<b>5,632</b>	<b>29,548</b>	<b>108,916</b>
Low-Income Energy Efficiency Program	2,844	10,106	32,240	5,632	29,548	83,286
Low-Income Conservation Voltage Reduction	N/A	N/A	N/A	0	0	25,630
<b>Non-Residential</b>	<b>716</b>	<b>1,099</b>	<b>5,193</b>	<b>97,390</b>	<b>197,793</b>	<b>799,839</b>
<b>Commercial and Industrial Total</b>	<b>571</b>	<b>774</b>	<b>4,064</b>	<b>68,829</b>	<b>112,938</b>	<b>583,855</b>
Smart Equipment Incentives - Retrofit	499	659	3,533	60,603	98,746	264,539
Smart Equipment Incentives - Multi-tenant <sup>4</sup>	16	44	405	219	506	645
Smart Equipment Incentives -Appliance Recycling	6	14	23	13	77	93
Smart Construction Incentives	50	57	103	6,721	8,323	13,554
C&I Conservation Voltage Reduction	N/A	N/A	N/A	0	0	150,575
Non-Residential Participation in Smart Lighting Discounts	4,734	19,957	591,031	1,272	5,286	154,449
<b>Government / Nonprofit Total</b>	<b>145</b>	<b>325</b>	<b>1,129</b>	<b>28,561</b>	<b>84,855</b>	<b>215,984</b>
Smart Equipment Incentives - Retrofit	124	273	975	24,921	74,041	157,582
Smart Equipment Incentives - Multi-tenant <sup>4</sup>	1	8	82	10	11	155
Smart Equipment Incentives -Appliance Recycling	0	0	5	0	0	33

Program	Participants			Reported Gross Impact (MWh/Year)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
Smart Equipment Incentives - New Construction	20	44	67	3,629	10,803	19,769
GIN Conservation Voltage Reduction	N/A	N/A	N/A	0	0	38,445
<b>Demand Reduction</b>	<b>-1,134</b>	<b>-1,756</b>	<b>79,341</b>	<b>0</b>	<b>201</b>	<b>201</b>
Residential Smart A/C Saver	-1,097	-1,675	76,976	0	0	0
Commercial Smart A/C Saver	-37	-277	2,169	0	0	0
Permanent Load Reduction	0	1	1	0	201	201
Demand Response Aggregators	0	193	193	0	0	0
Distributed Energy Resources	0	2	2	0	0	0
<b>Total Portfolio</b>	<b>5,668</b>	<b>21,793</b>	<b>439,275</b>	<b>109,922</b>	<b>253,745</b>	<b>1,472,811</b>

**NOTES:**

<sup>1</sup>Participation numbers shown are the numbers of discounted lamps sold. These are excluded from total portfolio participation numbers. The CPITD participant value reported here includes 17,856 lamps that were inadvertently removed from PY2 cumulative participation values, although their costs and savings were reported correctly in all previous reports.

<sup>2</sup>Participant values exclude sales of EnergyStar lighting fixtures and LED lamps, for which upstream rebates are provided.

<sup>3</sup>Act 129 includes a provision requiring electric distribution companies to offer a number of energy efficiency measures to low-income households that are "proportionate to those households' share of the total energy usage in the service territory." 66 Pa.C.S. §2806.1(b)(i)(G). The legislation contains no provisions regarding targets for participation, or energy or demand savings. Participation includes only those receiving the Weatherization Audit.

<sup>4</sup>The participation values shown here reflect the number of project IDs reported in the tracking data, rather than the number of billing account IDs. The values reported here better reflect the number of participating households, rather than the number of multi-family buildings in which the participants live.

Source: Navigant analysis

Table 1-6. Evaluation Verified Gross Energy Savings by Program

Program	PYTD Reported Gross Energy Savings (MWh/Year)	PYTD Energy Realization Rate	PYTD Verified Gross Energy Savings (MWh/Year)	PYTD Unverified Gross Energy Savings (MWh/Year)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Energy Savings (MWh/Year)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	16,997	0.96	16,257	0	0.0%	494,640	0.0%
Smart Appliance Recycling Program	4,138	0.94	3,873	0	0.6%	46,628	0.9%
Smart Home Rebates Program	10,582	1.00	10,584	0	0.0%	74,119	0.0%
Residential Conservation Voltage Reduction	0	N/A	0	0	N/A	105,723	0.0%
Low-Income Energy Efficiency Program	29,548	0.92	27,270	0	0.7%	79,892	3.7%
Low-Income Conservation Voltage Reduction	0	N/A	0	0	N/A	25,630	0.0%
Smart Equipment Incentives-C&I	99,329	0.86	64,530	24,386	11.9%	222,366	4.5%
Smart Construction Incentives	8,323	1.02	8,494	0	6.5%	13,341	3.9%
C&I Conservation Voltage Reduction	0	N/A	0	0	N/A	150,575	0.0%
Smart Equipment Incentives - GNI	84,855	0.95	77,817	2,677	11.7%	155,512	7.8%
GNI Conservation Voltage Reduction	0	N/A	0	0	N/A	38,445	0.0%
Residential Smart A/C Saver	0	N/A	0	0	0.0%	0	0.0%
Commercial Smart A/C Saver	0	N/A	0	0	0.0%	0	0.0%
Permanent Load Reduction	201	0.44	88	0	0.0%	88	0.0%
Demand Response Aggregators	0	N/A	0	0	0.0%	0	0.0%
Distributed Energy Resources	0	N/A	0	0	0.0%	0	0.0%
<b>TOTAL PORTFOLIO</b>	<b>253,973</b>	<b>0.82</b>	<b>208,912</b>	<b>27,063</b>	<b>5.6%</b>	<b>1,406,957</b>	<b>1.1%</b>

Source: Navigant analysis

Table 1-7. TRM Verified Gross Energy Savings by Program

Program	PYTD Reported Gross Energy Savings (MWh)	PYTD Energy Realization Rate	PYTD Verified Gross Energy Savings (MWh)	PYTD Unverified Gross Energy Savings (MWh)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Energy Savings (MWh)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	16,768	0.96	16,028	0	0.0%	487,813	0.0%
Smart Appliance Recycling Program	4,138	0.94	3,873	0	0.6%	46,628	0.9%
Smart Home Rebates Program	10,582	1.00	10,584	0	0.0%	74,119	0.0%
Residential Conservation Voltage Reduction	0	N/A	0	0	N/A	105,723	0.0%
Low-Income Energy Efficiency Program	29,548	0.91	26,876	0	0.7%	78,928	3.7%
Low-Income Conservation Voltage Reduction	0	N/A	0	0	N/A	25,630	0.0%
Smart Equipment Incentives - C&I	99,329	0.86	64,530	24,386	11.9%	222,366	4.5%
Smart Construction Incentives	8,323	1.02	8,494	0	6.5%	13,341	3.9%
C&I Conservation Voltage Reduction	0	N/A	0	0	N/A	150,575	0.0%
Smart Equipment Incentives - GNI	84,855	1	77,817	2,677	11.7%	155,512	7.8%
GNI Conservation Voltage Reduction	0	N/A	0	0	N/A	38,445	0.0%
Residential Direct Load Control	0	N/A	0	0	0.0%	0	0.0%
Commercial Direct Load Control	0	N/A	0	0	0.0%	0	0.0%
Permanent Load Reduction	201	0.44	88	0	0.0%	88	0.0%
Demand Response Aggregators	0	N/A	0	0	0.0%	0	0.0%
Distributed Energy Resources	0	N/A	0	0	0.0%	0	0.0%
<b>TOTAL PORTFOLIO</b>	<b>253,744</b>	<b>0.82</b>	<b>208,289</b>	<b>27,063</b>	<b>5.6%</b>	<b>1,399,166</b>	<b>1.1%</b>

Source: Navigant analysis

### 1.3 Summary of Fuel Switching Impacts

PECO customers conducted a small number of projects in PY4 in which services originally provided by electricity were converted to run on natural gas. Table 1-8 summarizes the numbers and electricity savings resulting from these projects. The only fuel switching projects in PY4 were conversions to gas furnaces and gas water heaters. These were conducted in PECO's SHR program.

**Table 1-8. Fuel Switching Project Summary**

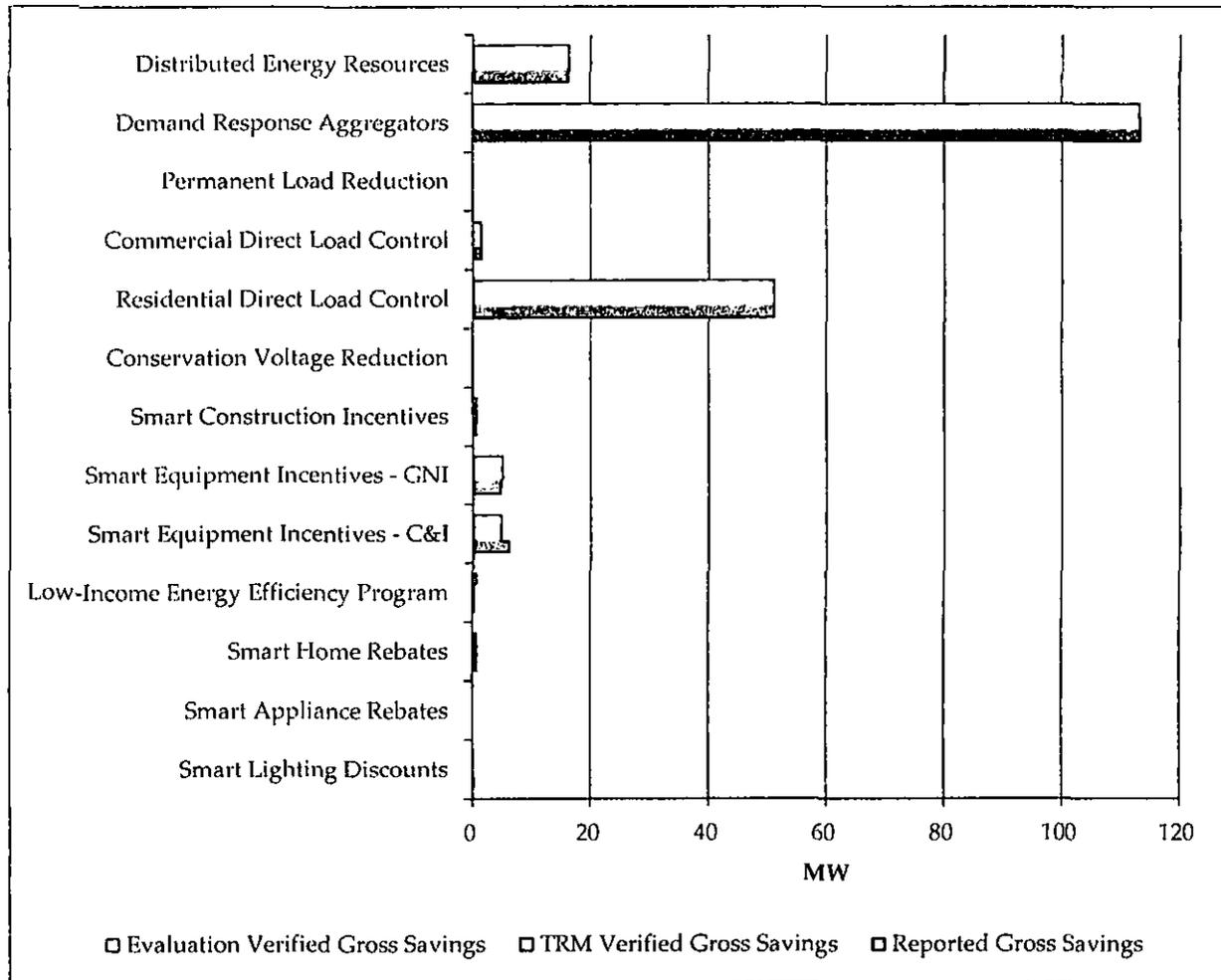
Program Name	Technology	Number of Projects	Electric Consumption Savings (kWh)	Rebates Paid
SHR	High-Efficiency Gas Furnaces	39	1,132,899	\$24,150
	ENERGY STAR Gas Storage Tank Water Heaters	10	41,040	\$2,500

*Source: Navigant analysis*

## 1.4 Summary of Demand Impacts

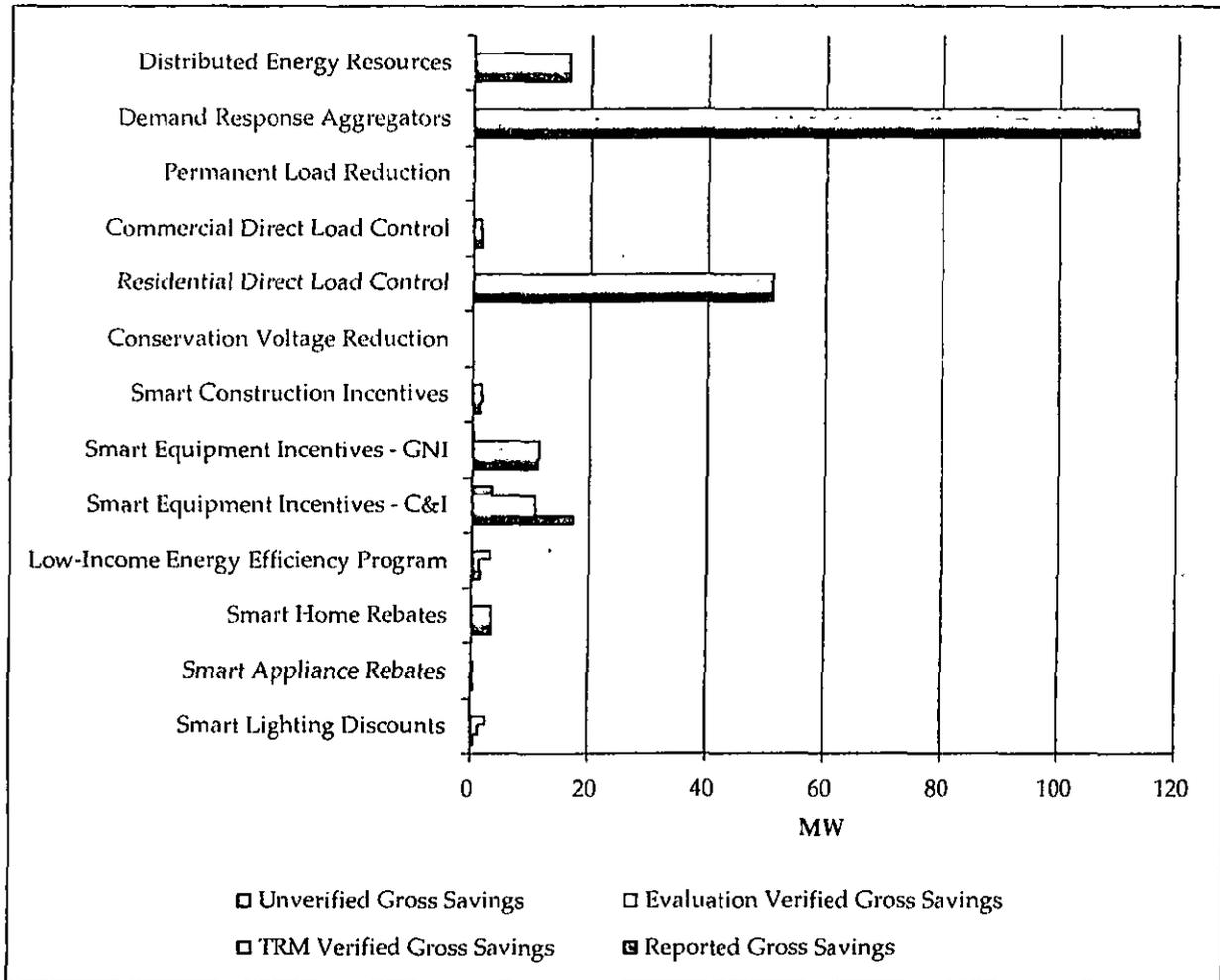
A summary of the reported and verified demand reduction by program within the Top 100 Hours for the program year is presented in Figure 1-7.

**Figure 1-7. PYTD Demand Reduction by Program (Top 100 Hours)**



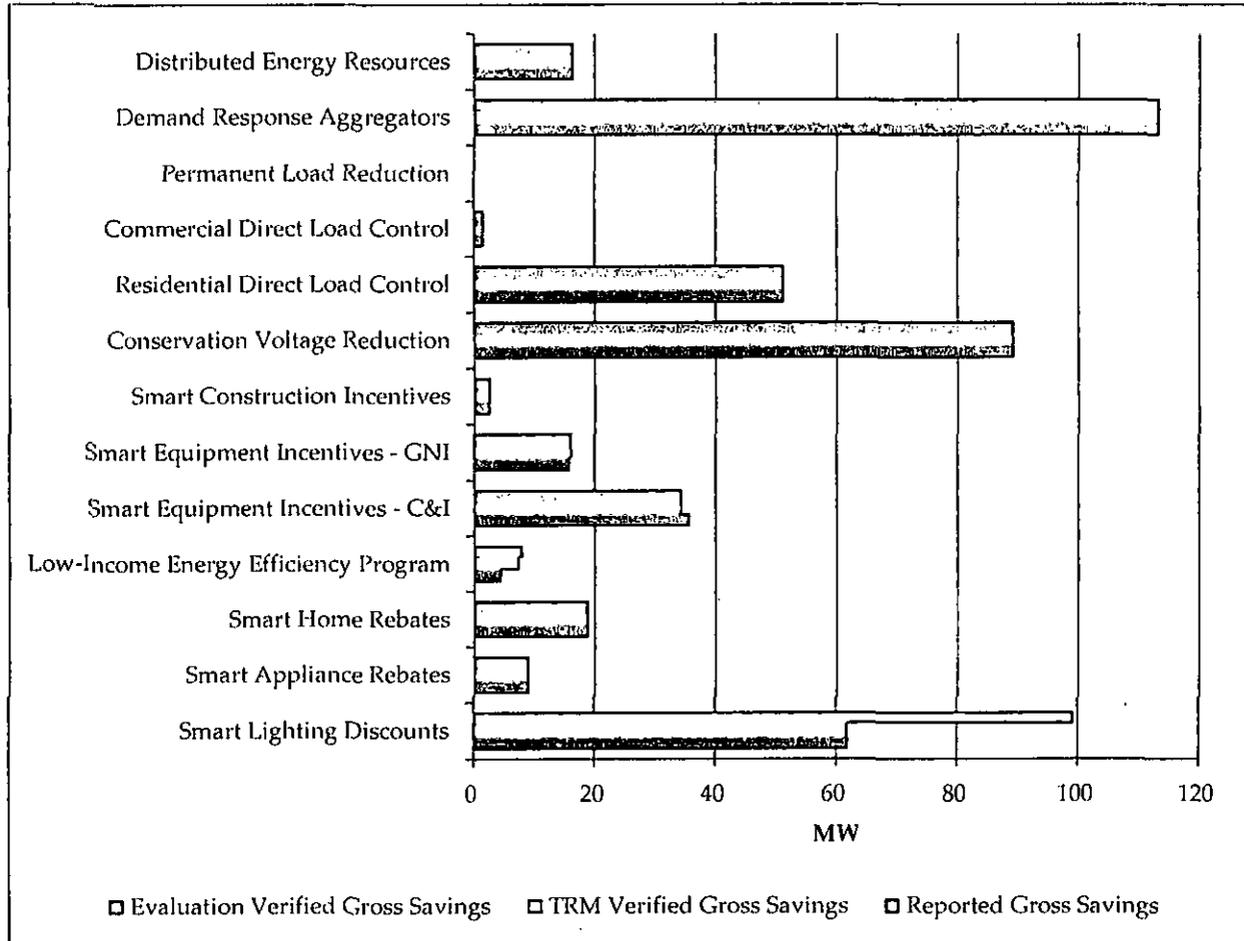
A summary of the reported, verified, and unverified demand reduction by program including all MW savings for the program year is presented in Figure 1-8. The impacts below reflect the line loss factors presented in Table 1-2.

**Figure 1-8. PYTD Demand Reduction by Program (All MW Savings)**



A summary of the cumulative reported and verified demand reduction by program within the Top 100 Hours is presented in Figure 1-9.

**Figure 1-9. CPITD Demand Reduction by Program (Top 100 Hours)**



A summary of the cumulative reported, verified, and unverified demand reduction by program including all MW savings for the program year is presented in Figure 1-10.

**Figure 1-10. CPITD Demand Reduction by Program (All MW Savings)**

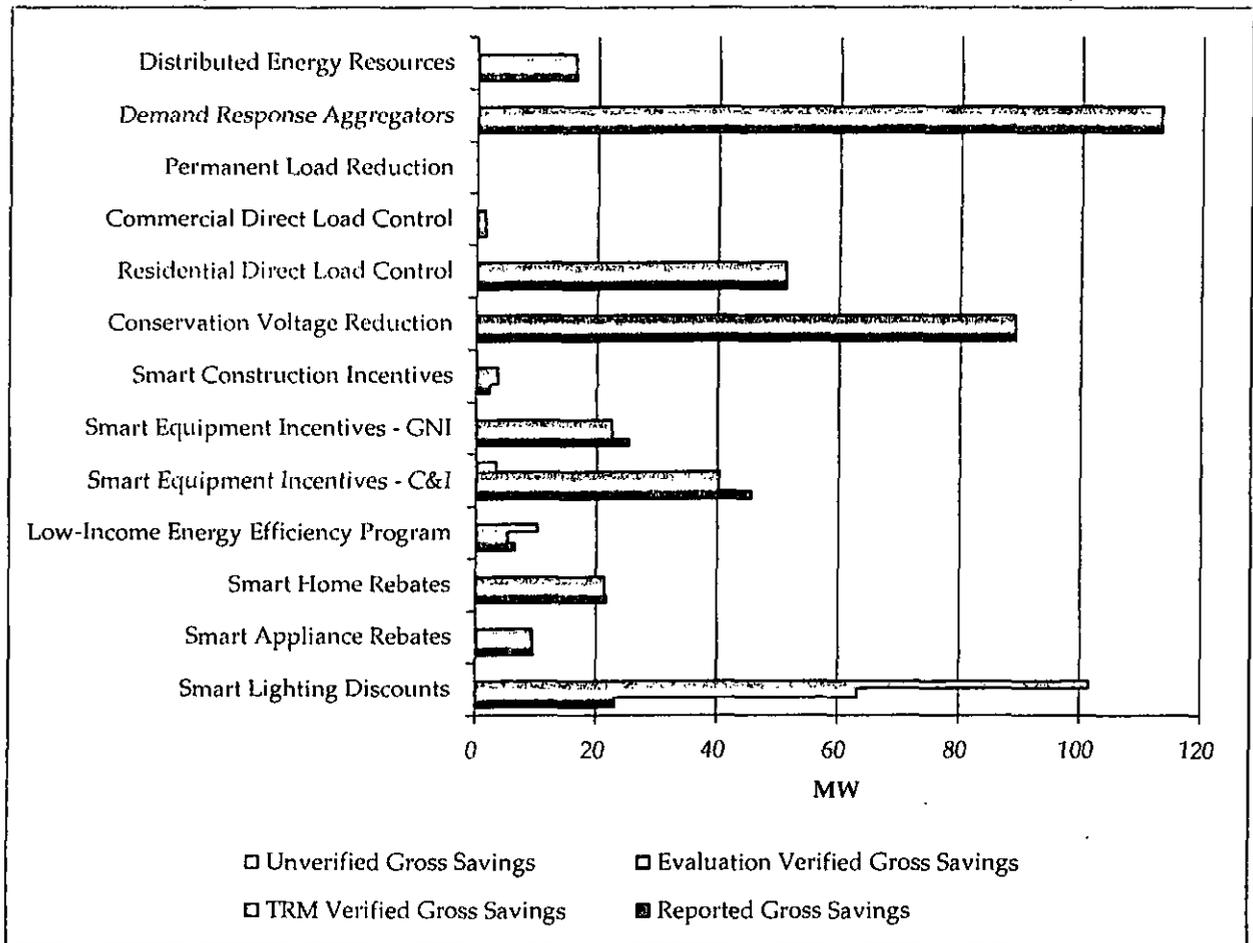


Table 1-9 presents participation and reported gross demand reduction in PY4 and throughout Phase I.

Table 1-9. EDC Reported Participation and Gross Demand Reduction by Program

Program	Participants			Reported Gross Impact (MW)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
<b>Residential</b>	<b>3,242</b>	<b>12,344</b>	<b>322,501</b>	<b>1.4</b>	<b>4.8</b>	<b>53.0</b>
Smart Lighting Discounts Program <sup>1</sup>	61,485	259,187	7,675,726	0.2	0.7	23.3
Reduction due to Non-residential Participation	-4,734	-19,957	-591,031	0.0	-0.1	-1.8
Smart Appliance Recycling Program	517	2,830	30,573	0.1	0.6	9.7
Smart Home Rebates Program <sup>2</sup>	2,725	9,514	291,928	1.1	3.6	21.8
<b>Low-Income Energy Efficiency Program Total<sup>3</sup></b>	<b>2,844</b>	<b>10,106</b>	<b>32,240</b>	<b>0.3</b>	<b>1.6</b>	<b>6.7</b>
Low-Income Energy Efficiency Program	2,844	10,106	32,240	0.3	1.6	6.7
<b>Non-Residential</b>	<b>716</b>	<b>1,099</b>	<b>5,193</b>	<b>14.8</b>	<b>31.4</b>	<b>115.7</b>
<b>Commercial and Industrial Total</b>	<b>571</b>	<b>774</b>	<b>4,064</b>	<b>12.0</b>	<b>20.1</b>	<b>90.3</b>
Smart Equipment Incentives - Retrofit	499	659	3,533	10.5	17.3	45.6
Smart Equipment Incentives - Multi-tenant <sup>4</sup>	16	44	405	0.0	0.1	0.2
Smart Equipment Incentives -Appliance Recycling	6	14	23	0.0	0.0	0.0
Smart Construction Incentives	50	57	103	1.2	1.5	2.4
Non-Residential Participation in SLD	4,734	19,957	591,031	0.3	1.2	42.1
<b>Government / Nonprofit Total</b>	<b>145</b>	<b>325</b>	<b>1,129</b>	<b>2.8</b>	<b>11.3</b>	<b>25.4</b>
Smart Equipment Incentives - Retrofit	124	273	975	2.0	9.4	22.3
Smart Equipment Incentives - Multi-tenant <sup>4</sup>	1	8	82	0.0	0.0	0.0
Smart Equipment Incentives -Appliance Recycling	0	0	5	0.0	0.0	0.0
Smart Equipment Incentives - New Construction	20	44	67	0.8	1.9	3.1
<b>Demand Reduction</b>	<b>-1,134</b>	<b>-1,756</b>	<b>79,341</b>	<b>0.0</b>	<b>182.8</b>	<b>272.1</b>
Conservation Voltage Reduction	0	0	93	0.0	0.0	89.3

Program	Participants			Reported Gross Impact (MW)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
Residential Smart A/C Saver <sup>5</sup>	-1,097	-1,675	76,976	0.0	51.3	51.3
Commercial Smart A/C Saver <sup>6</sup>	-37	-277	2,169	0.0	1.6	1.6
Permanent Load Reduction	0	1	1	0.0	0.1	0.1
Demand Response Aggregators	0	193	193	0.0	113.4	113.4
Distributed Energy Resources	0	2	2	0.0	16.4	16.4
<b>Total Portfolio</b>	<b>5,668</b>	<b>21,793</b>	<b>439,275</b>	<b>16.4</b>	<b>220.6</b>	<b>447.5</b>

**NOTES:**

<sup>1</sup>Participation numbers shown are the numbers of discounted lamps sold. These are excluded from total portfolio participation numbers. The CPITD participant value reported here includes 17,856 lamps that were inadvertently removed from PY2 cumulative participation values, although their costs and savings were reported correctly in all previous reports.

<sup>2</sup>Participant values exclude sales of EnergyStar lighting fixtures and LED lamps, for which upstream rebates are provided.

<sup>3</sup>Act 129 includes a provision requiring electric distribution companies to offer a number of energy efficiency measures to low-income households that are "proportionate to those households' share of the total energy usage in the service territory." 66 Pa.C.S. §2806.1(b)(i)(G). The legislation contains no provisions regarding targets for participation, or energy or demand savings. Participation includes only those receiving the Weatherization Audit.

<sup>4</sup>The participation values shown here reflect the number of project IDs reported in the tracking data, rather than the number of billing account IDs. The values reported here better reflect the number of participating households, rather than the number of multi-family buildings in which the participants live.

<sup>5</sup>The negative IQ and PYTD participation values shown for the Residential and Commercial Direct Load Control programs reflect participants that have left the programs.

Table 1-10 presents PY4 and Phase I Evaluation Verified demand reduction during the Top 100 Hours for each program and for the portfolio. Table 1-11 presents the same information, but uses the coincidence factor specified in the TRM for residential lighting, and does not apply the IEFd to residential lighting.

**Table 1-10. PYTD Evaluation Verified Gross Demand Reduction in the Top 100 Hours by Program**

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Demand Savings (MW/Year)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	0.4	92%	0.3	0.0%	99.3	0.0%
Smart Appliance Recycling Program	0.1	94%	0.1	0.5%	9.1	0.9%
Smart Home Rebates Program	0.9	100%	0.9	0.0%	18.9	0.0%
Low-Income Energy Efficiency Program	0.4	202%	0.9	0.6%	8.0	3.9%
Smart Equipment Incentives-C&I	6.3	80%	5.0	18.7%	34.4	7.8%
Smart Construction Incentives	0.7	120%	0.8	1.8%	2.7	30.6%
Smart Equipment Incentives - GNI	4.9	106%	5.2	4.2%	16.2	9.6%
Conservation Voltage Reduction	0.0	0%	0.0	0.0%	89.3	0.0%
Residential Smart A/C Saver	51.3	100%	51.3	9.7%	51.3	9.7%
Commercial Smart A/C Saver	1.6	100%	1.6	3.5%	1.6	3.5%
Permanent Load Reduction	0.1	167%	0.2	0.0%	0.2	0.0%
Demand Response Aggregators	113.4	100%	113.4	0.0%	113.4	0.0%
Distributed Energy Resources	16.4	100%	16.4	0.0%	16.4	0.0%
<b>TOTAL PORTFOLIO</b>	<b>196.5</b>	<b>100%</b>	<b>196.2</b>	<b>2.7%</b>	<b>461.0</b>	<b>1.3%</b>

Source: Navigant analysis

Table 1-11. PYTD TRM Verified Gross Demand Reduction in the Top 100 Hours by Program

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Demand Savings (MW/Year)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	0.2	87%	0.2	0.0%	62.0	0.0%
Smart Appliance Recycling Program	0.1	94%	0.1	0.5%	9.1	0.9%
Smart Home Rebates Program	0.9	100%	0.9	0.0%	18.9	0.0%
Low-Income Energy Efficiency Program	0.4	84%	0.4	1.5%	7.5	4.2%
Smart Equipment Incentives-C&I	6.3	80%	5.0	18.7%	34.4	7.8%
Smart Construction Incentives	0.7	120%	0.8	1.8%	2.7	30.6%
Smart Equipment Incentives - GNI	4.9	106%	5.2	4.2%	16.2	9.6%
Conservation Voltage Reduction	0.0	0%	0.0	0.0%	89.3	0.0%
Residential Smart A/C Saver	51.3	100%	51.3	9.7%	51.3	9.7%
Commercial Smart A/C Saver	1.6	100%	1.6	3.5%	1.6	3.5%
Permanent Load Reduction	0.1	167%	0.2	0.0%	0.2	0.0%
Demand Response Aggregators	113.4	100%	113.4	0.0%	113.4	0.0%
Distributed Energy Resources	16.4	100%	16.4	0.0%	16.4	0.0%
<b>TOTAL PORTFOLIO</b>	<b>196.4</b>	<b>100%</b>	<b>195.5</b>	<b>2.7%</b>	<b>423.1</b>	<b>1.4%</b>

Source: Navigant analysis

Table 1-12 and Table 1-13 present gross and verified demand reduction through the end of PY4 and throughout Phase I (i.e., not just the Top 100 Hours).

**Table 1-12. PYTD Total Evaluation Verified Gross Demand Reduction by Program**

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Unverified Gross Demand Savings (MW)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Demand Savings (MW)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	2.9	92%	2.7	0.0	0.0%	101.8	0.0%
Smart Appliance Recycling Program	0.6	94%	0.6	0.0	0.5%	9.6	0.9%
Smart Home Rebates Program	3.6	100%	3.6	0.0	0.0%	21.6	0.0%
Low-Income Energy Efficiency Program	1.6	202%	3.3	0.0	0.6%	10.4	2.8%
Smart Equipment Incentives-C&I	17.4	80%	11.0	3.6	18.7%	40.4	6.6%
Smart Construction Incentives	1.5	120%	1.8	0.0	1.8%	3.7	22.7%
Smart Equipment Incentives - GNI	11.3	106%	11.7	0.3	4.2%	22.7	6.9%
Conservation Voltage Reduction	0.0	0%	0.0	0.0	0.0%	89.3	0.0%
Residential Smart A/C Saver	51.3	100%	51.3	0.0	9.7%	51.3	9.7%
Commercial Smart A/C Saver	1.6	100%	1.6	0.0	3.5%	1.6	3.5%
Permanent Load Reduction	0.1	167%	0.2	0.0	0.0%	0.2	0.0%
Demand Response Aggregators	113.4	100%	113.4	0.0	0.0%	113.4	0.0%
Distributed Energy Resources	16.4	100%	16.4	0.0	0.0%	16.4	0.0%
<b>TOTAL PORTFOLIO</b>	<b>221.7</b>	<b>98%</b>	<b>217.5</b>	<b>3.9</b>	<b>2.5%</b>	<b>482.3</b>	<b>1.2%</b>

Source: Navigant analysis

Table 1-13.:PYTD Total TRM Verified Gross Demand Reduction by Program

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Unverified Gross Demand Savings (MW)	PYTD Achieved Precision at 90% Confidence	CPITD Verified Gross Demand Savings (MW)	CPITD Achieved Precision at 90% Confidence
Smart Lighting Discounts Program	1.8	87%	1.6	0.0	0.0%	63.4	0.0%
Smart Appliance Recycling Program	0.6	94%	0.6	0.0	0.5%	9.6	0.9%
Smart Home Rebates Program	3.6	100%	3.6	0.0	0.0%	21.6	0.0%
Low-Income Energy Efficiency Program	1.6	84%	1.4	0.0	1.5%	5.4	5.8%
Smart Equipment Incentives-C&I	17.4	80%	11.0	3.6	18.7%	40.4	6.6%
Smart Construction Incentives	1.5	120%	1.8	0.0	1.8%	3.7	22.7%
Smart Equipment Incentives - GNI	11.3	106%	11.7	0.3	4.2%	22.7	6.9%
Conservation Voltage Reduction	0.0	0%	0.0	0.0	0.0%	89.3	0.0%
Residential Smart A/C Saver	51.3	100%	51.3	0.0	9.7%	51.3	9.7%
Commercial Smart A/C Saver	1.6	100%	1.6	0.0	3.5%	1.6	3.5%
Permanent Load Reduction	0.1	167%	0.2	0.0	0.0%	0.2	0.0%
Demand Response Aggregators	113.4	100%	113.4	0.0	0.0%	113.4	0.0%
Distributed Energy Resources	16.4	100%	16.4	0.0	0.0%	16.4	0.0%
<b>TOTAL PORTFOLIO</b>	<b>220.6</b>	<b>97%</b>	<b>214.4</b>	<b>3.9</b>	<b>2.5%</b>	<b>439.0</b>	<b>1.3%</b>

Source: Navigant analysis

## 1.5 Reconciliation with Prior Annual Reports

Table 1-14 and Table 1-15 present gross Reported and Verified energy savings, respectively, as presented in the final annual reports for PY1 through PY3. The CPITD Reported and Verified Gross energy savings values presented in this report use the values in these tables with the following exceptions:

- Reported and Verified energy savings from the SLD program reflect non-residential participation in that program in all four years of Phase I. The cumulative increase in TRM Verified energy savings for PY1 through PY3 is 120,862 MWh. PECO first presented details on the justification for this adjustment in its preliminary demand response filing. The justification and methodology are presented in Appendix C of this report.
- When the PY1 report was submitted, there was no approved protocol for evaluation of savings from the LEEP program, so although there were Reported savings for that program in PY1, the program was not credited with Verified savings for PY1 until the PY2 report was submitted. The verified savings for the PY1 LEEP program have been included in the program's CPITD verified savings in all PECO annual reports since PY2. TRM Verified energy savings from the PY1 LEEP program amount to 3,407 MWh.
- The SCI program began operation late in PY2. As there were only four completed projects (two in the C&I sector and two in the GNI sector) as of the close of PY2, no impact evaluation was conducted for the program in that year, and no Verified savings were reported. Instead, the realization rates developed through the PY3 evaluation of SCI were applied to the four PY2 projects, and the resulting savings were added to the CPITD Verified savings presented in both the PY3 annual report and this report. The CPITD Verified savings presented in this report and the PY3 report include 463 MWh in the C&I sector (reported under the SCI program) and 745 MWh in the GNI sector (which is included in Verified savings for the SEI GNI program) resulting from new construction projects completed in PY2.
- As noted previously, the Evaluation Verified (as opposed to TRM Verified) savings presented in this report reflect the application of an interactive effects factor of 1.02 to savings from the SLD program and the components of the LEEP program that provide CFLs. Appendix B presents the justification for and methodology for calculating the IEF for energy.

**Table 1-14. Gross Reported Energy Savings from PY1 through PY3 Annual Reports**

Program	Gross Reported Savings (MWh)		
	PY1	PY2	PY3
Smart Lighting Discounts Program	133,212	189,248	28,580
Smart Appliance Recycling Program	4,538	25,908	12,848
Smart Home Rebates Program	2,971	40,701	20,948
Low-Income Energy Efficiency Program	3,407	24,664	25,667
Smart Equipment Incentives - Retrofit	11,446	88,244	66,094
Smart Equipment Incentives - Multi-tenant	0	0	139
Smart Equipment Incentives -Appliance Recycling	0	0	16
Smart Construction Incentives	0	1,031	4,688
Smart Equipment Incentives - Retrofit	1,383	42,058	39,440
Smart Equipment Incentives - Multi-tenant	0	0	144
Smart Equipment Incentives -Appliance Recycling	0	0	33
Smart Equipment Incentives - New Construction	0	0	8,479
Conservation Voltage Reduction	20,819	320,372	0
Residential Direct Load Control	0	0	0
Commercial Direct Load Control	0	0	0
Permanent Load Reduction	0	0	0
Demand Response Aggregators	0	0	0
Distributed Energy Resources	0	0	0
<b>Total</b>	<b>177,776</b>	<b>732,226</b>	<b>207,076</b>

Source: Navigant analysis

**Table 1-15. Gross TRM Verified Savings from PY1 through PY3 Annual Reports**

Program	Gross Verified Savings (MWh)		
	PY1	PY2	PY3
Smart Lighting Discounts Program	133,212	189,248	28,580
Smart Appliance Recycling Program	4,487	25,908	12,309
Smart Home Rebates Program	2,963	40,701	20,819
Low-Income Energy Efficiency Program	n/a	24,543	24,652
Smart Equipment Incentives - Retrofit	14,444	76,022	68,255
Smart Equipment Incentives - Multi-tenant	0	0	139
Smart Equipment Incentives -Appliance Recycling	0	0	15
Smart Construction Incentives	0	0	4,385
Smart Equipment Incentives - Retrofit	1,708	36,519	29,737
Smart Equipment Incentives - Multi-tenant	0	0	144
Smart Equipment Incentives -Appliance Recycling	0	0	32
Smart Equipment Incentives - New Construction	0	0	9,242
Conservation Voltage Reduction	0	320,372	0
Residential Direct Load Control	0	0	0
Commercial Direct Load Control	0	0	0
Permanent Load Reduction	0	0	0
Demand Response Aggregators	0	0	0
Distributed Energy Resources	0	0	0
<b>Total</b>	<b>156,814</b>	<b>713,313</b>	<b>198,309</b>

Source: Navigant analysis

Table 1-16 and Table 1-17 present Reported and Verified Gross demand reduction as presented in the final annual reports for PY1 through PY3. The CPITD Reported and Verified Gross energy savings values presented in this report use the values in these tables with the following exceptions:

- Reported and Verified demand reduction from the SLD program reflect non-residential participation in that program in all four years of Phase I. The cumulative increase in TRM Verified demand reduction for PY1 through PY3 is 39.2 MW. PECO first presented details on the justification for this adjustment in its preliminary demand response filing. The justification and methodology are presented in Appendix C of this report.
- When the PY1 report was submitted, there was no approved protocol for evaluation of savings from the LEEP program, so although there was a Reported demand reduction for that program in PY1, the program was not credited with Verified demand reduction for PY1 until the PY2 report was submitted. The 0.2 MW of Verified demand reduction

for the PY1 LEEP program have been included in the program's CPITD verified savings in all PECO annual reports since PY2.

- The SCI program began operation late in PY2. As there were only four completed projects (two in the C&I sector and two in the GNI sector) as of the close of PY2, no impact evaluation was conducted for the program in that year, and no Verified demand reductions were reported. Instead, the realization rates developed through the PY3 evaluation of SCI were applied to the four PY2 projects, and the resulting demand reductions were added to the CPITD Verified savings presented in both the PY3 annual report and this report. The CPITD Verified demand reduction presented in this report and the PY3 report include less than 0.1 MW in both the C&I and GNI sectors resulting from new construction projects completed in PY2.
- Adjustments for line losses changed over the course of Phase I. In the PY1 annual report, PECO made no line loss adjustments to demand reduction values. In the PY2 report, PECO applied an average line loss factor of 1.076 to all demand reduction values. Beginning with the PY3 annual report, PECO applied program-specific line loss factors reflecting the rate class of participating customers. These values are presented in Table 1-2. In this report, the CPITD demand reduction values reflect the application of program-level line loss factors to demand reduction throughout all four years of Phase I.
- As noted previously, the Evaluation Verified (as opposed to TRM Verified) demand reductions presented in this report reflect the application of a coincidence factor of 0.117 to demand reductions from the SLD program and the components of the LEEP program that provide CFLs. Appendix A presents the justification and methodology for calculating this alternate CF.
- As noted previously, the Evaluation Verified (as opposed to TRM Verified) demand reductions presented in this report reflect the application of a demand interactive effects factor of 1.19 to demand reductions from the SLD program and the components of the LEEP program that provide CFLs. Appendix B presents the justification for and methodology for calculating the IEF for energy.

**Table 1-16. Gross Reported Demand Reduction from PY1 through PY3 Annual Reports**

Program	Gross Reported Savings (MW)		
	PY1	PY2	PY3
Smart Lighting Discounts Program	7.3	11.2	1.7
Smart Appliance Recycling Program	0.9	5.1	2.2
Smart Home Rebates Program	0.7	10.5	5.7
Low-Income Energy Efficiency Program	0.3	2.1	1.5
Smart Equipment Incentives-C&I	2.3	13.2	13.0
Smart Equipment Incentives - Multi-tenant	0.0	0.0	0.1
Smart Equipment Incentives -Appliance Recycling	0.0	0.0	0.0
Smart Construction Incentives	0.0	0.1	1.9
Smart Equipment Incentives - GNI	0.2	7.1	4.3
Smart Equipment Incentives - Multi-tenant	0.0	0.0	0.0
Smart Equipment Incentives -Appliance Recycling	0.0	0.0	0.0
Smart Equipment Incentives - New Construction	0.0	0.0	1.3
Conservation Voltage Reduction	0.0	89.3	0.0
Residential Direct Load Control	0.0	0.0	0.0
Commercial Direct Load Control	0.0	0.0	0.0
Permanent Load Reduction	0.0	0.0	0.0
Demand Response Aggregators	0.0	0.0	0.0
Distributed Energy Resources	0.0	0.0	0.0
<b>Total</b>	<b>11.7</b>	<b>138.6</b>	<b>31.7</b>

Source: Navigant analysis

**Table 1-17. Gross TRM Verified Demand Reduction from PY1 through PY3 Annual Reports**

Program	Gross Verified Savings (MW)		
	PY1	PY2	PY3
Smart Lighting Discounts Program	7.3	11.2	1.7
Smart Appliance Recycling Program	0.9	5.1	2.2
Smart Home Rebates Program	0.7	10.5	5.7
Low-Income Energy Efficiency Program	0.0	2.1	1.5
Smart Equipment Incentives - Retrofit	2.2	13.4	13.0
Smart Equipment Incentives - Multi-tenant	0.0	0.0	0.1
Smart Equipment Incentives -Appliance Recycling	0.0	0.0	0.0
Smart Construction Incentives	0.0	0.0	1.9
Smart Equipment Incentives - Retrofit	0.2	5.1	3.7
Smart Equipment Incentives - Multi-tenant	0.0	0.0	0.0
Smart Equipment Incentives -Appliance Recycling	0.0	0.0	0.0
Smart Equipment Incentives - New Construction	0.0	0.0	1.9
Conservation Voltage Reduction	0.0	89.3	0.0
Residential Direct Load Control	0.0	0.0	0.0
Commercial Direct Load Control	0.0	0.0	0.0
Permanent Load Reduction	0.0	0.0	0.0
Demand Response Aggregators	0.0	0.0	0.0
Distributed Energy Resources	0.0	0.0	0.0
<b>Total</b>	<b>11.3</b>	<b>136.7</b>	<b>31.7</b>

Source: Navigant analysis

## 1.6 Summary of PY4 Net-to-Gross Ratios

Per the 2011 TRC Order, EDCs are required to conduct NTG research. NTG ratios are not applied to gross savings and are not used for compliance purposes, but are used for future program planning purposes. Table 1-18 presents a summary of NTG ratios by program.

**Table 1-18. PY4 NTG Ratios by Program**

Program Name	NTG Ratio PY4	NTG Categories Included
Smart Lighting Discounts Program	38%	Free riders, spillover
Smart Appliance Recycling Program	56%	Free riders
Smart-Home Rebates Program	49%	Free riders, spillover
Low-Income Energy Efficiency Program	100%	Assumed. Low-income customers typically do not have the resources to install energy efficiency measures.
Smart Equipment Incentives C&I	78%	Free riders, spillover
Smart Equipment Incentives GIN	64%	Free riders, spillover
Smart Construction Incentives	44%	Free riders
<b>PORTFOLIO</b>	<b>69%</b>	

Source: Navigant analysis

## 1.7 Summary of Portfolio Finances and Cost-Effectiveness

Table 1-19 presents portfolio-level costs and benefits for PY4 and cumulatively for Phase I. In this table, benefits are calculated using TRM Verified savings, meaning that all energy savings and demand reduction values were calculated in strict accordance with the TRM. Note that the portfolio was cost effective in both PY4 and throughout Phase I.

Table 1-20 presents the same information as Table 1-19, except that in this table, Navigant calculated lifetime benefits assuming Evaluation Verified savings. As described previously, in calculating Evaluation Verified savings, Navigant made use of the alternate parameters presented in Table 1-1 for residential lighting savings. Doing so increased the energy and demand savings from lighting measures in the SLD and LEEP programs, increasing lifetime benefits and resulting in the higher TRC ratios presented in Table 1-20.

**Table 1-19. Summary of Portfolio Finances Using TRM Verified Savings**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	10,214	20,416	62,337
EDC Incentives to Trade Allies	-368	14	8,334
<b>Subtotal EDC Incentive Costs</b>	<b>9,846</b>	<b>20,430</b>	<b>70,671</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	4,040	21,542	67,279
Management <sup>[2]</sup>	1,316	4,544	27,651
Marketing <sup>[3]</sup>	1,434	14,869	33,185
Technical Assistance	712	3,377	13,304
<b>Subtotal EDC Implementation Costs</b>	<b>7,502</b>	<b>44,332</b>	<b>141,420</b>
EDC Evaluation Costs	1,987	3,678	9,015
SWE Audit Costs	0	0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>19,335</b>	<b>68,440</b>	<b>221,106</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>109,112</b>	<b>297,002</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>157,123</b>	<b>447,438</b>
Total Lifetime Energy Benefits	N/A	185,791	1,183,070
Total Lifetime Capacity Benefits	N/A	30,041	154,241
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>217,320</b>	<b>1,287,485</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>1.38</b>	<b>2.88</b>

**NOTES**

*Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.*

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs. There may be residual evaluation costs incurred from transitional Phase I evaluation activity, those costs will be identified and footnoted in the PY5Q2 report.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

[10] For Phase roll-up, all values are discounted back to the beginning of PY1 using the PY4 discount rate of 7.60%.

Source: Navigant analysis

**Table 1-20. Summary of Portfolio Finances Using Evaluation Verified Savings**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	10,214	20,416	62,337
EDC Incentives to Trade Allies	-368	14	8,334
<b>Subtotal EDC Incentive Costs</b>	<b>9,846</b>	<b>20,430</b>	<b>70,671</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	4,040	21,542	67,279
Management <sup>[2]</sup>	1,316	4,544	27,651
Marketing <sup>[3]</sup>	1,434	14,869	33,185
Technical Assistance	712	3,377	13,304
<b>Subtotal EDC Implementation Costs</b>	<b>7,502</b>	<b>44,332</b>	<b>141,420</b>
EDC Evaluation Costs	1,987	3,678	9,015
SWE Audit Costs	0	0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>19,335</b>	<b>68,440</b>	<b>221,106</b>
Participant Costs <sup>[5]</sup>	N/A	109,112	297,002
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>157,123</b>	<b>447,438</b>
Total Lifetime Energy Benefits	N/A	186,241	1,188,057
Total Lifetime Capacity Benefits	N/A	31,058	168,272
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>218,788</b>	<b>1,385,319</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>1.39</b>	<b>3.10</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

[10] For Phase roll-up, all values are discounted back to the beginning of PY1 using the PY4 discount rate of 7.60%.

Source: Navigant analysis

## 1.8 Summary of Cost-Effectiveness by Program

TRC ratios are calculated by comparing the total TRC benefits and the total TRC costs. Per the 2009 Order, TRC benefits are the avoided energy and capacity costs. TRC costs are net participant costs and EDC program costs. Participant incentives are not included in the TRC test except, per the 2011 TRC Order, in the case of demand response (DR) programs.

Table 1-21 shows the TRC ratios by program and other factors used in the TRC ratio calculation. For the entirety of Phase I, the TRC ratio based on CPITD values was 2.88. The TRC ratio for the portfolio in PY4 was 1.38. The PY4 ratio is lower than in the previous years in Phase I. One primary reason for this decrease is that multiple programs reduced their level of activity in PY4 as Phase I savings goals were approached or exceeded. This resulted in lower savings and therefore lower TRC benefits. At the same time, fixed costs or an explicit market maintenance strategy often prevented TRC costs from falling at a comparable rate.

The discount rate used in the PY4 cost-effectiveness calculations was 7.60 percent. This is equivalent to the rate used in PY3, but slightly higher than the rate of 7.45 percent used in PY1 and PY2. For programs that achieved TRC benefits due to the value of avoided replacement incandescent light bulbs, these benefits were assigned at the measure level based on primary market research performed during the middle of PY4. The annual cost of avoided energy was calculated separately for each of four periods during which energy savings were achieved: summer on-peak, summer off-peak, winter on-peak, and winter off-peak. A single value was calculated for the annual value of avoided demand. Separate residential and commercial and industrial (C&I) values were used for the annual value of avoided transmission and distribution (T&D) and line loss factors. For C&I line loss factors, the value ranged from 1.0760 to 1.1172 depending on the estimated mix of savings from small C&I and large C&I participants.

Multiple programs that had the primary aim of achieving demand savings (rather than energy savings) had no T&D benefits included in the total resource cost (TRC) calculations, including the Demand Response Aggregator (DRA), Distributed Energy Resources (DER), and Direct Load Control (DLC) programs. This is because, in Phase I, T&D benefits were calculated using avoided costs expressed in dollars per kilowatt-hour (kWh). These programs did not claim any kWh savings. In Phase II, T&D benefits for programs with the primary aim of achieving demand savings will be calculated using avoided costs expressed in dollars per kW, as used in PECO's Revised Phase II EE&C Plan and discussed in PECO direct testimony in Docket P-2012-

23203441.<sup>12</sup> The TRC calculations for these programs would have been significantly improved had this methodology been utilized in the Phase I TRC calculations.

**Table 1-21. PYTD TRC Ratios by Program Using TRM Verified Savings**

Program	Total TRC Benefits (\$1,000)	Total TRC Costs (\$1,000)	TRC Ratio	Discount Rate	Line Loss Factor
Smart Lighting Discounts Program	\$13,147	\$2,897	4.54	7.60	1.19
Smart Appliance Recycling Program	\$2,810	\$823	3.41	7.60	1.19
Smart Home Rebates Program	\$15,292	\$20,236	0.76	7.60	1.19
Low-Income Energy Efficiency Program	\$20,099	\$5,323	3.78	7.60	1.19
Smart Equipment Incentives - C&I	\$75,909	\$42,181	1.80	7.60	1.11
Smart Construction Incentives	\$9,165	\$4,670	1.96	7.60	1.11
Smart Equipment Incentives - GNI	\$71,780	\$52,145	1.38	7.60	1.12
Conservation Voltage Reduction	\$0	\$310	0.00	7.60	1.00
Residential Direct Load Control	\$2,618	\$15,294	0.17	7.60	1.19
Commercial Direct Load Control	\$82	\$1,470	0.06	7.60	1.19
Permanent Load Reduction	\$221	\$2,067	0.11	7.60	1.11
Demand Response Aggregators	\$5,409	\$7,791	0.69	7.60	Varies by participant: 1.070 to 1.192
Distributed Energy Resources	\$788	\$1,915	0.41	7.60	Varies by participant: 1.070 to 1.192
<b>TOTAL PORTFOLIO</b>	<b>\$217,320</b>	<b>\$157,122</b>	<b>1.38</b>	<b>7.60</b>	

Source: Navigant analysis

Table 1-22 presents the same information as Table 1-21, but reflects the higher Evaluation Verified savings in the SLD and LEEP programs.

<sup>1</sup> Direct testimony, Frank Jiruska. September 5, 2012.

**Table 1-22. PYTD TRC Ratios by Program Using Evaluation Verified savings**

<b>Program</b>	<b>Total TRC Benefits (\$1,000)</b>	<b>Total TRC Costs (\$1,000)</b>	<b>TRC Ratio</b>	<b>Discount Rate</b>	<b>Line Loss Factor</b>
Smart Lighting Discounts Program	\$13,753	\$2,897	4.75	7.60	1.19
Smart Appliance Recycling Program	\$2,810	\$823	3.41	7.60	1.19
Smart Home Rebates Program	\$15,292	\$20,236	0.76	7.60	1.19
Low-Income Energy Efficiency Program	\$20,961	\$5,323	3.94	7.60	1.19
Smart Equipment Incentives - C&I	\$75,909	\$42,181	1.80	7.60	1.11
Smart Construction Incentives	\$9,165	\$4,670	1.96	7.60	1.11
Smart Equipment Incentives - GNI	\$71,780	\$52,145	1.38	7.60	1.12
Conservation Voltage Reduction	\$0	\$310	0.00	7.60	1.00
Residential Direct Load Control	\$2,618	\$15,294	0.17	7.60	1.19
Commercial Direct Load Control	\$82	\$1,470	0.06	7.60	1.19
Permanent Load Reduction	\$221	\$2,067	0.11	7.60	1.11
Demand Response Aggregators	\$5,409	\$7,791	0.69	7.60	Varies by participant: 1.070 to 1.192
Distributed Energy Resources	\$788	\$1,915	0.41	7.60	Varies by participant: 1.070 to 1.192
<b>TOTAL PORTFOLIO</b>	<b>\$218,788</b>	<b>\$157,122</b>	<b>1.39</b>	<b>7.60</b>	

Source: Navigant analysis

## **2 Smart Lighting Discounts**

The PECO SLD Program is an upstream-incentive program started in October 2009 that encourages and facilitates the adoption of CFLs and helps PECO's residential customers become conscious about their energy use. The program achieves this goal by providing incentives to manufacturers to increase the market share of ENERGY STAR-qualified CFLs sold through retail sales channels, as well as by distributing educational materials that increase customer awareness, acceptance, and understanding of energy-efficient lighting technology.

### **2.1 Program Updates**

In the first two years of Phase I, the SLD Program was responsible for the largest proportion of total PECO portfolio savings among all of the Act 129 PECO programs. In the early months of PY3, PECO reduced the SLD Program in size by approximately 95 percent to align overall Phase I savings with the previously established EE&C Plan targets. PECO also shifted the focus of the program from standard spiral CFLs to an almost exclusive focus on specialty CFLs. PECO maintained the program at approximately the same reduced size for PY4. Average monthly bulb sales were approximately 22,000 in PY4. Similar to PY3, the focus of the program in PY4 was on the sale of specialty CFLs.

There were modest changes to program offering, sales channels, and marketing approach in PY4. Several additional specialty CFL models were added to the program, which increased the offerings for reflector lamps, candelabras, and dimmable CFLs. Program sales took place almost exclusively through Home Improvement stores, whereas in past program years there was a significant minority of sales taking place through warehouse stores and big-box stores. Program messaging shifted in PY4 from emphasizing the incentives to emphasizing the more significant savings that one can achieve over the lifetime of a bulb by switching to energy-efficient lighting.

### **2.2 Impact Evaluation Gross Savings**

#### **2.2.1 Methodology**

The PY4 SLD Program evaluation draws upon several evaluation methods designed in light of the significant reduction in the program's size and the specific focus on specialty CFLs. The primary data sources for PY4 included PECO PY4 tracking data analysis, shelf-stocking surveys at a sample of participating retailers, and in-depth phone interviews with PECO program staff and the Ecova program implementers. Additional research activities that spanned the PY4 SLD

evaluation as well as informed updates to the 2013 PA TRM included deriving updated savings parameter values for Peak Load Coincidence Factor and Lighting-Heating, Ventilating, and Air Conditioning (HVAC) Interactive Effects Factors for energy and demand. Details on the methods and results of these parameter value updates are provided in separate memos sent to PECO.

In addition to the above activities, the evaluation team undertook an effort to conduct surveys with PY4 SLD Program participants and non-participant lighting purchasers regarding their lighting choices, through the use of in-store tear-off sheets displayed in the lighting aisle of participating stores. These business-card-sized tear-off sheets, which invited shoppers to participate in the survey and be entered for a chance to win a \$500 gift card, presented the shopper with three ways of accessing the survey: a phone number, uniform resource locator, and quick response code for a cell phone scanner. Unfortunately, the response rate was extremely low, with only 20 total surveys completed over the six-week period in which the tear-off sheets were in the stores. Eighteen of the respondents did the online version of the survey, and 2 respondents did the phone-based version of the survey. Of these 20 survey respondents, only 3 were purchasing program bulbs. This response rate is too low to be used for meaningful analysis of the PY4 SLD Program. As a result, parameter values for cross-sector installation of program bulbs and NTG ratio were developed from the PY2 intercepts.

### **2.2.2 Reported Savings**

The number of bulbs distributed through the program is derived from the Residential Lighting tracking database provided to the evaluation team as part of the PECO Smart Data System extract. In the case of the Smart Lighting Discounts Program, the calculation of gross energy and demand savings consists of two steps: 1) verifying program tracking data against scanned manufacturer invoices for program bulb sales, and 2) calculating gross energy and demand savings by applying the savings parameter values described above to each record in the tracking data and summing across all records.

A total of 248,548 CFLs were sold as part of the PY4 program. The products included in this program are all partially deemed measures in the 2012 TRM<sup>13</sup> for PY4. Program-reported

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<sup>13</sup> Pennsylvania Public Utility Commission. 2012. *Technical Reference Manual for Pennsylvania Act 129 Energy Efficiency and Conservation Program and Act 213 Alternative Energy Portfolio Standards.*

savings are based on deemed values for all savings parameters with the exception of Displaced Watts (or Delta Watts), which is derived on a per-bulb basis as the difference between the CFL wattage and the incandescent replacement wattage. The evaluation team verified all program bulb sales and deemed savings calculations in the PY4 compliance reporting process, and the verified program-reported gross energy and demand savings are shown as the Program-Reported savings in Table 2-1 below. Bulb sales were highest in Q2 and Q3, but did not show remarkable variation across quarters. Gross demand reduction in the Top 100 Hours was 0.1 MW, and all took place during Q1. Gross summer peak demand reduction attributed to bulbs sold throughout the year was 0.6 MW.

On the incentives side, it is important to note that in PY4 Q4, there were \$75,000 paid in incentives, but in that same quarter \$624,000 in incentive costs were moved from SLD to the Smart Equipment Incentives (SEI) program in recognition that a portion of overall portfolio incentive dollars were going to customers that were installing SLD program bulbs in non-residential sockets. The result was -\$549k in SLD incentives for PY4 Q4, and -\$265k in SLD incentives for PY4 overall.

**Table 2-1. PY4 SLD Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	53,324	2,518	0.1	0.1	79
PY4 Q2	69,274	3,305	0.0	0.2	97
PY4 Q3	75,104	3,623	0.0	0.2	107
PY4 Q4	61,485	2,994	0.0	0.2	-533
<b>PY4 Total</b>	<b>259,187</b>	<b>12,440</b>	<b>0.1</b>	<b>0.7</b>	<b>-250</b>
<b>CPITD Total</b>	<b>7,675,726</b>	<b>363,389</b>	<b>22.7</b>	<b>23.3</b>	<b>7,856</b>

Source: Navigant analysis

Although the in-store tear-off sheet survey conducted in PY4 included questions designed to inform an estimate of low-income participation in Smart Lighting Discounts and cross-sector installation of program bulbs in non-residential sockets, there was not a sufficient number of completed surveys to enable this analysis based on PY4 primary data. As was specified in the PY4 evaluation plan in anticipation of this possible outcome, the low-income participation rate from Smart Home Rebates (12%) is used as a proxy for low-income participation in SLD. The estimate of cross-sector installation of program bulbs derived from the PY2 in-store intercepts

(7.7%) is used to calculate commercial and industrial participation and savings. Results are shown in Table 2-2 below. Appendix C presents detailed information on the estimation of non-residential participation in the SLD Program.

**Table 2-2. PY4 SLD Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	210,522	13,619	0.2	1.5	(\$220)
Low-income	28,708	1,857	0.0	0.2	(\$30)
Commercial and Industrial	19,957	1,291	0.0	0.1	\$624
Government and Nonprofit	0	0	0.0	0.0	\$0
<b>PY4 Total</b>	<b>259,187</b>	<b>16,768</b>	<b>0.2</b>	<b>1.8</b>	<b>\$374</b>
<b>CPITD Total</b>	<b>7,675,726</b>	<b>489,941</b>	<b>62.0</b>	<b>63.6</b>	<b>\$7,856</b>

*Source: Navigant analysis*

### 2.2.3 Verified Savings

Because the verification process consists of checking the program tracking data against manufacturer invoices, rather than performing savings measurement and verification activities for a subset of participants, there are no sampling methodology or strata designations associated with the Smart Lighting Discounts Program savings verification. There is also no coefficient of variation. Consequently, Table 2-3 shows that both the target sample size and the achieved sample size are the whole population size of program bulbs for the year.

**Table 2-3. SLD Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Smart Lighting Discounts	All program bulbs	259,187	N/A	90%/±0.00%	259,187	259,187	Verify program bulb sales against manufacturer invoices, apply deemed savings parameters to calculate savings.
<b>Program Total</b>		<b>259,187</b>	<b>N/A</b>	<b>90%/±0.00%</b>	<b>259,187</b>	<b>259,187</b>	

Source: Navigant analysis

In addition to the program-reported energy and demand savings, which were based strictly on savings parameters from the TRM, the evaluation team calculated savings by two other methods:

1. TRM-Verified savings and Evaluation Verified savings. These calculation methods differed from the Program-Reported energy and demand savings. The TRM-Verified approach to savings calculations used the same savings parameters from the TRM as program-reported savings, but was modified to reflect the fact that 7.7 percent of program bulbs are going into commercial installations.
2. The Evaluation Verified savings incorporated the 7.7 percent cross-sector installations, an updated peak load coincidence factor of 11.7 percent based on literature review, and lighting-HVAC interactive effects factors for energy (1.02) and demand (1.19) based on building energy simulation modeling.

*Coincidence Factor*

Prior to the PY4 Q3 report, demand reduction impacts for residential lighting measures had been calculated using the Peak Load Coincidence Factor (CF) of 5 percent in the 2012 Pennsylvania TRM. This value comes from a 2007 report by RLW Analytics, entitled “Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the

ISO Forward Capacity Market (FCM)."<sup>14</sup> As the 5 percent CF has been acknowledged by both the statewide evaluator (SWE) and the technical utility staff of the PUC to be erroneous,<sup>15</sup> Navigant has used a residential lighting load shape developed through the 2009 Northeast residential lighting logger study conducted by Nexus Market Research, RLW Analytics, and GDS Associates (the NMR 2009 study) to calculate a revised CF of 11.7 percent over PECO's Top 100 Hours during the summer of 2012.<sup>16</sup> Details on the derivation of this CF are presented in Appendix A.

#### *Lighting Interactive Effects Factor*

Navigant constructed building energy computer simulation models to determine the HVAC impacts from efficient lighting installations in the PECO service territory. Navigant used these models to calculate energy and demand IEFs, which are used to adjust the program lighting savings to account for the additional impacts on HVAC energy and demand. Navigant has not applied energy and demand interactive effects in previous evaluations of PECO's residential programs because these were not included in the TRM. However, the evaluation team believes that by not including this factor, the TRM is significantly underestimating demand savings from efficient lighting installations. Details on the derivation of the IEFs are presented in Appendix B.

Reported PY4 gross energy savings that reflected the 7.7 percent commercial installation of program bulbs were 16,768 MWh, as shown in Table 2-4. However, in that calculation, the evaluation team did not apply the PY4 realization rate for non-residential program bulbs, 0.86, calculated in the SEI evaluation. When this factor is applied, TRM-verified gross energy savings are 16,028 MWh, and the resulting energy realization rate for SLD is 95.6 percent.

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<sup>14</sup> RLW Analytics, 2007. "Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market (FCM)", prepared for the New England State Program Working Group (SPWG), March 25, 2007, p. IV.

<sup>15</sup> See the minutes of the Program Evaluation Group meeting from March 20, 2013 (forwarded to all EDCs and evaluators on March 29, 2013).

<sup>16</sup> Nexus Market Research, Inc., RLW Analytics, Inc., and GDS Associates, 2009. Residential Lighting Markdown Impact Evaluation. Prepared for Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009.

**Table 2-4. PY4 SLD TRM-Verified Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Smart Lighting Discounts	16,768	96%	0	0	16,028	0
<b>Program Total</b>	<b>16,768</b>	<b>96%</b>	<b>0</b>	<b>0</b>	<b>16,028</b>	<b>0</b>

Source: Navigant analysis

Using the calculations that include the 7.7 percent cross-sector installations, the updated peak load coincidence factor of 11.7 percent, and the lighting-HVAC interactive effects factors for energy and demand, reported PY4 gross energy savings were 16,997 MWh, as shown in Table 2-5. However, similar to the TRM-based calculations above, the evaluation team did not apply the PY4 realization rate for non-residential program bulbs, 0.86, calculated in the Smart Equipment Incentives evaluation. When this factor is applied, TRM-verified gross energy savings are 16,257 MWh, and the resulting energy realization rate for SLD is 95.6 percent.

**Table 2-5. PY4 SLD Evaluation-Verified Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Smart Lighting Discounts	16,997	96%	0	0	16,257	0
<b>Program Total</b>	<b>16,997</b>	<b>96%</b>	<b>0</b>	<b>0</b>	<b>16,257</b>	<b>0</b>

Source: Navigant analysis

Table 2-6 and Table 2-7 show the peak demand savings calculations using the TRM approach and the Navigant approach described above for energy. As discussed for energy savings above, non-residential savings parameters were applied to the 7.7 percent of program bulbs that were installed in non-residential sockets. Reported PY4 gross energy savings using this method were 1.8 MW, and when adjusted to incorporate the SEI demand realization rate yielded verified gross demand savings of 1.6 MW. The demand realization rate is 87 percent.

**Table 2-6. PY4 SLD TRM-Verified Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Smart Lighting Discounts	1.8	87%	0	0	1.6	0
<b>Program Total</b>	<b>1.8</b>	<b>87%</b>	<b>0</b>	<b>0</b>	<b>1.6</b>	<b>0</b>

Source: Navigant analysis

Reported PY4 gross energy savings were 2.9 MW when applying the 7.7 percent cross-sector installations, the 11.7 percent peak coincidence factor, and the lighting-HVAC demand interactive effects factor of 1.19. After adjusting to incorporate the SEI demand realization rate, Navigant verified gross demand savings are 2.7 MW. The demand realization rate is 92 percent.

**Table 2-7. PY4 SLD Evaluation-Verified Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Smart Lighting Discounts	2.9	92%	0	0	2.7	0
<b>Program Total</b>	<b>2.9</b>	<b>92%</b>	<b>0</b>	<b>0</b>	<b>2.7</b>	<b>0</b>

Source: Navigant analysis

### 2.3 Impact Evaluation Net Savings

Due to the insufficient number of in-store tear-off survey completes, it was not feasible to develop an estimated NTG ratio based specifically on PY4 sales. Instead, the PY2 sales-weighted NTG ratio was used to calculate PY4 net savings. The PY2 NTG ratio was calculated as the simple average of the values arising from four NTG methods: General population telephone survey (NTG 0.44 for standard CFLs, 0.40 for specialty CFLs), in-store intercept survey (NTG 0.35 for all CFLs), trade ally surveys (NTG 0.40 for standard CFLs, 0.35 for specialty CFLs), and revealed preference purchase modeling (NTG 0.35 for all CFLs).

Of the four NTG estimation methods employed in PY2, the only method that specifically captures spillover is the general population telephone survey. Two types of spillover were estimated for the PY2 general population self-report method: participant and non-participant

spillover. Spillover for both participants and non-participants includes all adoptions of energy-efficient lighting measures that are influenced by the program, but are not done through the program (i.e., are not rebated).

The PY2 participant spillover rate was calculated by summing the spillover adoptions over all program participants and then dividing it by the total number of purchases made through the program. The PY2 non-participant spillover rate was calculated in a similar manner as participant spillover except the spillover adoptions were divided by the number of surveyed customers. This value then was applied to the appropriate population of non-participating customers to estimate the number of spillover adoptions occurring in that population.

To generate the PY4 overall NTG estimate, the evaluation team applied each of the PY2 NTG estimates by bulb type to the PY4 distribution of standard and specialty CFL sales. The sales-weighted NTG ratio for PY4 arising from these values is 0.38, the same as the sales-weighted value from PY2.

## **2.4 Process Evaluation**

The process evaluation used information from the in-depth program manager and implementer interviews and shelf surveys to assess process-related aspects of the SLD Program. The in-depth interviews provided information about the program strategy and focus in comparison with prior program years. The shelf surveys gave the evaluation team insight into the current state of the lighting market through an inventory of the types of bulbs available in stores for purchase.

Two in-depth program manager and implementer interviews were conducted as part of the PY4 evaluation. The interview with program managers featured three senior-level PECO staff with decision-making power over the program and who know the history of the program's implementation, operation, successes, and failures. These interviews were completed over the phone in January and February of 2013.

Interviewees verified that the program design has been generally consistent from PY3 into PY4. Discount levels for each type of bulb featured in the program were not changed significantly from prior program years. A small number of additional specialty CFL models were added to the program and resulted in increasing the program offerings for reflector lamps, candelabras, and dimmable CFLs. In PY4 the program focused almost completely in Home Improvement/DIY stores with a minimal presence in small hardware stores, whereas in PY1 and PY2 it also featured prominently in big-box stores and warehouse/club stores. While the signage and other point-of-purchase (POP) materials in participating stores have not been

substantially modified, the general messaging of the program has shifted from emphasizing the incentives on CFLs as a source of savings to emphasizing the more significant savings that one can achieve over the lifetime of a bulb by switching to energy-efficient lighting. Store visits and lighting demonstrations were conducted by two field staff that helped answer customers' questions about the specific lighting types that would meet their needs. The PECO website, bill inserts, and radio advertisements remain the primary marketing tools for the program.

The evaluation team conducted shelf surveys at a sample of eight stores across two retailers that were participants in the PY4 program. As a point of comparison, the evaluation team compared the Pennsylvania shelf survey data against shelf survey data from several stores at those same retailers in California. Because California has an accelerated schedule of adoption of Energy Independence and Security Act (EISA) legislation by one year compared with the rest of the country, this comparison offers a look one year ahead in terms of the sell-through of traditional incandescent bulbs of certain wattages whose manufacture and import are no longer permitted under EISA, and the resulting influence on the availability of products on the shelves.

*The shelf surveys documented the presence of a variety of information materials related to energy-efficient lighting in the lighting aisles of participating stores.*

Overall, the shelf surveys revealed a lighting market in transition, as retailers, manufacturers, and PECO all focus on the increasing array of energy-efficient lighting options available. The focus of SLD on specialty CFLs in PY4 is evident from the shelf survey data. Traditional incandescent bulbs affected by EISA are on an expected trend of reduced presence on store shelves, though at a somewhat slower time trajectory than expected. PECO incentives on program bulbs are typically \$1.50 per bulb across most bulb types and represent a discount of 17 to 38 percent.

*Process recommendations listed in Table 2-8 are largely carried forward from the PY3 evaluation, reinforced by the findings from the PY4 program manager and implementer interviews and shelf surveys.*

**Table 2-8. Status Report for SLD Process Evaluations**

<p><b>Recommendations</b></p>	<p><b>EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)</b></p>
<p>Prioritize in-store intercept surveys using field staff in the aisles of participating stores to collect information for key evaluation parameters</p>	<p>Implemented. EDC is working with program implementer to facilitate logistics and permission for these in PY5 participating stores.</p>
<p>Use a Segmented Marketing Approach for PECO Customers Based on Socket Saturation</p>	<p>Being considered. PECO managers and the evaluation team are scheduling a call to discuss options.</p>
<p>Focus education and marketing efforts on the wide variety of specialty CFLs that are available</p>	<p>Being considered. PECO managers and the evaluation team are scheduling a call to discuss options.</p>
<p>Use the phase-out under EISA of traditional incandescent 60-W and 40-W bulbs as of January 2014 as an opportunity to emphasize growing diversity and excellent performance of energy-efficient lighting options</p>	<p>Being considered. PECO managers and the evaluation team are scheduling a call to discuss options.</p>
<p>Expect the education process around lumen awareness to take a long time, and sustain education efforts</p>	<p>Being considered. PECO managers and the evaluation team are scheduling a call to discuss options.</p>
<p>Increase the Coordination of Community Outreach and In-Store Tabling Events Across PECO's Portfolio of Energy Efficiency Programs</p>	<p>Being considered. PECO managers and the evaluation team are scheduling a call to discuss options.</p>

Source: Navigant analysis

## 2.5 Financial Reporting

Table 2-9 and Table 2-10 present program finances. The costs are the same in both tables; however, Table 2-9 presents benefits based on TRM Verified savings, whereas Table 2-10 presents benefits based on Evaluation Verified savings. The program was highly cost effective during both PY4 and all of Phase I in both scenarios. In PY4 Q4, there were \$75,000 paid in incentives however, in that same quarter, \$624,000 in incentive costs were moved from SLD to the Smart Equipment Incentives Program in recognition that a portion of overall portfolio incentive dollars were going to customers that were installing SLD Program bulbs in non-residential sockets. The CPITD TRC for the duration of Phase I was 11.77 (15.45 using

Evaluation Verified savings), due to the larger program size in PY1-PY3, which generated larger savings benefits set against the relatively fixed nature of some program costs.

**Table 2-9. Summary of SLD Finances Using TRM Verified Savings**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	-533	-249	7,857
<b>Subtotal EDC Incentive Costs</b>	<b>-533</b>	<b>-249</b>	<b>7,857</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	135	485	2,599
Management <sup>[2]</sup>	131	360	1,142
Marketing <sup>[3]</sup>	476	882	4,116
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>742</b>	<b>1,727</b>	<b>7,857</b>
EDC Evaluation Costs	217	416	1,110
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>426</b>	<b>1,893</b>	<b>16,823</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>755</b>	<b>17,379</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>2,897</b>	<b>26,346</b>
Total Lifetime Energy Benefits	N/A	11,675	339,330
Total Lifetime Capacity Benefits	N/A	609	22,382
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>13,147</b>	<b>310,001</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>4.54</b>	<b>11.77</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

**Table 2-10. Summary of SLD Finances Using Evaluation Verified Savings**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	-533	-249	7,857
<b>Subtotal EDC Incentive Costs</b>	<b>-533</b>	<b>-249</b>	<b>7,857</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	135	485	2,599
Management <sup>[2]</sup>	131	360	1,142
Marketing <sup>[3]</sup>	476	882	4,116
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>742</b>	<b>1,727</b>	<b>7,857</b>
<b>EDC Evaluation Costs</b>	<b>217</b>	<b>416</b>	<b>1,110</b>
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>426</b>	<b>1,893</b>	<b>16,823</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>755</b>	<b>17,379</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>2,897</b>	<b>26,346</b>
Total Lifetime Energy Benefits	N/A	11,858	344,051
Total Lifetime Capacity Benefits	N/A	1,032	35,819
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>13,753</b>	<b>406,973</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>4.75</b>	<b>15.45</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

- [1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.
- [2] Includes EDC program management, CSP program management, general management oversight, and major accounts.
- [3] Includes the marketing CSP and marketing costs by program CSP's.
- [4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.
- [5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.
- [6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.
- [7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.
- [8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.
- [9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

### **3 Smart Appliance Recycling**

The Smart Appliance Recycling (SAR) program offers free pickup and recycling services for older, working refrigerators and freezers that households no longer want. Program savings are based on the accelerated removal, dismantling, and recycling of these older, inefficient units. In exchange for participating in the program, PECO pays participants an incentive for each removed unit (up to a maximum of two recycled refrigerators or freezers).

The program has two components, JACO recycling and retailer pickups. The JACO recycling component concentrates on removal of existing secondary units from homes and apartments. The retailer component of the program focuses on preventing former primary refrigerators and freezers from being retained and used as secondary units when customers purchase new units. Through the program, units are removed from customers' homes and retailers' facilities to a collection facility and disassembled for environmentally responsible disposal and recycling. There is no charge to the customer for the appliance pickup and recycling.

#### **3.1 Program Updates**

The design of the Smart Appliance Recycling program has remained largely the same as in previous program years, with the exception of the program incentive level and elimination of the room air conditioner measure. On November 1, 2011, the incentive was reduced from \$35/unit to \$15/unit and the room air conditioner measure was eliminated from the program. This was part of a broader strategy by PECO to reduce incentives across most of its programs. The lower incentive level has resulted in a significant drop in participation levels, which are now less than one-third of the levels seen prior to this incentive reduction.

#### **3.2 Impact Evaluation Gross Savings**

##### **3.2.1 Methodology**

The impact evaluation of the Appliance Recycling program is based on an in-depth review and analysis of tracking data, application of the deemed savings factors approved by the SWE and published in the TRM or a related work paper, and a separate verification of units being picked up by the program via a telephone survey. The verification was based on a screening question in the telephone survey to verify the appliances were picked up as reported in the program tracking database. The first and second waves of participant telephone surveys, for all PY4 participants, were completed in early March and July 2013, respectively.

The energy and demand savings for this program are straightforward. All values in the calculation are deemed, with the exception of the verification factor, which is derived from the telephone survey. Per the TRM, separate savings factors are applied for replaced units (reflecting somewhat lower savings) and non-replaced units (incorporating somewhat higher savings). In addition, replaced units are differentiated by whether the unit is ENERGY STAR certified or non-ENERGY STAR certified. ENERGY STAR-certified units have a somewhat higher deemed savings value than non-ENERGY STAR certified units. Verified savings are equal to the number of recycled units times the TRM savings per unit times the verification factor.

### 3.2.2 Reported Savings

Table 3-1 presents program participation, savings, and incentives on a quarterly basis. Table 3-2 indicates how program participation, savings, and incentives through the end of PY4 are distributed across customer sectors. Low-income savings was calculated by applying a percentage of low-income participants times overall program MWh and MW savings. The percentage of low-income participants was based on survey findings to a question regarding family income levels. These income levels were tailored to each respondent based on the number of persons they indicated in their household. The threshold used to define low income was 200 percent of Federal Poverty Levels (FPLs). Based on these findings, 18.6 percent of participants in the program are defined as low income.

**Table 3-1. PY4 Smart Appliance Recycling Program Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	1,070	1,550	0.1	0.2	17
PY4 Q2	732	1,051	0	0.2	12
PY4 Q3	511	781	0	0.1	8
PY4 Q4	517	756	0	0.1	8
<b>PY4 Total</b>	<b>2,830</b>	<b>4,138</b>	<b>0.1</b>	<b>0.6</b>	<b>45</b>
<b>CPITD Total</b>	<b>30,573</b>	<b>47,431</b>	<b>9.2</b>	<b>9.7</b>	<b>1,077</b>

Source: Program tracking data, reviewed by Navigant team

**Table 3-2. PY4 Smart Appliance Recycling Program Reported Results by Sector**

<b>Sector</b>	<b>Participants</b>	<b>Reported Gross Energy Savings (MWh)</b>	<b>Top 100 Hours Reported Gross Demand Reduction (MW)</b>	<b>Total Reported Gross Demand Reduction (MW)</b>	<b>Incentives (\$1,000)</b>
Residential	2,304	3,368	0.1	0.5	36
Low-Income	526	770	0.0	0.1	8
Commercial and Industrial	0	0	0	0	0
Government and Nonprofit	0	0	0	0	0
<b>PY4 Total</b>	<b>2,830</b>	<b>4,138</b>	<b>0.1</b>	<b>0.6</b>	<b>45</b>
<b>CPITD Total</b>	<b>30,573</b>	<b>47,431</b>	<b>9.2</b>	<b>9.7</b>	<b>1,077</b>

Source: Navigant analysis

The sample for the telephone survey of program participants was drawn to achieve 90/10 confidence/precision levels on an annual basis. As shown in Table 3-3, the target sample size for the telephone survey in PY4 was 250 completed surveys. In total, 256 surveys were completed, slightly higher than the target. In addition, surveys were conducted with the three largest retailers associated with units replaced by participants after the program had removed their units. These retailer survey results are factored into the NTG ratio calculation.

**Table 3-3. Smart Appliance Recycling Program Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Population	N/A	2,972	0.35	85/15	250	256	Participant survey: Part-use factor, NTC, Process
Attempted census of largest firms	N/A	3	N/A	N/A	N/A	N/A	Retailer survey. NTC
<b>Program Total</b>	N/A	<b>2,972</b>	<b>0.35</b>	<b>85/15</b>	<b>250</b>	<b>256</b>	Participant survey: Part-use factor, NTC, Process

Source: Navigant analysis

### 3.2.3 Verified Savings

Table 3-4 and Table 3-5 present evaluation results for energy and demand, respectively. Results are significantly down from prior years,<sup>17</sup> reflecting the results of the significant drop-off in participation levels. In addition, the energy and demand realization rates of 94 percent, resulting from the phone survey conducted, reflects the fact that not all customers were able to verify that PECO’s program had, in fact, collected their unit. Some 6 percent did not.

<sup>17</sup> For example, PY3 savings were 12,309 MWh and in PY2 they were 16,749 MWh.

**Table 3-4. PY4 Smart Appliance Recycling Program Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Population	4,138	94.0%	0.184	0.49%	3,873	0
<b>Program Total</b>	<b>4,138</b>	<b>94.0%</b>	<b>0.184</b>	<b>0.49%</b>	<b>3,873</b>	<b>0</b>

Source: Navigant team analysis

**Table 3-5. PY4 Smart Appliance Recycling Program Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Population	0.6	94%	0.253	0.14%	0.564	0
<b>Program Total</b>	<b>0.6</b>	<b>94%</b>	<b>0.253</b>	<b>0.14%</b>	<b>0.564</b>	<b>0</b>

Source: Navigant team analysis

### 3.3 Impact Evaluation Net Savings

The NTG assessment of retailer-sourced units has been expanded in PY4 to assess program influence in all cases where an existing unit has been replaced. Such an inquiry involves investigating the used appliance disposal practices of most of the major retailers associated with unit replacements. Navigant used responses from the participating customer survey to determine the analytical approach for the retailer associated units, as well as the non-replaced units picked up by JACO at customers' homes. The NTG ratio has been calculated using a two-step process: first, to the participant survey for information on unit disposal absent PECO's program; second, for those participants that replaced existing units and that indicated they would have had their unit removed by the dealer that they got their replacement unit from. The results from the retailer interviews are used directly to calculate the NTG ratio.

The NTG ratio thus encompasses free ridership from each of these segments in terms of the following:

- » Retailers associated with new unit purchases who indicated they would have otherwise:

- o Deconstructed the unit (including re-selling and/or recycling its component parts)
  - o Taking the unit to a landfill/dump/scrap dealer
- » Participating customers who indicated they would have otherwise:
- o Sent the unit to a recycling facility, or
  - o Taken the unit to a landfill/dump/scrap dealer

Because the program approach does not support a theory for how meaningful spillover might occur, and because it does seem unlikely to be significant, Navigant did not estimate spillover.

The program NTG ratio for PY4 is thus a weighted average based on responses from each participating retailer interviewed and each participating customer surveyed for units sourced from each source, respectively.

Of those survey respondents that replaced their units, some 54 percent (94 of 174) indicated they would have had their unit removed by the dealer. The remaining 46 percent (80 of 174) would have used various other methods such as donating it to a charity, hauling it to the dump and recycling center, hiring someone to haul it away, and keeping it stored, unplugged.

***Participating Customer Findings.*** In total, 63 out of 224 refrigerator respondents (28%) and 14 of 38 freezer respondents (37 %) revealed they would have used a method to dispose of their unit that would have permanently destroyed it, indicating they are free riders. Note that the total number of refrigerator and freezer respondents of 262 exceeds the total number of survey completes (N = 256). This is because a small number of respondents, six in total, had both types of units. Resulting NTG ratios for non-replacer recycling customers and those that replaced a unit are 0.72 for refrigerators, and 0.63 for freezers. These values were applied to both non-replaced units, and those who would have used a method not involving the retailer from whom they bought the replacement unit in calculating the NTG ratio.

***Program-Induced Replacements.*** The NTG ratio also reflects the impact of program-induced replacements. This accounts for the role played by PECO's SAR program and incentive in inducing a customer to replace their unit after the old unit was removed by the program and recycled. Such inducement could result from the program incentive, the convenience of the home pickup, or some other factor named by the respondent. The program-induced replacement effect on the NTG ratio is extremely small—+0.01 in magnitude—and is added to the final NTG ratio after all other calculations are done.

**Retailer Findings.** A total of three retailers that provided replacement units to participating customers were interviewed thoroughly to learn of their appliance disposal practices in the absence of PECO’s program. Retailers were asked a series of questions regarding the following:

- » Pickup and disposal services for replaced units
  - Charges, if any for such services
  - Percentage of customers that receive such services
  
- » Recycling and/or deconstruction of units picked up by the retailer
  - Approach for units outside of PECO’s program – percentage of units affected
  - Approach prior to the start-up of PECO’s program – percentage of units affected
  
- » Other disposition of units
  - Percentage that are picked up by a hauler/third party and resold (i.e., remain grid connected)

Each retailer provided specific answers to each of these topic areas. In general, a high percentage of units turned over to retailers are being disposed of via a method that permanently removes them from the grid. Only small percentages—the newest units in the best condition — are resold and therefore, remain grid connected.

From this information, we were able to construct a retailer-specific NTG ratio, representing 1 minus the percentage of units that would otherwise have been recycled or deconstructed in the absence of PECO’s program. The results, by retailer, are shown in Table 3-6.

**Table 3-6. PY4 Net-to-Gross Ratios by Retailer**

Retailer	Free Rider % **	NTG ratio	Percentage of Respondents
Retailer # 1 - national chain	59%	0.41	25%
Retailer #2 - regional chain	79%	0.21	4%
Retailer #3 - national chain	70%	0.30	1%

\*\* Self-reported percentage of units that are recycled or deconstructed in the absence of PECO’s program. These are based on each retailer’s direct responses.

Source: Navigant analysis

Responses from the participating customer survey were used in all cases to determine the basis for the NTG ratio. The NTG ratio was calculated using a two-step process. First the participant survey provided information on unit disposal absent PECO’s program. Second, for those participants that replaced existing units and that indicated they would have had their unit

removed by the dealer that they got their replacement unit from, the results from the retailer interviews were used directly to calculate the NTG ratio. Some 30 percent of respondents fell into this category. The remaining 70 percent of respondents provided answers not related to retailer disposal. Their NTG ratios are based on answers such as giving the unit to a friend or neighbor, reselling it, giving it to a charity, taking it to a landfill, or having a recycler haul it away. The latter two response categories are considered free riders.

Thus, the NTG ratio is a weighted average of retailer-associated responses and non-retailer-associated responses. Once this weighted average was computed, the impact of the program-induced replacement factor of +0.01 was then incorporated.

Based on this weighted average, the verified NTG ratios for PY4 of 0.58 for refrigerators and 0.43 for freezers (or 0.56 across the entire program), are somewhat lower than the verified NTG values in PY3 of 0.64 for refrigerators and 0.65 for freezers. A primary cause of this reduction is the high percentage of units, some 70 percent in the program, that were recently replaced, triggering the retailer NTG results in many cases. In general, the retailer NTG ratio values are significantly lower than the values obtained from traditional phone survey response categories (e.g., taking the unit to a landfill, giving to a friend or neighbor). Retailer values are low because the retailers' existing disposal practices already remove the vast majority of units from the grid using methods such as recycling units or permanently deconstructing them.

## **3.4 Process Evaluation**

### **3.4.1 Methodology**

The process evaluation component of the SAR evaluation focuses on program awareness/marketing, reasons for participation, and satisfaction with program processes, including sign-up, appliance pickup, incentive levels, and receipt of the refund check. Data sources for the process evaluation include the telephone survey of program participants (N = 256) and discussions with program staff.

### **3.4.2 Process Findings**

Process findings, based on survey results, are below.

***Sources of information about the Program.*** When asked, unprompted, where they had heard of the program, slightly less than half of the participants (44%) recalled seeing the program mentioned in a bill insert with just over one-third (35%) saying that was where they first

learned of the program. Other sources where participants heard of the program include word of mouth (32%), the retailer that they purchased a new unit from (11%), and the PECO website (9%), among others. The retailer and PECO website sources have increased in influence relative to previous years.

**Reasons for participating.** Participants were asked, unprompted, why they chose the PECO SAR Program to dispose of their appliance instead of some other disposal method. The convenience of the home pickup was the main selling point of the program for more participants (36%) than any other reason. An additional 10 percent cited it as a secondary reason for why they participated. This was somewhat of a contrast to previous years' evaluations where the cash incentive was the most compelling reason. More than likely, the reduction in the incentive amount is leading to it being of lesser importance. The second most frequently given reason was the cash incentive provided by the program, which was cited by 30 percent as a main reason for participating, and another 23 percent as a secondary reason. The third most popular reason was the environmentally responsible disposal option provided by the program, with 16 percent saying it was the main reason and an additional 13 percent a secondary reason. Finally, some were just happy they did not have to pay for the pickup (5 % main, 6% secondary).

**Satisfaction with the Program.** Overall, 90 percent of customers were satisfied with their experience with the *Smart Appliance Recycling Program*, as indicated by scores of 8, 9, or 10 on a 0 to 10-point satisfaction scale. Nearly two-thirds (60%) scored the program a perfect 10, indicating they were highly satisfied with it. This is down somewhat from previous years, more than likely reflecting the effects of the incentive reduction, and general scaling back of the program.

Customer **satisfaction with the sign-up process** is very high, with 95 percent of participants rating their satisfaction as an 8, 9 or 10 on a 0 to 10-point scale, where 0 is very dissatisfied and 10 is very satisfied. Only 6 of 209 customers surveyed (3%) rated their experience lower than a 6 on the 0 to 10-point satisfaction scale. Participants who signed up via the phone said that the representative was polite and courteous (100%) answered all of their questions about the program (98%), and that they only needed to call once to successfully sign up for the program (91%). Participants who signed up online reported that the sign-up screen was easy to find (99%), and that they received confirmation that the sign-up had been successful (99%).

Program records indicated that appliance pickup wait time during PY4 averaged just less than 12 days. as most customers were able to schedule a pickup date that was within two weeks of the initial contact (95%) and were generally very satisfied with the amount of time between the

time they made the appointment and the pickup date. (85% gave scores of 8, 9 or 10 on a 0 to 10-point satisfaction scale.) Most importantly, 97 percent of participants said they were able to schedule a pickup date that was convenient for them.

Overall, 91 percent of participants were **satisfied with the collection team** who came to pick up the appliance, as indicated by scores of 8, 9, or 10 on a 0 to 10-point satisfaction scale. Only two respondents said they were dissatisfied, citing that the collection team was rude.

While down from previous program years, a majority of participants still reported the incentive payment to be a key reason why they participated in the program. Furthermore, less than two-thirds of participants (61%) said that they were very **satisfied with the payment**, as indicated by satisfaction scores of 8, 9, or 10 on a 0 to 10-point satisfaction scale. This is significantly lower than in PY3, when 75 percent of participants reported high satisfaction with the size of the incentive payment. However, given the significant reduction in the size of the incentive starting in November 2011, it is somewhat surprising that satisfaction with the incentive level generally remains relatively high. Twenty participants (8%) reported being dissatisfied with the size of the incentive payment they received as a result of their participation in the program, as indicated by their very low satisfaction scores of 1, 2, or 3. This is approximately triple the level in PY3; however, it is still a very small percentage of participants.

Only one-third of participants (33%) indicated they have noticed a reduction in their energy bill since their appliance was removed. Nearly 4 percent of customers said it was too soon to tell, while another 15 percent said they were not sure if they had seen any savings. These responses may indicate that people are not that attentive to changes in their electric bill. It is also possible that given seasonal variations in electric use, customers have a difficult time attributing changes in their bills to their own behaviors.

*Additional actions to improve energy efficiency.* Participants were asked, unaided, whether they had taken additional actions to save energy at their home since participating in the SAR Program. Well over half (58%) of the participants surveyed said they had. The most common changes that people have made are behavioral in nature—turning off lights and appliances when not in use (83%), adjusting thermostat set-points for heating and cooling (90%), and using dimmer switches (93%). The percentages of participants undertaking these behaviors is about the same as in PY3, but much higher than in PY2, when only 20 to 30 percent reported taking these actions.

Table 3-7 provides a summary of the recommendations made to improve the program delivery processes and the current status of their implementation.

**Table 3-7. Status Report for Smart Appliance Recycling Program Process Evaluations**

<p><b>Recommendations</b></p>	<p><b>EDC Status Report for Process Evaluations (Implemented, Being considered, Rejected AND Explanation of Action Taken by EDC)</b></p>
<p>Recommendation 1: Synchronize marketing elements to throttle program participation up or down, as desired to meet goals.</p>	<p>Implemented. Current marketing strategy is expanded from PY4 due to significantly increased program goals in PY5.</p>
<p>Recommendation 2: Continue to reinforce the value of recycling older appliances, since there continues to be a large stock of secondary units out there.</p>	<p>Implemented. PECO's marketing messages include information on the annual cost of operating an old refrigerator or freezer.</p>
<p>Recommendation 3: Educate customers on how much money they could save each month by taking different energy-saving actions, including recycling an old appliance. When customers see the monetary savings and are able to attribute them to their behaviors, they will be more likely to make additional changes in the future.</p>	<p>Implemented. PECO's marketing messages include information on the annual cost of operating an old refrigerator or freezer.</p>
<p>Recommendation 4: Continue to provide information about PECO's other residential programs when the contractors come to pick up the appliance and on PECO's website.</p>	<p>Implemented. JACO crew members distribute energy efficiency program collateral when they visit homes to pick up appliances for recycling.</p>

Source: Navigant analysis

### 3.5 Financial Reporting

The Smart Appliance Recycling program remains highly cost effective, with a benefit-cost ratio during PY4 of 3.63. The benefit-cost ratio for the CPITD period is higher, at 6.02. During PY4, program costs totaled \$697,000, while life-cycle program benefits are \$2,810,000. A breakdown of the program finances is presented in Table 3-8.

**Table 3-8. Summary of Smart Appliance Recycling Program Finances**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	46	253	2,788
Management <sup>[2]</sup>	44	217	963
Marketing <sup>[3]</sup>	111	227	1,818
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>201</b>	<b>697</b>	<b>5,569</b>
<b>EDC Evaluation Costs</b>	<b>67</b>	<b>126</b>	<b>304</b>
<b>SWE Audit Costs</b>		<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>268</b>	<b>823</b>	<b>5,873</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>0</b>	<b>1,032</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>823</b>	<b>6,905</b>
Total Lifetime Energy Benefits	N/A	2,626	38,119
Total Lifetime Capacity Benefits	N/A	183	3,167
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>2,810</b>	<b>41,287</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>3.41</b>	<b>5.98</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## **4 Smart Home Rebates**

The Smart Home Rebates Program offers PECO residential customers rebates for the purchase of qualifying energy-efficient appliances, heating and cooling equipment, and light-emitting diode (LED) lamps and lighting fixtures. The program provides promotional and marketing materials and support to participating retailers and contractors to encourage their promotion of rebated products. For non-lighting measures, customers submit applications via web or mail. Each application includes accompanying proof-of-purchase receipts or invoices. For qualifying lighting measures, PECO provides manufacturers with a cost buy-down, which is passed on to the customer as a discounted price.

Program measures include the following: high-efficiency electric water heaters; LED lamps; ground source heat pumps; room air conditioners; central air conditioning ( $\geq 15$  Seasonal Energy Efficiency Rating [SEER]); refrigerators; clothes washers; heat pump water heaters; high-efficiency gas water heaters (fuel switching); and high-efficiency gas furnaces (fuel switching from electric resistance baseboard or heat pump).

### **4.1 Program Updates**

The Smart Rebates Program remained largely unchanged in PY4. The primary focus of the program was a market maintenance strategy and overall ramp-down of activity in the final year of Phase I. Further, the program did not offer rebates for consumer electronics at all in this program year and continued to shift its focus to heating, ventilating, and air conditioning equipment.

### **4.2 Impact Evaluation Gross Savings**

#### **4.2.1 Gross Impact Methodology**

All PY4 savings for the Smart Home Rebates program are from deemed or partially deemed measures as established by the 2012 TRM. For gross impacts, Navigant staff conducted an engineering review in which staff calculated energy savings and demand reduction per the algorithms of the TRM using data from the program's tracking system and compared the results with PECO's claimed savings. This was the same practice as applied by the evaluation of PY2 and PY3 savings. As an added level of rigor for the evaluation of PY3 and PY4, however, Navigant staff reviewed a sample of project files to confirm that this documentation matched the data in the tracking system and made follow-up calls to those participants to confirm installation and type of replacement (replace on burnout or early replacement). Table 4-1

details energy and demand savings as well as incentive payments by quarter for this program year.

**Table 4-1. PY4 Smart Home Rebates Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	3,473	2,544	0.9	1.0	\$638
PY4 Q2	1,958	2,611	0	0.8	\$557
PY4 Q3	1,358	2,048	0	0.6	\$400
PY4 Q4	2,725	3,379	0	1.1	\$727
<b>PY4 Total</b>	9,514	10,582	0.9	3.6	\$2,323
<b>CPITD Total</b>	291,928	75,210	19.1	21.8	\$22,733

*Source: Navigant analysis*

For ENERGY STAR lighting measures, the PY1 and PY2 evaluations did not include the number of installed measures in the totals for participation. The justification for this exclusion was that PECO paid the rebates “upstream” to manufacturers and it was not possible to ascertain how many participants benefited from the multi-pack fixtures and bulbs. The previous evaluations did not apply this practice to Consumer Electronics measures because PECO paid “mid-stream” rebates to retailers for products that were unitary (i.e., not multi-pack) and the previous evaluations could reasonably designate each rebated sale as one unit of participation. In the evaluation of gross savings for PY3 and PY4, Navigant has continued these practices. For these reasons, the total number of measures does not match the total level of participation (9,089) for the program year.

As shown in Table 4-2, participation, energy savings, and demand reduction are all residential in nature. Based on participant telephone survey responses to a battery of questions developed by the LEEP evaluation team, Navigant estimates that 5 percent of SHR participants are below 150 percent of the Federal Poverty Level (FPL). Interpolating this finding, Navigant provides an estimate of SHR low-income participation, savings, and incentive spending in Table 4-2, as well.

**Table 4-2. PY4 Smart Home Rebates Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential (less Low-Income)	9,038	10,053	0.8	3.4	\$2,207
Low-Income	476	529	0.0	0.2	\$116
Commercial and Industrial	0	0	0.0	0.0	\$0
Government and Nonprofit	0	0	0.0	0.0	\$0
<b>PY4 Total</b>	<b>9,514</b>	<b>10,582</b>	<b>0.9</b>	<b>3.6</b>	<b>\$2,323</b>
<b>CPITD Total</b>	<b>291,928</b>	<b>75,210</b>	<b>19.1</b>	<b>21.8</b>	<b>\$22,733</b>

Source: Navigant analysis

**4.2.2 Gross Impact Sampling Strategy**

For the impact evaluation, Navigant stratified by measure type as described in Table 4-3. Navigant reviewed the tracking data for each measure in the database and recalculated the savings based on the TRM. In addition, Navigant randomly selected 67 project files for HVAC, ground source heat pumps, and appliances for review to confirm equipment and installation details. For HVAC and ground source heat pumps, Navigant also randomly selected a subset of the project files for follow-up telephone calls to review installation details with participants. Since no customer information is available for the 2,203 lighting measures, Navigant did not sample these measures but only conducted the review and recalculation of tracking data.

**Table 4-3. Smart Home Rebates Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
HVAC	Measure category	5,597	0.5	85/15	25	85	Process: Participant Phone Survey
Ground Source Heat Pumps	Measure category	306	0.5	85/15	24	29	
ENERGY STAR Appliances	Measure category	3,186	0.5	85/15	25	86	
<b>Activity Subtotal</b>		<b>9,089</b>		<b>85/15</b>	<b>74</b>	<b>200</b>	

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
HVAC	Measure category	5,597	0.5	85/15	10	31	Impact: File Review
Ground Source Heat Pumps	Measure category	306	0.5	85/15	20	15	
ENERGY STAR Appliances	Measure category	3,186	0.5	85/15	10	21	
<b>Activity Subtotal</b>		9,089		85/15	40	67	
HVAC	Measure category	5,597	0.5	85/15	10	10	Impact: Phone Survey (Partially Deemed Measures)
Ground Source Heat Pumps	Measure category	306	0.5	85/15	5	5	
<b>Activity Subtotal</b>		5,903		85/15	15	15	
<b>Program Total</b>		24,081		85/15	129	282	

Source: Navigant analysis

### 4.2.3 Energy Savings and Demand Reduction by Stratum

The differences between ex ante and ex post savings were less than 1 percent for both energy and demand. This minimal difference is due to the deemed and partially deemed nature of the program's measures as well as accurate accounting of these measures. The realization rate for energy savings was 100.04 percent (see Table 4-4) and the realization rate for demand was 100.35 percent (see Table 4-5).

This is not an unexpected result since the evaluation of gross energy savings and demand reduction is a comparison of PECO's calculation of claimed savings to Navigant's computation of savings based on the application of tracking data to the 2012 TRM algorithms.

This review found no significant difference between tracking system data and file data for the HVAC, ground source heat pump, and ENERGY STAR appliance strata. While ENERGY STAR Lighting did have a realization rate greater than 1.00 (due to a recalculation of base watts per TRM requirements), these measures constituted less than 1 percent of total energy savings and so did not significantly affect the program's overall realization rate.

**Table 4-4. PY4 Smart Home Rebates Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
HVAC	7,713	100%	0	0%	7,713	0
Ground Source Heat Pumps	1,697	100%	0	0%	1,697	0
ENERGY STAR Appliances	1,050	100%	0	0%	1,050	0
ENERGY STAR Lighting	121	102%	0	0%	124	0
<b>Program Total</b>	<b>10,582</b>	<b>100%</b>	<b>0</b>	<b>0%</b>	<b>10,584</b>	<b>0</b>

Source: Navigant analysis

**Table 4-5. PY4 Smart Home Rebates Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
HVAC	3.1	100%	0	0%	3.1	0
Ground Source Heat Pumps	0.3	100%	0	0%	0.3	0
ENERGY STAR Appliances	0.2	100%	0	0%	0.2	0
ENERGY STAR Lighting	0.0	102%	0	0%	0.0	0
<b>Program Total</b>	<b>3.6</b>	<b>100%</b>	<b>0</b>	<b>0%</b>	<b>3.6</b>	<b>0</b>

Source: Navigant analysis

### 4.3 Impact Evaluation Net Savings

As detailed in the next section, the evaluation team conducted a telephone survey of 200 PY4 participants. The survey included a battery of NTG questions.

#### 4.3.1 Free Ridership

Navigant used a method of calculating free ridership in PY4 similar to earlier years and also a more detailed method.

The single input method used in PY2 and PY3 identified free riders as respondents to the participant telephone survey who stated that they had purchased or ordered rebated appliances or HVAC equipment before learning about the rebate. In PY4, out of the 200 participants surveyed, 30 participants (15%) reported that they had purchased the measure before hearing about the PECO Smart Home Rebate. Another two respondents (1%) had ordered the measure before learning about the rebate. Using this single input method of calculating free ridership as in PY3, these findings would suggest a PY4 free-ridership rate of 0.16, consistent with the findings of 0.16 in PY3 and 0.15 in PY2.

However, the energy efficiency industry is moving towards more rigorous approaches to estimate free ridership and the SWE has provided guidance towards methods that rely on more than a single input for Phase II. Greater rigor tends to require additional inputs for free-ridership calculation as well as provision for “partial” free riders per the scoring process.

The SWE has recently recommended the use of the Energy Trust of Oregon (ETO's) method to determine free ridership.<sup>18</sup> The approach focuses on only two inputs:

- Intent to purchase/install in the absence of the program
- Program influence

Applying this method to the PY4 responses to the participant telephone survey, yielded a range of 0.38 to 0.875 with a mid-point of 0.63.

#### 4.3.2 Spillover

Fifty-six (28%) of the 200 survey respondents reported installing a total of 411 additional energy-efficient measures without receiving a rebate because of the influence of the program upon their purchase decision. Compared to PY3, where 58 (29%) of survey respondents installed 206 additional measures, PY4 respondents installed nearly double the number of un-incented measures. Of the 411 additional measures installed by PY4 survey respondents, 27 percent were CFLs, 25 percent were windows, and 18 percent were LEDs.

Navigant estimates a spillover rate of 0.12. This spillover rate, which is nearly double the rate using PY3's methodology, suggests that the program is having influence on participants' decisions to purchase un-incented measures, even when a rebate is not involved.

#### 4.3.3 Net-to-Gross

Although this analysis used an NTG value of 1.0 for compliance purposes for PY4, based on the customer survey estimates of free ridership and applied to the ETO methodology of 0.63 and self-reported spillover of additional measures of 0.12, the Navigant team estimates that the NTG ratio is  $1.00 - 0.63$  (free ridership)  $+ 0.12$  (spillover)  $= 0.49$ .

### 4.4 Process Evaluation

The data collection activities for this program evaluation were the following:

- » **Program-Tracking Database**: Navigant relied upon quarterly extracts from the tracking database to both conduct the review of tracking data for the impact evaluation and to develop a sample frame for the participant surveys.

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<sup>18</sup> Phil Degens and Sarah Castor, August 2013. *Energy Trust Free Ridership Methodology*, Energy Trust of Oregon.

- » **Staff Interviews:** Navigant conducted in-depth interviews with the PECO program manager and the Ecova program manager. The interviews focused on marketing and outreach activities, implementation strategies, data tracking, and program management and identified areas for program improvement.
- » **Participant Surveys:** A subcontracted telephone survey house collected data from 200 Smart Home Rebates program participants to support the net impact and process analyses. Participants provided feedback regarding program delivery, program awareness, overall satisfaction, free ridership, spillover, and areas for improvement.
- » **Trade Ally (HVAC) Interviews:** Navigant interviewed 11 HVAC contractors who were selected based on their overall participation levels in the program. The interviews focused on program marketing and participation questions, and administration and delivery questions.
- » **Mystery Shopping:** Navigant conducted mystery shopping of 106 retailer visits based on store participation levels in the program.

#### **4.4.1 Process Evaluation Findings**

In general, the process evaluation found the program to be effective and well run. Specific findings include the following:

- » Survey respondents learned about the Smart Home Rebates program in a variety of ways. Of note, the percentage of PY4 respondents mentioning the PECO website nearly doubled from PY3 while the percentage mentioning store staff decreased by half from PY3.
- » The trend toward fewer respondents learning about the program from installers/contractors was even more dramatic in PY4, with only 5 percent citing this source vs. 28 percent in PY3 and 43 percent in PY2.
- » Sixty-five percent of PY4 respondents were not aware of other PECO programs, suggesting that the disconnect between PECO's Smart Home Rebates program and other offerings needs to be addressed and overcome in future marketing and outreach activities.
- » The telephone survey respondents indicated their overall satisfaction with PECO was high. The average rating, using a 10-point scale, was 8.3.
- » The Smart Home Rebates program appears to be tracking program information adequately and processing rebates just as rapidly as in PY3. Navigant's review of tracking data and interviews with program staff did not reveal significant errors or systemic problems.
- » Per the participant survey, motivation for purchases has changed from PY3 to PY4 with replacement of "old or outdated equipment" declining from 67 percent to 52 percent while respondents citing "energy efficiency" as their primary motivation increased from 8 percent to 23 percent.

- » Mystery shoppers reported that retailers mentioned the PECO rebate without prompting in only 11 percent of their visits.
- » Only 14 percent of participant survey respondents for PY4 cited sales staff influence as a reason for purchase, whereas 30 percent of PY3 respondents cited this reason.
- » HVAC contractor satisfaction was high for all aspects of the Smart Home Rebates program. However, these same contractors expressed the opinion that they would have offered the same level of efficiency to program participants in the absence of their program. These contractors further expressed that the program rebates and materials were not the most significant drivers of customer choice.

Table 4-6 presents Navigant’s recommendations for program improvement, based on the above findings, along with the implementation status for these recommendations.

**Table 4-6. Status Report for Smart Homes Rebates Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Develop agreements with HVAC contractors to assure promotional efforts identify PECO's contribution to the delivery of high-efficiency equipment to residential customers.	PECO is considering the most effective approach to achieve this recommendation.
Re-engage retailers and HVAC contractors to promote rebates and better coordinate PECO activities with trade ally marketing plans	PECO plans to implement this recommendation in PY5.
PECO should continue to identify ways to link more closely its successful Smart Home Rebates program with other PECO efficiency activities to encourage broader participation across all programs:	PECO is considering this recommendation.

Source: Navigant analysis

## 4.5 Financial Reporting

This program achieved a TRC of 0.89 for PY1–PY2 and 1.53 for PY3. This increased cost-effectiveness was due to an emphasis on the most efficient appliance and HVAC measures. However, in PY4, the TRC fell to 0.75 as the program ramped down activity while maintaining overhead costs as part of its market maintenance strategy. The overall TRC for this program in Phase I was 0.97.

A breakdown of the program finances is presented in Table 4-7.

**Table 4-7. Summary of Smart Home Rebates Finances**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	727	2,323	22,733
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>727</b>	<b>2,323</b>	<b>22,733</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	693	1,618	8,399
Management <sup>[2]</sup>	150	677	2,753
Marketing <sup>[3]</sup>	273	667	3,084
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>1,116</b>	<b>2,962</b>	<b>14,236</b>
<b>EDC Evaluation Costs</b>	<b>257</b>	<b>480</b>	<b>1,158</b>
<b>SWE Audit Costs</b>		<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>2,101</b>	<b>5,765</b>	<b>38,127</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>16,793</b>	<b>91,217</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>20,236</b>	<b>106,612</b>
Total Lifetime Energy Benefits	N/A	12,914	90,573
Total Lifetime Capacity Benefits	N/A	2,378	12,794
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>15,292</b>	<b>103,443</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.76</b>	<b>0.97</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 5 Low-Income Energy Efficiency Program

The purpose of the LEEP is to educate and assist eligible residential customers in making their homes more energy efficient. The program builds upon the Low-Income Usage Reduction Program (LIURP) objective: to make low-income customers' energy bills more affordable by helping to reduce energy usage. LEEP was built on the existing LIURP infrastructure for outreach and delivery of services. The same contractor (CMC Energy Services) delivers both LIURP and LEEP. The direct install portion of LEEP is identical to LIURP from a customer standpoint, because the funding source is the primary difference between the two programs. Additionally, LEEP distributes additional CFLs to low-income customers. LEEP primarily targets households below 150 percent of the FPL, with some additional targeting of households between 150 and 200 percent of the FPL. The program consists of four primary components:

- » **Component 1: In-home Audits, Education, and Direct Install Measures**
  - On-site inspections and tests used to identify energy savings opportunities
  - Education of residents about ways to reduce energy usage
  - Direct installation of energy efficiency measures to address savings opportunities identified during the audit
  - Installation of minor safety-related measures, including smoke alarms
  - All services and measures are provided at no charge to participants.
- » **Component 2: Direct Installation of CFLs for LIURP Participants**
  - Increase the number of direct installations of CFLs for LIURP participants
- » **Component 3: Distribution of CFLs to Low-Income Customers**
  - Participation in low-income community events and distribution of CFL bulbs to low-income customers
- » **Component 4: Direct Installation of Refrigerators and Freezers**
  - Removal of old, inefficient working refrigerators and freezers
  - Direct installation of new ENERGY STAR® refrigerators and freezers
  - Target low-income customers that do not meet the usage requirement for Component 1 participation

Component 1 is broken into four measure groups, defined as follows:

- » **Electric Baseload – Basic Measures:** including measures such as CFL bulbs, faucet aerators, showerheads, water heater pipe insulation, and water heater tank insulation.

- » **Electric Baseload – Major Measures:** including measures such as AC replacement, refrigerator replacement, electric water heater replacement, and water heater timers in addition to measures included in Electric Baseload – Basic Measures.
- » **Electric Heat – Basic Measures:** including measures such as duct and pipe insulation in addition to measures included in Electric Baseload – Basic Measures.
- » **Electric Heat – Major Measures:** including measures such as blower door guided air sealing, heat pump installation or replacement, programmable thermostats, and insulation installation in addition to measures included in Electric Baseload – Major Measures.

## 5.1 Program Updates

There were no changes to the LEEP design during PY4. All audits were Electric Baseload, with no Electric Heat audits conducted in PY4. The majority of participants received basic measures and CFLs. The number of bulbs installed decreased from PY3 to PY4, indicating reduced opportunity for generating savings from the installation of standard CFLs.

## 5.2 Impact Evaluation Gross Savings

This section describes the methodology and results of the impact evaluation.

### 5.2.1 Evaluation Methodology

Navigant employed a billing analysis to quantify energy savings for Component 1 measures. Savings for Components 2 through 4 were determined in accordance with the 2012 TRM and the program-tracking database. The following is a detailed description of the impact evaluation methodology for each component.

#### **Component 1 – In-home Audits, Education, and Direct Install Measures**

The impact analysis for Component 1 consisted of an integrated billing analysis and engineering analysis, per the LEEP protocol.<sup>19</sup> The engineering analysis provided customer-specific estimates of energy savings and the basis for demand savings estimates. The engineering estimates of energy savings were included in the Statistically Adjusted Engineering (SAE) billing analysis, which provided a realization rate on the engineering estimates.

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<sup>19</sup> Custom Measure Protocol: Low-Income Energy Efficiency Program (LEEP) Component 1, Approved September 2010.

Collectively, these approaches provide significant improvements in accuracy over reliance on LIURP estimates. The evaluation team conducted site visits at the homes of 25 participants from Component 1. The information gathered during these visits is for research purposes only and does not affect verified program savings.

The billing analysis conducted for the PY4 evaluation included participants from PY2. This is in accordance with the custom measure protocol, which states that verified energy savings will be based on a four-year rolling average. For PY4, the four-year rolling average comprises the results of the PY1 and PY2 LEEP billing analyses and the 2008 and 2009 LIURP analyses. Billing analyses for weatherization programs such as LEEP perform best when a full 12 months of post-installation billing data are available. The billing analysis incorporated usage data for monthly billing cycles ending between June 1, 2009 and May 31, 2012.

The billing analysis included 7,279 participants: 476 electric heat participants and 6,803 electric baseload participants. This represents approximately 83 percent of the PY2 Component 1 participants. Program enrollment occurred fairly steadily over the course of the year. A “rolling enrollment” of this type provides the opportunity to examine the effect of a program via regression analysis, because, except for the first and last months of the study period, each month involves a mix of customers who have already enrolled in the program and those who have not yet enrolled. Navigant assumed that late participants and early participants are, on average, the same in terms of their energy consumption in the absence of the program. Under this assumption, the “late” participants effectively serve as unbiased comparison households for the “early” participants in the regression analysis.

Navigant estimated a fixed effects SAE regression model. The regression equation included a unique constant term for each participant (the “fixed effect”) to implicitly account for participant-specific characteristics that affect energy usage but are constant over time, such as the square footage of the residence and indoor temperature preferences. Average daily usage (kWh) is a function of heating and cooling degree days, a binary variable indicating the post period for participants with basic measures, a binary variable indicating the post period for participants with major measures, interactions between the post and degree day variables, and the participant-specific engineering estimate of savings interacted with an indicator variable for basic or major measures. This model specification allows both usage and program savings to vary with weather conditions. Navigant estimated separate models for electric heat customers and electric baseload customers. Because the regression includes the participant-specific engineering estimates of savings, this type of regression analysis is called an SAE analysis. Formally, the regression equation is given by:

**Equation 5-1. Regression Equation**

$$ADU_{it} = \alpha_i + \beta_1 * HDD_t + \beta_2 * CDD_t + \beta_3 * Post_{it} * Basic_i + \beta_4 * Post_{it} * Major_i + \beta_5 * Post_{it} * Basic_i * HDD_t + \beta_6 * Post_{it} * Basic_i * CDD_t + \beta_7 * Post_{it} * Major_i * HDD_t + \beta_8 * Post_{it} * Major_i * CDD_t + \beta_9 * Post_{it} * Basic_i * EngEst_i + \beta_{10} * Post_{it} * Major_i * EngEst_i + \epsilon_{it}$$

where *i* indexes the participant and *t* indexes the billing cycle and:

- ADU<sub>it</sub> = Average daily usage (kWh) for participant *i* in billing cycle *t*
- HDD<sub>t</sub> = Average daily heating degree days (base temperature 65°F) during billing cycle *t*
- CDD<sub>t</sub> = Average daily cooling degree days (base temperature 65°F) during billing cycle *t*
- Post<sub>it</sub> = A binary variable taking a value of 1 if participant *i* is in the post-installation period during billing cycle *t* and 0 otherwise
- Basic<sub>i</sub> = A binary variable taking a value of 1 if participant *i* has installed basic measures during billing cycle *t* and 0 otherwise
- Major<sub>i</sub> = A binary variable taking a value of 1 if participant *i* has installed major measures during billing cycle *t* and 0 otherwise
- EngEst<sub>i</sub> = A variable taking a value of 0 in the pre-installation period for participant *i*, otherwise equal to the participant-specific engineering estimate of savings per day (kWh)
- α<sub>*i*</sub> = The participant-specific constant term (“fixed effect”), to be estimated in the regression
- β<sub>*k*</sub>'s = Parameters to be estimated in the regression
- ε<sub>*it*</sub> = The cluster-robust error term for participant *i* in billing cycle *t*.<sup>20</sup>

Savings, given in average daily kWh, are calculated using all regression terms that involve the post variable:

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<sup>20</sup> Cluster-robust errors account for heteroscedasticity and autocorrelation at the customer level. Ordinary Least Squares (OLS) regression models assume the data are homoscedastic and not auto correlated. If either of these assumptions is broken, the resulting standard errors of the parameter estimates are likely underestimated. A random variable is heteroscedastic when the variance is not constant. A random variable is auto correlated when the error term in this period is correlated with the error term in previous periods.

**Equation 5-2. Regression Analysis Savings Calculation - Basic Measures**

$$\text{Basic Measure Savings} = -(\beta_3 + \beta_5 * \overline{HDD} + \beta_6 * \overline{CDD} + \beta_9 * \overline{EngEst}_{\text{Basic}})$$

**Equation 5-3. Regression Analysis Savings Calculation - Major Measures**

$$\text{Major Measure Savings} = -(\beta_4 + \beta_7 * \overline{HDD} + \beta_8 * \overline{CDD} + \beta_{10} * \overline{EngEst}_{\text{Major}})$$

where  $\overline{HDD}$  and  $\overline{CDD}$  are long-term average heating and cooling degree days per day, calculated from typical meteorological year (TMY) data.<sup>21</sup>  $\overline{EngEst}$  is the average daily engineering estimate of savings.<sup>22</sup> The parameter estimates are given in Table 5-1.

**Table 5-1. Component 1 Regression Analysis Parameter Estimates**

	Electric Baseload		Electric Heat	
	Estimate	t-statistic	Estimate	t-statistic
HDD	1.927	50.03	0.436	92.02
CDD	-0.167	-8.11	0.276	75.78
Post*Basic	0.956	0.53	-0.560	-3.53
Post*Major	-0.061	-0.05	1.588	2.18
Post*Basic*HDD	-0.460	-5.41	0.024	3.31
Post*Basic*CDD	0.011	0.24	0.011	3.24
Post*Major*HDD	0.048	0.92	0.057	2.82
Post*Major*CDD	0.016	0.82	-0.039	-3.58

*Note: T-statistics greater than 1.645 in magnitude indicate results are statistically significantly different from 0 at the 90% confidence level.*

Source: Navigant analysis

The billing analysis captures savings from all measures, including the extra CFLs. Per the protocol, verified savings are determined by a four-year rolling average of the available LEEP and LIURP billing analysis savings estimates. An important distinction between LEEP and LIURP is that the LEEP includes extra CFLs. To appropriately compare the LEEP results to the LIURP results, Navigant subtracted savings from extra CFLs from the billing analysis savings

<sup>21</sup> TMY data (1981-2010) for Philadelphia International Airport obtained from the National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC), available at <<http://gis.ncdc.noaa.gov/map/cdo/?thm=themeAnnual>>. TMY data indicated annual CDD of 1,301 and annual HDD of 4,613.

<sup>22</sup> Average daily engineering estimates of savings are 1.3135 kWh for electric heat – basic, 8.7427 kWh for electric heat – major, 1.0359 kWh for electric baseload – basic, and 3.5499 kWh for electric baseload – major.

estimates before calculating the four-year rolling average of savings. Savings from the extra CFLs are added back in later for each customer.<sup>23</sup>

Verified energy and demand savings for the Component 1 extra CFLs were calculated using the TRM protocol for CFLs, as described below for Components 2 and 3. Savings were based on the delta watts between the actual removed lamp and the installed CFL as recorded in the tracking system for each participant. All CFLs were assigned the 3.0 hours of use (HOU) per the TRM protocol. Due to the small contribution of these bulbs to overall program savings, Navigant applied the deemed coincidence factor (5%) and assumed the lighting Interactive Effects Factor to be 1.0 rather than applying the higher CF (11.7%) and IEFs applied to lighting savings in Components 2 and 3.

Navigant calculated demand savings estimates for each participant based on the actual measures installed at each individual site based on program-tracking data. After calculating site-specific demand savings estimates, Navigant averaged savings estimates across the four measure types and groups. The energy realization rate on engineering estimated savings determined by the billing analysis was applied to the engineering estimated demand savings to determine verified demand savings.

**Components 2 & 3 – Direct Installation of CFLs for LIURP Participants, Distribution of CFLs to Low-Income Customers**

Navigant verified the number of measures installed (CFLs) according to the program-tracking database. The equations to calculate energy and demand savings for ENERGY STAR CFL bulbs are presented below.

**Equation 5-4. Energy Savings Calculation for ENERGY STAR CFL bulbs**

$$\Delta kWh = (Watts_{base} - Watts_{CFL}) \times CFL_{Hours} \times 365/1000 \times ISR_{CFL} \times IEF_{e,Phase 1}$$

**Equation 5-5. Demand Savings Calculation for ENERGY STAR CFL bulbs**

$$\Delta kW = (Watts_{base} - Watts_{CFL})/1000 \times CF \times ISR_{CFL} \times IEF_{d,Phase 1}$$

where:

$Watts_{base}$  = Wattage of baseline lamp

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<sup>23</sup> Component 1 extra CFLs account for 920,073 kWh and 42 kW of savings. This amounts to 91 kWh and 0.00416 kW of savings per audit. This amount is subtracted from the SAI; regression results prior to calculating the 4-year rolling average.

$Watts_{CFL}$	= Wattage of installed CFL
$CFL_{Hours}$	= Average hours of use per day per CFL; deemed at 3.0
$ISR_{CFL}$	= In-service rate per CFL; deemed at 0.84
$CF$	= Demand coincidence factor, defined as the fraction of the total technology demand that is coincident with the utility system summer peak, as defined by Act 129; deemed at 0.05; research-verified value of 0.117
$IEF_{e\_phase\ I}$	= Lighting Interactive Effects Factor for Energy; research-verified value of 1.02
$IEF_{d\_phase\ I}$	= Lighting Interactive Effects Factor for Demand; research-verified value of 1.19

Note that Navigant has determined an alternative coincidence factor value of 11.7 percent, increased from 5 percent. Additionally, Navigant determined a lighting Interactive Effects Factor for energy (1.02) and demand (1.19). The 2012 TRM ignores the IEF, implicitly assuming a value of 1.0. These values were applied retroactively to all Component 2 and 3 bulbs during Phase I (PY1-PY4). The derivation of these values is described below.

### **Coincidence Factor**

Prior to the PY4 Q3 report, demand reduction impacts for residential lighting measures had been calculated using the Peak Load Coincidence Factor of 5 percent in the 2012 Pennsylvania TRM. This value comes from a 2007 report by RLW Analytics, entitled “Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market.”<sup>24</sup> As the 5 percent CF has been acknowledged by both the SWE and the technical utility staff of the PUC to be erroneous,<sup>25</sup> Navigant has used a residential lighting load shape developed through the 2009 Northeast residential lighting logger study conducted by Nexus Market Research, RLW Analytics, and GDS Associates (the NMR 2009 study) to calculate

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<sup>24</sup> RLW Analytics, “Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market (FCM)”, prepared for the New England State Program Working Group (SPWG), March 25, 2007, p. IV.

<sup>25</sup> See the minutes of the Program Evaluation Group meeting from March 20, 2013 (forwarded to all EDCs and evaluators on March 29, 2013).

a revised CF of 11.7 percent over PECO's Top 100 Hours during the summer of 2012.<sup>26</sup> Details on the derivation of this CF are presented in Appendix A.

### ***Lighting Interactive Effects Factor***

Navigant constructed building energy computer simulation models to determine the HVAC impacts from efficient lighting installations in the PECO service territory. Navigant used these models to calculate energy and demand IEFs, which are used to adjust the program lighting savings to account for the additional impacts on HVAC energy and demand. Navigant has not applied energy and demand interactive effects in previous evaluations of PECO's residential programs because these were not included in the TRM. However, the evaluation team believes that by not including this factor, the TRM is significantly underestimating demand savings from efficient lighting installations. Details on the derivation of the IEFs are presented in Appendix B.

### **Component 4 – Direct Installation of Refrigerators and Freezers**

Navigant verified the reported number of units installed according to the program-tracking database. The installation rate was verified via participant self-reports as part of the participant phone survey. Navigant applied the per-unit deemed savings value provided in the 2012 TRM.

#### **5.2.2 Reported and Verified Savings**

The Component 1 regression analysis indicates that average energy savings generally decreased, comparing participants from PY1 to PY2. Component 1 savings estimates are generally lower than the sum of deemed savings values from the TRM, indicating that behavior savings generated by the educational component of the program are likely small and indistinguishable from the noise in the billing data. Navigant analyzed the type and quantity of measures installed for Component 1 during PY1 through PY4 and identified several trends that corroborate the decreased savings estimates. These trends are summarized below:

- The average number of Component 1 bulbs per customer is decreasing. In PY4 the average number of bulbs installed was 5.3, down from 6.0 in PY3, 6.1 in PY2, and 8.3 in PY1.

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<sup>26</sup> Nexus Market Research, Inc., RI.W Analytics, Inc., and GDS Associates, 2009. Residential Lighting Markdown Impact Evaluation. Prepared for Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009.

- The diversity of Component 1 measures installed has decreased. The primary measures installed in PY4 were CFLs, aerators/showerheads, refrigerator/freezers, and water heater measures. Installation of air conditioners, duct sealing and insulation, gas furnace/boilers, heat pumps, infiltration measures, insulation measures, and thermostats was non-existent in PY4 or lower than in previous years.
- Occasionally, LEEP participants receive an audit but the contractor does not identify any opportunities to install program measures. The number of participants with no energy-saving measures is increasing. In PY4 approximately 10 percent of Component 1 participants received no energy-saving measures, up from 8 percent in PY3, 6 percent in PY2, and 2 percent in PY1.

The primary goal of the PY4 site visits was to collect CFL installation information. Navigant determined a CFL in-service rate of 97.3 percent for Component 1 direct install bulbs. This is significantly higher than the deemed in-service rate of 84 percent in the 2012 TRM. Navigant recommends that the Pennsylvania Act 129 Program Evaluation Group (PEG) include in future versions of the TRM CFL in-service rates that are specific to program delivery method (i.e., direct install, mailings, and giveaways). The majority of bulbs were installed in high-usage locations, including bathrooms, dining rooms, kitchens, living rooms, and bedrooms. The reported average HOU was 3.2 hours and the reported median HOU was 2.0 hours.

Ninety-six percent of the Component 4 respondents (n = 24) verified that refrigerators or freezers were installed. One respondent reported that a new unit was not installed.<sup>27</sup> Per section 1.11.4 of the 2012 TRM, verified measure counts within 5 percent of reported values are considered within reasonable error and do not require an adjustment to the realization rate. Therefore, Navigant applied an installation rate of 1.0 when calculating verified savings for Component 4 measures.

Table 5-2 and Table 5-3 in this section summarize the PY4 reported savings for LEEP. Table 5-4 describes the sampling strategy. Table 5-5 and Table 5-6 show research-verified energy and demand savings. Table 5-7 and Table 5-8 show strict TRM verified savings.

Participation rates were fairly steady during PY4, with approximately 2,500 audits conducted in each quarter.

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<sup>27</sup> Navigant attempted to contact this respondent by telephone to obtain additional information, but was not able to reach the customer.

**Table 5-2. PY4 LEEP Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100-Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	2,394	9,171	0.4	0.5	996
PY4 Q2	2,390	7,532	0	0.4	914
PY4 Q3	2,478	7,213	0	0.4	755
PY4 Q4	2,844	5,632	0	0.3	712
<b>PY4 Total</b>	<b>10,106</b>	<b>29,548</b>	<b>0.4</b>	<b>1.6</b>	<b>3,377</b>
<b>CPITD Total</b>	<b>32,240</b>	<b>83,286</b>	<b>7.8</b>	<b>6.7</b>	<b>13,303</b>

*Note: The number of participants is equal to the number of Component 1 audits.*

Source: Navigant analysis of PECO LEEP tracking data

**Table 5-3. PY4 LEEP Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential					
Low-Income	10,106	29,548	0.4	1.6	3,377
Commercial and Industrial	0	0	0	0	0
Government and Nonprofit	0	0	0	0	0
<b>PY4 Total</b>	<b>10,106</b>	<b>29,548</b>	<b>0.4</b>	<b>1.6</b>	<b>3,377</b>
<b>CPITD Total</b>	<b>32,240</b>	<b>83,286</b>	<b>7.8</b>	<b>6.7</b>	<b>13,303</b>

*Note: The number of participants is equal to the number of Component 1 audits.*

Source: Navigant analysis of PECO LEEP tracking data

The billing analysis was conducted on a census of PY2 participant data, per the approved protocol. Approximately 17 percent of customers were excluded from the regression model due to incomplete or incorrect data. In the billing analysis section of Table 5-4, the Target Sample Size is the number of participants in each stratum and the Achieved Sample Size is the number of participants included in the model.

The evaluation team conducted 25 site visits for Component 1 participants. The findings of these site visits are for research purposes only and do not impact PY4 verified savings.

The participant phone survey was conducted for a sample of 92 participants drawn from Components 1, 3, and 4. Component 2 consists of direct installation of additional CFLs in the homes of LIURP participants. Given that LEEP and LIURP are jointly implemented, Navigant expects no difference between LEEP and LIURP participants. Furthermore, LIURP participants would not be able to distinguish LEEP and LIURP activities. For these reasons Navigant did not survey Component 2 participants.

Component 3 consists of distribution of CFLs at low-income community events. PECO tracks the number of bulbs distributed and asks recipients to provide their name and contact information on a sign-in form at each event. The customer information is not converted to an electronic format and therefore it is difficult to identify the number of participants in Component 3. Therefore, the Population Size is listed as unknown in Table 5-4.

**Table 5-4. LEEP Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
C1 - Electric Baseload	Heat Type	8,221	N/A	85/15	8,221	6,804	Impact: Billing Analysis on PY2 Participants
C1 - Electric Heat	Heat Type	568	N/A	85/15	568	476	
<b>Activity Subtotal</b>		<b>8,789</b>	N/A	<b>85/15</b>	<b>8,789</b>	<b>7,280</b>	
Component 1	N/A	10,106	0.5	85/15	25	25	Impact: Site Visits
<b>Activity Subtotal</b>		<b>10,106</b>	N/A	<b>85/15</b>	<b>25</b>	<b>25</b>	
Component 1	N/A	10,106	0.8	85/15	38	38	Process: Phone Survey
Component 3	N/A	unknown	0.8	85/15	30	30	
Component 4	N/A	536	0.95	85/15	24	24	
<b>Activity Subtotal</b>		<b>10,642</b>	N/A	<b>85/15</b>	<b>92</b>	<b>92</b>	
<b>Program Total</b>		<b>29,537</b>	N/A	<b>85/15</b>	<b>8,906</b>	<b>7,397</b>	

Source: Navigant analysis.

The research-verified energy and demand savings include the research-verified lighting IEF and higher coincidence factor, both applied to Component 2 and 3 bulbs. Research-verified energy savings were slightly lower than reported savings (27,270 MWh verified versus 29,548 MWh reported), resulting in a realization rate of 92 percent for energy savings. The lower research-verified energy savings are primarily due to a decrease in the Component 1 savings, as indicated by the billing analysis. Note that Component 3 CFLs account for approximately 69 percent of program energy savings in PY4.

Research-verified demand savings were significantly higher than reported demand savings (3.3 MW verified versus 1.6 MW reported), resulting in a realization rate of 202 percent for demand savings. The higher research verified demand savings are primarily due to an increased coincidence factor and application of the lighting IEF to Component 2 and 3 bulbs. The low

realization rates for Component 1 demand savings results from the billing analysis findings. Note that Component 3 CFLs account for approximately 85 percent of program demand savings in PY4.

**Table 5-5. PY4 LEEP Summary of Evaluation Results for Energy – Research Verified**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (CV) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Electric Baseload - Basic	7,630	71%	0.14	3%	5,387	0
Electric Baseload - Major	1,568	73%	0.32	8%	1,139	0
Electric Heat - Basic	-1	100%	N/A	0%	-1	0
Electric Heat - Major	1	77%	N/A	0%	1	0
Component 2	1,129	102%	N/A	0%	1,152	0
Component 3	18,555	102%	N/A	0%	18,926	0
Component 4	666	100%	0.96	6%	666	0
<b>Program Total</b>	<b>29,548</b>	<b>92%</b>	<b>0.14</b>	<b>1%</b>	<b>27,270</b>	<b>0</b>
<i>Note: The program total CV values for LEEP reflect the CV for Component 1 measures only. Navigant did not calculate the program total CV due to differences in units of measurement.</i>						

Source: Navigant analysis

**Table 5-6. PY4 LEEP Summary of Evaluation Results for Demand – Research Verified**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Electric Baseload - Basic	0.2	49%	0.01	6%	0.1	0
Electric Baseload - Major	0.2	33%	0.04	25%	0.1	0
Electric Heat - Basic	0.0	100%	0.00	0%	0.0	0
Electric Heat - Major	0.0	71%	0.00	0%	0.0	0
Component 2	0.1	279%	0.00	0%	0.2	0
Component 3	1.0	278%	0.00	0%	2.8	0
Component 4	0.1	100%	0.96	5%	0.1	0
<b>Program Total</b>	<b>1.6</b>	<b>202%</b>	<b>0.03</b>	<b>1%</b>	<b>3.3</b>	<b>0</b>
<i>Note: The program total CV values for LEEP reflect the CV for Component 1 measures only. Navigant did not calculate the program total CV due to differences in units of measurement.</i>						

Source: Navigant analysis

Strict TRM verified energy savings were slightly lower than reported savings (26,876 MWh verified versus 29,548 MWh reported), resulting in a realization rate of 91 percent for energy savings. The lower strict TRM verified energy savings are primarily due to a decrease in the Component 1 savings, as indicated by the billing analysis.

Strict TRM verified demand savings were slightly lower than reported savings (1.4 MW verified versus 1.6 MW reported), resulting in a realization rate of 84 percent for demand savings. The lower strict TRM verified demand savings are primarily due to a decrease in the Component 1 savings, as indicated by the billing analysis.

**Table 5-7. PY4 LEEP Summary of Evaluation Results for Energy – Strict TRM Verified**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Electric Baseload - Basic	7,630	71%	0.14	3%	5,387	0
Electric Baseload - Major	1,568	73%	0.32	8%	1,139	0
Electric Heat - Basic	-1	100%	N/A	0%	-1	0
Electric Heat - Major	1	77%	N/A	0%	1	0
Component 2	1,129	100%	N/A	0%	1,129	0
Component 3	18,555	100%	N/A	0%	18,555	0
Component 4	666	100%	0.96	6%	666	0
<b>Program Total</b>	<b>29,548</b>	<b>91%</b>	<b>0.14</b>	<b>1%</b>	<b>26,876</b>	<b>0</b>
<i>Note: The program total CV values for LEEP reflect the CV for Component 1 measures only. Navigant did not calculate the program total CV due to differences in units of measurement.</i>						

Source: Navigant analysis

**Table 5-8. PY4 LEEP Summary of Evaluation Results for Demand – Strict TRM Verified**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Electric Baseload - Basic	0.2	49%	0.01	6%	0.1	0
Electric Baseload - Major	0.2	33%	0.04	25%	0.1	0
Electric Heat - Basic	0.0	100%	0.00	0%	0.0	0
Electric Heat - Major	0.0	71%	0.00	0%	0.0	0
Component 2	0.1	100%	0.00	0%	0.1	0
Component 3	1.0	100%	0.00	0%	1.0	0
Component 4	0.1	100%	0.96	5%	0.1	0
<b>Program Total</b>	<b>1.6</b>	<b>84%</b>	<b>0.03</b>	<b>1%</b>	<b>1.4</b>	<b>0</b>
<i>Note: The program total CV values for LEEP reflect the CV for Component 1 measures only. Navigant did not calculate the program total CV due to differences in units of measurement.</i>						

Source: Navigant analysis

### 5.3 Impact Evaluation Net Savings

Navigant assumed an NTG ratio of 1.0, as in prior years, because low-income customers typically do not have the resources to install energy efficiency measures. Any Component 1 participant free ridership or spillover that occurs is captured in the billing analysis. To the extent that participants were already purchasing program measures or taking energy-saving actions, this will be captured in the usage prior to LEEP participation (the baseline). To the extent that participants purchase additional measures or take additional actions in response to participation in the program, this will be captured in the usage after LEEP participation. The billing analysis compares usage prior to and after LEEP participation, with the difference indicating program impacts. This difference incorporates free ridership and spillover, but does not allow for separating out these effects.

### 5.4 Process Evaluation

The process evaluation included two primary tasks: in-depth interviews with key program personnel and participant telephone surveys. The evaluation team conducted four in-depth interviews with key program personnel, including two staff at PECO and two staff at the

program implementer (CMC Energy Services). The primary goals of the interviews were to document changes in the program delivery and gather insight from staff members that work closely with the program. The interviews took place in April 2013. The evaluation team surveyed a random sample of 92 participants from Components 1, 3, and 4. The primary goals of the participant surveys were to gauge satisfaction with the program, gather participant and site information, and research measure installation rates. The surveys took place in July 2013.

#### **5.4.1 Customer Perspectives**

In general, participants are very satisfied with all elements of the program delivery. Respondents reported that educational materials were “clear and informative” and awarded an average satisfaction rating of 9.34 on a 10-point scale. Respondents were also asked to rate their satisfaction with the contractor, scheduling process, installation process, and quality of measures installed. Respondents were very satisfied with each of these elements, awarding average satisfaction ratings ranging from 9.29 to 9.78.

In general, participants were able to verify measure installation and were very satisfied with the measures installed (see Table 5-9). Note that participant-reported installation rates for Components 1 and 3 are for research purposes only and do not affect verified savings.

**Table 5-9. Participant-Reported Installation Rates and Satisfaction with Measures**

Measure Description	PY4 Reported (# Participants)	PY4 Verified (# Participants)	PY4 % Verified (# Participants)	PY4 Average Satisfaction Rating (0-10 scale)	PY3 Average Satisfaction Rating (0-10 scale)
<i>Component 1 (n = 38)</i>					
CFLs	34	30	88%	9.73	9.05 (n = 99)
Aerator	6	4	67%	9.50	9.14 (n = 7)
Showerhead	5	5	100%	9.60	8.80 (n = 15)
Refrigerator	4	4	100%	9.50	8.88*
Water Heater Pipe Insulation	2	2	100%	9.00	9.80 (n = 5)
Thermostat	1	1	100%	10.00	7.50 (n = 2)
Water Heater Timer	1	1	100%	10.00	-
All Measures	38	32	84%	-	-
<i>Component 3 (n = 30)</i>					
CFLs	30	27	90%	9.10	-
<i>Component 4 (n = 24)</i>					
Refrigerator/Freezer	24	23	96%	8.70	8.88*
<i>*No base number reported in PY3</i>					

Source: Navigant analysis

Participants reported taking energy-saving actions after the energy audit. Most reported actions are the low-cost/no-cost activities emphasized in the program’s educational materials, such as turning off lights (35%), unplugging appliances (22%), or reducing the use of air conditioners (15%) and other appliances (14%). Notably, the proportion of respondents reporting these actions generally increased compared to PY3.

The average square footage of homes reported by PY4 respondents was appreciably smaller than for PY3, decreasing from 2,305 square feet in PY3 to 1,259 square feet in PY4. Decreasing square footage is likely a driver of the lower energy savings indicated by the regression analysis. The large majority of respondents reported household incomes falling below 150 percent of the FPL.

Ninety percent of the Component 3 respondents (n = 30) reported receipt of CFLs. On average, respondents reported receiving 6.3 bulbs and reported installing 3.8 bulbs. The average installation rate was 65 percent.<sup>28</sup> Respondents reported that all remaining bulbs were in storage at the time of the survey. This suggests that some customers are keeping CFLs provided by the program in storage as “backups,” but other customers may require further education and encouragement to install the CFLs provided to them. The majority (71%) of CFLs installed replaced incandescent bulbs; 11 percent of respondents reported that the program CFLs replaced existing CFLs. The program CFLs largely replaced 60-watt bulbs (31% of respondents) and 75-watt bulbs (18% of respondents).

Consistent with PY3 findings, PY4 satisfaction with PECO either increased (58%) or stayed the same (36%) for LEEP participants. Only a small minority (6%) indicated their satisfaction with PECO had decreased. Many respondents had positive comments about the services provided, ranging from discounted billing, providing CFLs and refrigerators or adjusting thermostats and air conditioners, to just “*taking an interest.*” Several respondents commented that they felt safer due to the installation of smoke alarms.

#### **5.4.2 Program Management and Implementation Staff Perspectives**

In effect, PECO has piggybacked LEEP onto the existing LIURP. While the interviewees noted that this has worked well in achieving operational efficiencies and ensuring a smooth implementation of LEEP, there was often confusion on both the PECO and IC sides as to how the programs and their Components actually overlap.

Throughout the courtship of potential participants and in the day-to-day workings of the program, much emphasis was placed on making sure that the program staff addresses the customers’ needs. As one respondent put it:

*“There’s a lot of emphasis on respect - making the customer feel that they’re happy to be part of the program. We don’t want them to feel that this is something that’s being forced or mandated on them.”*

The telephone interviewees reported, “*There is a lot of poverty*” in the region being served, and suggested that Phase I (and forthcoming Phase II) qualifying criteria may exclude an

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<sup>28</sup> The average installation rate was calculated by: first, calculating the installation rate for each respondent that reported both the number of bulbs received and the number of bulbs installed; and second, taking the average of the customer-level installation rates. Alternatively, the average installation rate weighted by the number of bulbs received is 58%.

appreciable proportion of households that would benefit from these programs. All of the respondents commented that it would be desirable for Phase II to lower the threshold energy usage criterion in order to qualify more customers for the program. Table 5-10 contains Navigant's recommendations for revising the participant selection criteria.

While LEEP has been quite successful in distributing CFLs, as shown in this report and those for previous program years, respondents raised concerns as to whether the LEEP market for standard CFLs is nearing saturation.

The respondents indicated that in the past year significant effort has gone into quality assurance at the IC level to ensure that the database supplied to PECO is complete, error free, system compatible, and easy to access and use. One PECO staff respondent noted that the database has those characteristics and noted that, even though occasional errors occur, they are occurring less frequently.

While all the respondents noted that customer feedback has been positive, two key areas for program improvement were identified:

1. Create additional materials to further educate customers about additional ways to reduce energy usage
2. Explain the interactions and differences between LEEP and LIURP and clarify the program metrics of success

Table 5-10 contains the recommendations for program improvement from the process evaluation.

**Table 5-10. Status Report for LEEP Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being considered, Rejected AND Explanation of Action Taken by EDC)
Modify criteria for selection program participants to target customers with high energy density instead of customers with high usage. Add a series of questions about energy-efficient measures already installed to identify customers that have little opportunity for energy savings.	Under consideration
(For Pennsylvania Act 129 PEC) Include in future versions of the TRM CFL in-service rates that are specific to program delivery (i.e., direct install, mailings, and giveaways).	Under consideration
Develop additional educational materials for customers, especially focusing on consumer electronics.	Under consideration
Explain to PECO and IC staff how LEEP and LIURP interface and how they differ.	Under consideration

Source: Navigant analysis

## 5.5 Financial Reporting

LEEP continues to be cost effective, with a PY4 evaluation-verified cost-benefit ratio of 3.94 and a PY4 strict TRM-verified cost-benefit ratio of 3.78. The increased cost-benefit ratio is primarily driven by an increase in Total Lifetime Energy Benefits and a 19 percent decrease in costs as compared to PY3. The PY3 cost-effectiveness analysis aggregated Component 1 savings at the measure level; whereas the PY4 cost-effectiveness analysis aggregates Component 1 savings at the participant level, which is consistent with the methodology for reporting Component 1 savings. Additionally, CFLs make up an increasing proportion of program energy savings (63% in PY4 compared to 46% in PY3) and are generally cost-effective measures. A breakdown of the program finances under each scenario is presented in Table 5-11 and Table 5-12.

**Table 5-11. Summary of LEEP Finances – TRM Verified**

	IQ <sup>(9)</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>(1)</sup>	215	873	2,854
Management <sup>(2)</sup>	76	285	1,276
Marketing <sup>(3)</sup>	178	550	922
Technical Assistance	712	3,377	13,304
<b>Subtotal EDC Implementation Costs</b>	<b>1,181</b>	<b>5,084</b>	<b>18,355</b>
EDC Evaluation Costs	132	239	594
SWE Audit Costs	0	0	0
<b>Total EDC Costs<sup>(4)</sup></b>	<b>1,313</b>	<b>5,323</b>	<b>18,949</b>
Participant Costs <sup>(5)</sup>	0	0	0
<b>Total TRC Costs<sup>(6)</sup></b>	<b>N/A</b>	<b>5,323</b>	<b>18,949</b>
Total Lifetime Energy Benefits	N/A	19,107	53,788
Total Lifetime Capacity Benefits	N/A	420	2,122
<b>Total TRC Benefits<sup>(7)</sup></b>	<b>N/A</b>	<b>20,099</b>	<b>57,835</b>
<b>TRC Ratio<sup>(8)</sup></b>	<b>N/A</b>	<b>3.78</b>	<b>3.05</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

**Table 5-12. Summary of LEEP Finances – Evaluation Verified**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	215	873	2,854
Management <sup>[2]</sup>	76	285	1,276
Marketing <sup>[3]</sup>	178	550	922
Technical Assistance	712	3,377	13,304
<b>Subtotal EDC Implementation Costs</b>	<b>1,181</b>	<b>5,084</b>	<b>18,355</b>
<b>EDC Evaluation Costs</b>	<b>132</b>	<b>239</b>	<b>594</b>
<b>SWE Audit Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>1,313</b>	<b>5,323</b>	<b>18,949</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>5,323</b>	<b>18,949</b>
Total Lifetime Energy Benefits	N/A	19,374	54,055
Total Lifetime Capacity Benefits	N/A	1,014	2,716
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>20,961</b>	<b>58,697</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>3.94</b>	<b>3.10</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 6 Smart Equipment Incentives: Commercial and Industrial Program

The purpose of the Smart Equipment Incentives Commercial and Industrial program is to increase awareness of energy savings opportunities and assist customers in acting on those opportunities to decrease energy usage in commercial and industrial facilities and in master-metered multifamily residential buildings. This program offers incentives to customers who install high-efficiency electric equipment and engages equipment suppliers and contractors to promote the incentive-eligible equipment. The SEI C&I program has three sub-components: retrofit projects, multi-tenant projects, and appliance-recycling projects.

The SEI program offers both a prescriptive and custom incentive approach for customers. The prescriptive approach follows pre-established incentives typically based on a dollar per unit-installed incentive for C&I businesses interested in purchasing more common efficient technologies. The custom incentive approach is available to customers interested in less common or more complex energy-saving measures installed in qualified retrofit or equipment replacement projects. The program provides incentives for the following equipment categories: HVAC, Lighting, Drives and Motors, Refrigeration, and Custom Solutions. In addition, the program provides incentives for ENERGY STAR® appliances and HVAC equipment in multi-tenant master-metered buildings and appliance recycling for C&I customers. The program launched March 1, 2010, although incentives were also offered for projects completed between July 1, 2009, and February 28, 2010. In PY4, the C&I program incented a total of 717 projects covering C&I retrofit projects (659 projects<sup>29</sup>), C&I multi-tenant projects (44 projects), and C&I appliance recycling projects (14 projects).

*PECO's four-year energy efficiency plan separates the program efforts targeting private C&I businesses from the program efforts targeting the government and nonprofit sectors. For the limited post-launch period of PY1, the marketing and implementation of the Smart Equipment Incentives program was not differentiated between C&I and Government/Nonprofit to a degree that made it necessary to conduct separate evaluations. For PY2 through PY4, C&I and Government/Nonprofit programs are sufficiently differentiated that the two programs are now being evaluated separately.*

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<sup>29</sup> Two projects were not verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation. These projects and the savings will be reported as "unverified" savings in the Phase I compliance report. These projects were not verified in the PY4 evaluation and report because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. The projects represent two parts of a larger overall project installation (PECO-11-02812 and PE:CO-11-04673). These projects are included in this total count of C&I retrofit projects.

## 6.1 Program Updates

PECO sought and received approval from the Pennsylvania Public Utility Commission to establish a waitlist procedure for new project applications. New project applications received on or after October 1, 2011 were placed on the waitlist with no incentive funds reserved or guaranteed. During the waitlist, projects were evaluated in the order in which they were received. If program savings goals allowed, the projects would be granted active status, with an incentive fund reservation. Due to the waitlist, the program had shifted its marketing message from that of an incentive-based program to more of an educational message focusing on energy savings in general.

The SEI C&I program remained in waitlist status for Q1-Q3 of PY4 (June–February 2013) and for the first half of March 2013. However, as of March 15, 2013, PECO lifted the waitlist for customers applying to the SEI C&I program. At that time, PECO worked through all projects on the waitlist to ensure they were completed and paid or cancelled.

## 6.2 Impact Evaluation Gross Savings

Table 6-1 shows the total participants, reported gross energy savings, Top 100 Hours reported gross demand reduction, and total reported gross demand reduction and incentives for PY4 and Phase I. The total Phase I SEI C&I reported gross savings were 265,277 MWh and 45.7 MW. Table 6-2 shows the SEI C&I reported results by sector. All reported results for the SEI C&I program fall under the Commercial and Industrial sector. The remainder of this section details the measurement and verification (M&V) methodology, sample design, and evaluation findings for the SEI C&I program gross impact evaluation.

**Table 6-1. PY4 SEI C&I Reported Results by Quarter**

Reporting Period	Participants <sup>[1]</sup>	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	108	10,448	6.3	1.9	800
PY4 Q2	56	24,770	0.0	4.5	2,222
PY4 Q3	32	3,276	0.0	0.6	189
PY4 Q4	521	60,836	0.0	10.5	5,841
<b>PY4 Total<sup>[2]</sup></b>	<b>717</b>	<b>99,329</b>	<b>6.3</b>	<b>17.4</b>	<b>9,052</b>
<b>CPITD Total</b>	<b>3,961</b>	<b>265,277</b>	<b>6.3</b>	<b>45.7</b>	<b>21,020</b>

**NOTES:**  
 [1] The total participants (projects) for PY4 was 717. However, PY4 verified savings were based on 715 projects. Two project numbers (one project) were not included in the PY4 evaluation because the savings estimates were not ready in time.  
 [2] Total savings and incentives will not match amounts reported in PY4 Q4 report due to the addition of savings and incentive amounts for one post PY4 Q4 retrofit project (project PECO-11-04673) and one post PY4Q4 incentive adjustment (project PECO-11-03058).

Source: Navigant analysis

**Table 6-2. PY4 SEI C&I Reported Results by Sector**

Sector	Participants <sup>[1]</sup>	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0	0	0
Low-Income	0	0	0	0	0
Commercial and Industrial <sup>[2]</sup>	717	99,329	6.3	17.4	9,052
Government and Non-profit	0	0	0	0	0
<b>PY4 Total</b>	<b>717</b>	<b>99,329</b>	<b>6.3</b>	<b>17.4</b>	<b>9,052</b>
<b>CPITD Total</b>	<b>3961</b>	<b>265,277</b>	<b>6.3</b>	<b>45.7</b>	<b>21,020</b>

**NOTES:**  
 [1] The total participants (projects) for PY4 was 717. However, PY4 verified savings were based on 715 projects. Two project numbers (one project) were not included in the PY4 evaluation because the savings estimates were not ready in time.  
 [2] Total savings and incentives will not match amounts reported in PY4 Q4 report due to the addition of savings and incentive amounts for one post PY4 Q4 retrofit project (project 4673) and one post PY4 Q4 incentive adjustment (project 3058).

Source: Navigant analysis

### 6.2.1 M&V Methodology

The evaluation of the SEI C&I program consisted of three sub-components: retrofit projects, multi-tenant projects, and appliance-recycling projects. The M&V methodology for the SEI C&I program was very similar to the PY3 methodology. The primary modification was that the multi-tenant and appliance recycling projects were not evaluated in PY4 due to the very small percentage of overall program savings. The realization rate for SEI multi-tenant projects and appliance recycling projects was deemed at 1.0 for PY4 for the purposes of evaluation. The remainder of this section focuses exclusively on the M&V methodology for C&I retrofit projects.

Measurement and verification in PY4 included on-site data collection for most sampled sites. C&I sampled sites that met the following criteria received phone verification instead of on-site verification: 1) the project was a small partially deemed project where the TRM or an Interim Measure Protocol (IMP) applied, 2) the project had relatively small savings (i.e., those in C&I Stratum 3), and 3) the project documentation was complete and could be used to verify that the measures were installed.

Gross impacts for demand and energy were verified through different approaches for the three categories of measures in this program: 1) deemed, 2) partially deemed, and 3) custom measures. The measures in these categories are defined by the TRM<sup>30</sup> plus IMPs approved by the Pennsylvania Public Utility Commission through the SWE team. If a measure was deemed, the impacts for the measure were provided in the TRM or in an approved IMP. The evaluation approach for deemed measures was to verify both the installed quantity and that the installed measure matched the TRM-required specifications.

If a measure was partially deemed, the TRM or approved IMP provided the algorithms and default assumptions for calculating impacts and the variables to be verified. Depending on the complexity of the partially deemed measure, the evaluation team applied either a Basic or Enhanced level of rigor as described in the applicable protocols and the Audit Plan.<sup>31</sup> The evaluation team conducted an application and file review and developed a site-specific M&V

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<sup>30</sup> Pennsylvania Public Utility Commission, Technical Reference Manual (TRM) for Pennsylvania Act 129 Energy Efficiency and Conservation Program and Act 213 Alternative Energy Portfolio Standards, June 2012.

<sup>31</sup> The Statewide Evaluation Team: GDS Associates, Inc., Nexant, & Mondre Energy; contracted under the Pennsylvania Public Utility Commission RFP 2009-1 for the Statewide Evaluator, Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs, November 4, 2011.

plan (SSMVP) for all partially deemed projects. The team completed site visits or phone interviews (if the criteria described above were satisfied) following the activities laid out in the SSMVP, and calculated verified savings using the variables determined through the site visit or phone interview in accordance with the TRM or IMP.

For projects that included custom measures (defined as measures not included in the TRM or in an IMP, or measures that were initially reported as TRM measures, but determined through the evaluation to be custom), the evaluation team conducted an application review, developed SSMVPs, and conducted site visits. The primary difference was that there were no deemed variables and all custom measures followed an Enhanced Rigor level of effort.

The evaluation team produced ex post engineering-based estimates of gross annual energy and summer peak demand impacts for each sampled project. The peak kW savings estimation methodology was consistent with PECO requirements for each project and utilized the approved Act 129 peak demand calculators, where applicable. The evaluation of PY4 projects included a review of program-tracking data and supporting documentation (invoices, spec sheets) before developing a SSMVP and conducting a site inspection or phone interview. The focus of the data collection was to verify and/or update the assumptions that feed into analyses of measure-level savings. Data collection included verification of installation quantity, operating schedule, system loading conditions, validation of baseline selection, assessment of persistence, and verification that the systems are functioning and operating as planned (and if not, how the current operation differs from planned operation, taking into account daily, weekly, and seasonal variations).

The enhanced rigor level site evaluations generally included performing on-site measurement and/or obtaining customer-stored data to support downstream M&V calculations. Measurement included spot measurements, run-time hour data logging, and post-installation interval metering, depending on the needs of the project. Evaluators used customer-supplied data from an energy management system (EMS) or supervisory control and data acquisition (SCADA) system when available. In addition, the team requested billing data for all projects from PECO on a monthly or 15-minute interval basis, depending on the site.

## 6.2.2 Sample Design

The sample design for PY4 SEI retrofit projects used stratified ratio estimation similar to the method used in PY1 through PY3. Based on a combined paid annual population of 657<sup>32</sup> C&I retrofit projects, the final verified sample size was 30 C&I projects for the program year, with samples allocated by participation from each quarter and by stratum. The evaluation team designed the final C&I sample to achieve the required 85/15 confidence and precision at the program level. All of the sampled projects were completed and included in the final program analysis.

The strata boundaries were defined with Q1 data, Q2 data, and pipeline data at the end of Q2. The boundaries were defined to include the top 33 percent of reported kWh savings in Stratum 1, the middle 33 percent of reported kWh savings in Stratum 2, and the lower 33 percent of reported kWh savings in Stratum 3. For the C&I program, the team also determined that the EMS and combined heat and power (CHP) projects should be in their own strata due to the unique properties of these projects. The EMS projects are unique because the implementer has historically used a deemed savings value per square foot of affected area for the ex ante savings, while the evaluation team used a custom approach as the EMS measure is not in the TRM. CHP projects were also separated into their own stratum due to the large and distinct nature of these projects. Finally, the implementation team and PECO informed the evaluation team that one sampled C&I project had a large savings discrepancy due to a spreadsheet error. This project was placed into its own stratum for purposes of the final program analysis as the team expected this large error to be an exception and thus should not affect the verified savings for the rest of the projects.

Table 6-3 details the SEI C&I sampling strategy for PY4 and includes the impact evaluation sample design. The table also includes the sampling strategy for the process evaluation activities: the participant survey and the participating contractor survey.

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<sup>32</sup> The total number of PY4 C&I retrofit projects is 659. However, two projects will not be verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation.

Table 6-3. SEI C&I Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
C&I - Large III	>1,000,000 kWh	8	0.4	85/15	6	6	Impact Evaluation: Site visits and phone verification (2)(3)
C&I - Medium	> 300,000 and ≤ 1,000,000 kWh	36	0.4	85/15	8	8	
C&I - Small	≤ 300,000 kWh	596	0.4	85/15	9	9	
C&I - CHP	N/A	1	0.5	85/15	1	1	
C&I - EMS	N/A	16	0.4	85/15	6	6	
Activity Subtotal		657		85/15	30	30	
C&I Lighting - Large	> 700,000 kWh	8	0.5	85/10	7	1	Process Evaluation: Participant survey and NTG research
C&I Lighting - Medium	> 100,000 and ≤ 700,000 kWh	65	0.5	85/10	7	5	
C&I Lighting - Small	> 20,000 and ≤ 100,000 kWh	97	0.5	85/10	8	8	
Activity Subtotal		170		85/10	22	14	
C&I Non-lighting - Very Large	> 9,000,000 kWh	3	0.5	85/10	2	1	Process Evaluation: Participant survey and NTG research
C&I Non-lighting - Large	> 800,000 and ≤ 5,000,000 kWh	5	0.5	85/10	5	3	
C&I Non-lighting - Medium	> 100,000 and ≤ 800,000 kWh	19	0.5	85/10	6	6	
C&I Non-lighting - Small	> 20,000 and ≤ 100,000 kWh	30	0.5	85/10	7	6	
Activity Subtotal		57		85/10	20	16	
Stratum 1 - Very Large	> 9,000,000 kWh	3	0.5	85/10	3	0	Process Evaluation: Participating contractor
Stratum 2 - Large	> 1,000,000 and ≤ 6,000,000 kWh	12	0.5	85/10	10	3	

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Stratum 3 - Medium	> 300,000 and ≤1,000,000 kWh	48	0.5	85/10	7	7	survey
Stratum 4 - Small	> 60,000 and ≤ 300,000 kWh	148	0.5	85/10	8	8	
Activity Subtotal		211		85/10	28	18	
Program Total		1,095		N/A	100	78	

**NOTES:**

- [1] A single project (PECO-I1-03058) was placed into its own stratum during the evaluation process due to a large known error.
- [2] C&I - Appliance Recycling and C&I - Multi-tenant projects were not sampled in PY4.
- [3] The total number of SEI C&I retrofit projects in PY4 was 659. (Note that the total SEI C&I project count in PY4 is 717 if C&I multi-tenant and appliance recycling projects are included.) However, two projects were not verified in the PY4 evaluation, but they will be verified at a later date once the project files are ready for evaluation.

Source: Navigant analysis

### 6.2.3 Gross Impact Evaluation Findings

The evaluation team developed ex post gross impacts for each sampled SEI C&I retrofit project and analyzed these results to determine the program-level ex post gross impacts. The evaluation team completed site-specific evaluations of 30 sampled projects in PY4 for the SEI C&I retrofit program. Table 6-4 and Table 6-5 show the reported gross savings, verified gross savings, and unverified gross savings for the SEI C&I program. From the evaluation, the team found the energy realization rate for the C&I program (including retrofit projects, multi-tenant projects, and appliance recycling projects) to be 0.86 (85 percent confidence/10 percent precision) and the demand realization rate to be 0.80 (85 percent confidence/16 percent precision).

The evaluation team found that the ex ante calculations for projects involving EMS measures utilized assumed savings values of 2 kWh per square foot and 0.0001 kW per square foot<sup>33</sup> as was common in PY3. The evaluation team believes that the deemed savings values may be a

<sup>33</sup> Columns AH-AI of the '300' tab of the EDC quarterly tracking database extracts.

viable rule of thumb in certain cases, but they are an inaccurate way of estimating site-specific savings for impact evaluations. Use of these factors has typically caused an inaccurate estimation of energy savings and peak demand savings due to the EMS controlling a range of equipment in varying building types with diverse schedules. This resulted in widely varying project realization rates.

The evaluation team also found a range of realization rates for other retrofit project types due to the following reasons:

- Incorrect baseline classification in the ex ante estimates
- Adjustments to hours of use and equipment quantities for lighting projects
- Peak demand savings not based on the SWE-approved peak demand calculators
- Evaluation site visit findings varied from the assumptions used in the ex ante calculations.

As discussed previously, the C&I multi-tenant and appliance recycling projects were not evaluated in PY4 due to the very small percentage of overall program savings. The realization rate for SEI multi-tenant projects and appliance recycling projects was deemed at 1.0 for PY4 for the purposes of evaluation.

The total PY4 verified gross energy savings for the C&I retrofit, C&I multi-tenant, and C&I appliance recycling projects is 64,530 MWh. The total PY4 verified gross demand savings for the C&I retrofit, C&I multi-tenant, and C&I appliance recycling projects is 11.0 MW.

**Table 6-4. PY4 SEI C&I Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh) <sup>[1][2]</sup>	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
C&I - Large	11,433	1.09	0.16	0.07	12,481	-
C&I - Medium	16,656	0.88	0.31	0.21	14,666	-
C&I - Small	31,718	0.84	0.29	0.24	26,672	-
C&I - CHP	35,853	0.62	0.00	0.00	7,134	24,386
C&I - EMS	967	0.41	0.44	0.43	392	-
C&I - 3058	2,119	1.23	0.00	0.00	2,603	-
C&I - Appliance Recycling	77	1.00	0	0.00	77	-
C&I - Multi-tenant	506	1.00	0	0.00	506	-
<b>Program Total</b>	<b>99,329</b>	<b>0.86</b>	<b>N/A</b>	<b>0.10</b>	<b>64,530</b>	<b>24,386</b>

**NOTES:**

[1] Reported gross energy savings includes all savings - both verified and unverified gross savings - for PY4 projects.

[2] The reported gross energy savings include one additional project number and associated savings that was not included in the PY4Q4 report because the project savings were estimated after the PY4Q4 report. This project is the second part to a single project that is tracked using two project numbers. See additional note on these projects: The total number of PY4 C&I retrofit projects is 659. However, two projects will not be verified in the PY4 evaluation and report and will be verified at a later date once the project files are ready for evaluation. These projects and the savings will be reported as "unverified" savings in the Phase I compliance report. These projects will not be verified in the PY4 evaluation and report because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. These projects are two parts to the same installation (PECO-11-02812 and PECO-11-04673). Therefore, these two projects were not included in the sample design.

Source: Navigant analysis

**Table 6-5. PY4 SEI C&I Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW) <sup>[1] [2]</sup> <sup>[3]</sup>	Demand Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW) <sup>[3]</sup>	Unverified Gross Demand Reduction (MW) <sup>[3]</sup>
C&I - Large	1.8	1.0	0.2	0.1	1.9	0.0
C&I - Medium	3.1	0.7	0.3	0.3	2.2	0.0
C&I - Small	6.5	0.7	0.4	0.4	4.8	0.0
C&I - CHP	5.2	0.9	0.0	0.0	1.5	3.6
C&I - EMS	0.1	1.4	2.4	0.7	0.1	0.0
C&I - 3058	0.4	1.1	0.0	0.0	0.5	0.0
C&I - Appliance Recycling	0.0	1.0	0.0	0.0	0.0	0.0
C&I - Multi-tenant	0.1	1.0	0.0	0.0	0.1	0.0
<b>Program Total</b>	<b>17.4</b>	<b>0.8</b>	<b>N/A</b>	<b>0.2</b>	<b>11.0</b>	<b>3.6</b>

**NOTES:**

[1] Reported gross demand reduction includes all savings - both verified and unverified gross savings - for PY4 projects.

[2]The reported gross demand reduction includes one additional project number and associated savings that was not included in the PY4 Q4 report because the project savings were estimated after the PY4 Q4 report. This project is the second part to a single project that is tracked using two project numbers. See additional note on these projects: The total number of PY4 C&I retrofit projects is 659. However, two projects will not be verified in the PY4 evaluation and report and will be verified at a later date once the project files are ready for evaluation. These projects and the savings will be reported as “unverified” savings in the Phase I compliance report. These projects will not be verified in the PY4 evaluation and report because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. These projects are two parts to the same installation (PECO-11-02812 and PECO-11-04673). Therefore, these two projects were not included in the sample design.

[3]The reported gross demand reduction, verified gross demand reduction, and unverified gross demand reduction include the line loss factor.

Source: Navigant analysis

### 6.3 Impact Evaluation Net Savings

The primary objective of the net savings analysis was to determine the program's net effect on the program savings. After gross program impacts have been assessed, net program impacts are derived by estimating an NTG ratio that quantifies the percentage of the gross program impacts that can reliably be attributed to the program.

Once free ridership and spillover have been estimated, the NTG ratio is calculated as follows:

$$\text{NTG Ratio} = 1 - \text{Free-ridership Rate} + \text{Spillover Rate}$$

Free ridership was assessed using a customer self-report approach following a framework that was developed for evaluating net savings of California's 2006-2008 non-residential energy efficiency programs. This method calculates free ridership using data collected during participant phone surveys concerning the following three items:

1. A Timing and Selection score that reflects the influence of the most important various program and program-related elements in the customer's decision to implement the specific program measure at this time.
2. A Program Influence score that reveals the perceived importance of the program (whether rebate, recommendation, or other program intervention) relative to non-program factors in the customers' decision to implement the specific program measure. This score is cut in half if they learned about the program after they decided to implement the measures.
3. A No-Program score that captures the likelihood of various actions the customer might have taken at this time and in the future if the program had not been available. This score accounts for deferred free ridership by incorporating the likelihood that the customer would have installed program qualifying measures at a later date if the program had not been available.

Each of these scores represents the highest response or the average of several responses given to one or more questions about the decision to install a program measure. The rationale for using the maximum value is to capture the most important element in the participant's decision-making process.

The calculation of free-ridership for the program is a multi-step process. The participant survey covered a battery of questions used to assess free ridership for a specific end use and project. The evaluation team uses survey responses to calculate a Timing and Selection score, a Program Influence score, and a No-Program score for each project covered through the survey. These three scores can be given values of 0 to 10 where a lower score indicates a higher level of free ridership. The calculation then averages those three scores to come up with a measure-level free-ridership score. If the customer has additional measures at the same site as part of the same project, the survey asked whether the customer's responses also apply to the other measures. If that is the case, the entire project is given the same score. In addition, the survey asked if the responses apply to other PY4 projects, if applicable.

The evaluation team used a separate ratio estimation statistical method to combine the participant net of free-ridership ratios for the C&I sampled projects up to the program-level net of free-ridership ratios. In this method, a separate ratio is calculated for each stratum and then

applied to the population savings in each stratum. The sum of the verified net savings for each stratum is calculated and is compared to the sum of the verified gross savings resulting in a program-level net of free-ridership ratio.

In addition, the evaluation team asked program participants a battery of questions to quantitatively assess spillover. Below are examples of the spillover questions:

1. Since your participation in the program, did you install any additional energy efficiency measures at this facility that did not receive incentives through any utility or government program?
2. Could you describe the energy efficiency measure installed?
3. Thinking of the additional measure(s) you installed on your own at this same facility; how does the energy savings compare to what you installed through the program? Were the savings lower, about the same or higher? (Probe for percentage as compared to all incented projects)
4. How significant was your experience in PECO's program in your decision to install this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?
5. Since participating in the program, have you installed any energy-efficient measures in other facilities within PECO's territory?
6. Thinking of these additional measure(s) you installed on your own at other facilities, how does the quantity compare to what you installed through the program? Did you install more, less or the same amount of measures? (Probe for percentage as compared to all incented projects)
7. Have or will these measures receive incentives through the program?
8. What were the reasons that they did not receive an incentive?

Additionally, the evaluation team asked participating contractors whether they were seeing more customers within PECO's service territory purchase energy-efficient equipment without program incentives.

Spillover was calculated by asking participants how the energy savings of the un-incented measures compared, as a percentage saved (e.g., 10%, 20%, and 30%), to the savings of all of their incented projects. This self-reported percentage was then multiplied by the amount of influence PECO's program had on the decision to install the additional measures (Program Influence Score for spillover). The program spillover percentage was determined by dividing the total self-reported kWh described above by the total of all incented kWh savings obtained

by the program in PY4. All spillover estimates were calculated by Navigant using customer self-reported data and no follow-up interviews or site visits were conducted.

For C&I customers, the evaluation team found a combined kWh-weighted NTG ratio at the program level of 0.78 and a kW-weighted NTG ratio of 0.79; ratios were based on free ridership and spillover.

## **6.4 Process Evaluation**

The evaluation team conducted process evaluation activities jointly for the SEI C&I and the SEI GNI programs, as many of the administrators and contractors were common. Navigant conducted three primary research activities to perform the process evaluation. These activities consisted of in-depth phone interviews with PECO program management and KEMA implementation staff (6), Computer-Aided Telephone Interview (CATI) surveys with participating contractors (18 contractors), and CATI surveys with program participants (30 C&I customers).

Table 6-3 provides a summary of the evaluation activities and the sampling strategy. The tracking data for the sample frame was extracted from a copy of the PECO online database delivered electronically to the evaluation team on a quarterly basis. The activities conducted during the process evaluation are further described in the following sections.

### **6.4.1 PECO Program Management Staff and KEMA Staff Interviews**

The evaluation team conducted three in-depth interviews with PECO staff and three in-depth interviews with key members of the Smart Equipment Incentives program implementation contractor team, KEMA, during the months of February and March 2013. The interviews were designed to enable the evaluation team to ask closed-ended questions about the program's administration and delivery during PY4 and also to obtain "real-time" information about current program activity through asking open-ended questions that created a "free-flowing" conversation. To inform these interviews, the evaluation team reviewed current program reporting documents, marketing materials, and customer materials, such as the Wait-list Policies and Procedures document.

The evaluation team found the following information during the in-depth interviews:

- PECO and KEMA staff both reported the waitlist continued to have an effect on the program in PY4. In anticipation of the waitlist being lifted in PY4, PECO and KEMA staffs were proactive in reaching out to customers with waitlisted projects to aide them in moving the project forward or making the decision to cancel them.

- Of the projects that remained in the pipeline and were accepted before the waitlist was instituted, program staff reported that the majority were large projects, such as CHP projects accounting for sizable savings. The complexity of these projects continued to challenge both PECO and KEMA staff. While PECO staff was confident that up to 450 projects from the waitlist would be moved to fill the pipeline, there was concern that a “phantom” rush of applications could be encountered when the waitlist was ultimately lifted.
- Both PECO and KEMA staff commented there is a renewed focus on Quality Assurance and Quality Control. For instance, PECO now documents gold quality inspections, silver quality inspections, and inspections of unacceptable quality. In the future, PECO plans to have iPads to take on-site visits, enabling more pictures and real-time uploads of new data.

#### **6.4.2 Program Participating Customer Survey**

The evaluation team conducted a participating customer CATI survey for the PY4 SEI program. The survey assessed all of the parameters necessary to calculate free ridership, spillover, and NTG ratios. Additional data was collected to support the process evaluation (such as program design and implementation, program marketing and awareness, and customer satisfaction) and business demographics for the process component of the evaluation.

The sampling unit for the process evaluation was the unique participating customers; it did not include projects where the primary contact person in the database was a contractor or the project did not have contact information.<sup>34</sup> The rationale for contacting unique participating customers was to get project information from the final decision maker. Overall, 227 unique participant contacts completed 475 C&I retrofit projects in PY4.

The evaluation team targeted 90 completed surveys for the SEI retrofit program, 42 C&I surveys, and 48 GNI surveys. The samples were designed to achieve 85/10 confidence/precision individually and exceed that when combined to the program level. The evaluation team completed 30 SEI C&I surveys (14 lighting project participants and 16 non-lighting/custom project participants). A large number of SEI program participants (40) were not interviewed due to the maximum number of contact attempts being reached.

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<sup>34</sup> There were 212 projects with a contractor as the primary contact person in the database. There were 6 projects without contact information. These were not included in the sample. The 3 project numbers that were not included in the PY4 impact evaluation were included in the process evaluation sampling population. At the time of the process evaluation sample design, the team only had information on 3 of the 6 project numbers that were not included in the PY4 impact evaluation.

The analysis of the participant survey data showed customer satisfaction was high across the various program processes and sectors. Ninety-two percent of C&I participants were satisfied<sup>35</sup> with the SEI program and 88 percent were satisfied with PECO. Satisfaction with the SEI program was similar between lighting and non-lighting C&I participants. Seventy-seven percent of C&I participants also reported satisfaction with the incentive amount. The PY4 evaluation found 83 percent of C&I participants were satisfied with their interaction with program staff. Ninety-seven percent of C&I program participants were satisfied with the measures offered, and 100 percent of C&I program participants were satisfied with the contractor used to complete their project.

### **6.4.3 Participating Contractor Survey**

A Computer-Aided Telephone Interview survey was conducted at the contractor level; thus, the sample covered both SEI C&I retrofit and SEI GNI retrofit projects. In total, 211 contractors completed 639 SEI projects<sup>36</sup> in PY4. The contractor database was first sorted to reflect unique participating contractors. After the data cleaning process, the design resulted in a target of 28 interviews with participating contractors. The evaluation team completed a total of 18 contractor interviews in July 2013. The evaluation team did not meet the target due to a large number of refusals, disconnected phone numbers, and maximum attempts reached.

The analysis of the data collected through the participating contractor survey showed there was somewhat less satisfaction among participating contractors than participants. In general, about three-quarters of participating contractors were satisfied with PECO and two-thirds were satisfied with the SEI program. Contractors suggested that PECO more effectively communicate changes to the program now that funds were again available, including any rule changes. Additionally, contractors suggested shortening the amount of time it takes to get the rebate, expanding the types of measures that are eligible through the program such as induction lighting and LEDs, and increasing the amount of the rebates.

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<sup>35</sup> Survey respondents are considered satisfied if they answered 7 or greater, on a scale of 0 to 10 where 0 is “extremely dissatisfied” and 10 is “extremely satisfied.”

<sup>36</sup> Total number of projects does not include projects without contractor contact information. Navigant eliminated 290 projects that did not have complete contractor contact information in the database. The 3 project numbers that were not included in the PY4 impact evaluation were included in the process evaluation sampling population. At the time of the process evaluation sample design, the team only had information on 3 of the 6 project numbers that were not included in the PY4 impact evaluation.

Table 6-6 lists the key PY4 SEI C&I process recommendations and the EDC status for each recommendation. The processes recommendations are either currently being implemented, have been partially implemented, or are being considered.

**Table 6-6. Status Report for SEI C&I Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being considered, Rejected AND Explanation of Action Taken by EDC)
<p>PECO should increase communication with contractors and more closely manage relationships to improve the contractor and participant experience with the program. Contractors indicated that increased communication from PECO was desired. In addition, program participants expressed that contractors were a main source of information about the program. PECO should leverage contractor relationships to communicate program goals to customers and use contractor training and communication as a way to scale up or ratchet down program participation.</p>	<p>Implemented:</p> <ul style="list-style-type: none"> <li>• PECO has increased the frequency of the Trade Ally newsletter and already sent first edition for phase II.</li> <li>• PECO has conducted 3 seminars in October with attendance of 50-100 at each event.</li> <li>• PECO is holding trade ally certification seminars (First one Oct. 15).</li> <li>• PECO is holding a trade ally webinar series.</li> <li>• PECO launched an online trade ally portal for materials and live online project tracking.</li> </ul>
<p>PECO should consider a sliding scale for incentive payments, rather than reaching program targets and abruptly throttling the program with a waitlist. Incentive amounts could be reduced when certain program sub-goals are met (e.g., 50% of program goal, 75% of program goal, 90% of program goal).</p>	<p>Being considered: Incentives were filed as a range, and thus PECO can adjust the rates without re-filing.</p>
<p>PECO should continue to review the program measure list to ensure that the latest proven technologies are being incented by the program. For example, PECO has expanded the prescriptive program LED offerings. This review of measures should be an ongoing process.</p>	<p>Implemented: KEMA is under contract to evaluate new technologies from potential suppliers; leverage KEMA's national technology group to keep us up to date.</p>
<p>PECO and/or the implementation team should develop a completed application example for both lighting and custom projects that can be utilized as a guide for prospective participants in the program.</p>	<p>Being Considered</p>

Source: Navigant analysis

## 6.5 Financial Reporting

A breakdown of the program finances is presented in Table 6-7. The SEI C&I program has a PY4 TRC ratio greater than 1.0 and thus the PY4 program was cost effective. The TRC ratio for PY4 (1.80) is lower than the TRC ratio in PY3 (2.21), but is slightly higher than the TRC ratio in PY2 (1.79). The TRC ratio for the program in Phase I is 1.94 and thus the Phase I SEI C&I program was cost effective.

**Table 6-7. Summary of SEI C&I Finances**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	5,841	9,052	21,019
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>5,841</b>	<b>9,052</b>	<b>21,019</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	1,649	3,767	10,433
Management <sup>[2]</sup>	93	427	2,124
Marketing <sup>[3]</sup>	152	327	1,333
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>1,894</b>	<b>4,521</b>	<b>13,890</b>
EDC Evaluation Costs	546	1,035	2,390
SWE Audit Costs	0	0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>8,281</b>	<b>14,608</b>	<b>37,299</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>36,625</b>	<b>91,151</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>42,181</b>	<b>107,431</b>
Total Lifetime Energy Benefits	N/A	67,473	184,482
Total Lifetime Capacity Benefits	N/A	8,418	23,847
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>75,909</b>	<b>208,435</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>1.80</b>	<b>1.94</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## **7 Smart Equipment Incentives - Government, Nonprofit, Institutional Program**

The purpose of the SEI GNI program is to increase the energy efficiency of GNI facilities. This program provides all of the same services offered within the C&I segment of the SEI program. However, the GNI program only offers incentives to GNI customers who install high-efficiency electric equipment. The SEI GNI program also enables customers to capture opportunities to reduce consumption by retrofitting street lighting and traffic signal lights. The street and traffic signal lighting projects are referred to as “municipal lighting” projects in this report. In addition, the GNI program was intended to provide assistance with obtaining facility audits, but this portion of the program has not been used to date. The SEI GNI program has four sub-components: retrofit projects, multi-tenant projects, appliance-recycling projects, and new construction projects.

### **7.1 Program Updates**

The SEI GNI program remained unchanged for the first three quarters of PY4 with project applications being placed on a wait list. PECO instituted this wait list as it appeared from savings projections that the Phase I program goals were achieved. However, as of March 15, 2013, PECO lifted the wait list and there was a surge in the number of applications that were submitted in Q4 of the program year.

In PY4, GNI Multi-tenant projects within the GNI sector were not evaluated in PY4 due to the very small percentage of overall program savings and the realization rates were set to 1.0. Likewise, GNI appliance recycling projects conducted in the GNI sector were not evaluated in PY4 due to the very small percentage of overall program savings and the realization rates were set to 1.0.

New Construction projects in the GNI sector were evaluated as part of the Smart Construction Incentive (SCI) program. Complete details on evaluation of these projects can be found in the SCI section of this report.

### **7.2 Impact Evaluation Gross Savings**

Table 7-1 shows the total participants, reported gross energy savings, Top 100 Hours reported gross demand reduction, and total reported gross demand reduction and incentives for PY4 and Phase I (CPITD). The total Phase I SEI GNI reported gross savings were 215,682 MWh and 36.2 MW. The reported results and incentives from GNI Retrofit projects, GNI Multi-tenant projects,

GNI New Construction Projects, and GNI Appliance Recycling projects combined and shown under the GNI sector. Table 7-2 shows the reported results by program component. In PY4, the program incentivized a total of 325 projects covering 273<sup>37</sup> SEI GNI retrofit projects, 8 GNI Multi-tenant projects, 44 SEI GNI New Construction (GNI NC) projects. The table below also details the reported gross energy savings, reported gross demand reduction, and incentives for each program component.

**Table 7-1. PY4 GNI Program Reported Results by Quarter**

Reporting Period	Participants <sup>(1)</sup>	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	81	9,416	4.9	1.4	905
PY4 Q2	57	13,574	0.0	1.7	1378
PY4 Q3	42	33,305	0.0	5.3	2957
PY4 Q4	145	28,561	0.0	2.8	2909
<b>PY4 Total<sup>(2)</sup></b>	<b>325</b>	<b>84,855</b>	<b>4.9</b>	<b>11.3</b>	<b>8,149</b>
<b>CPITD Total</b>	<b>1,129</b>	<b>177,540</b>	<b>19.1</b>	<b>25.5</b>	<b>17,176</b>

**NOTES:**  
 [1] The total participants (projects) for PY4 was 325. However, PY4 verified savings were based on 321 projects. Four project numbers (two projects) were not included in the PY4 evaluation because the savings estimates were not ready in time.  
 [2] Total incentives will not match amounts reported in PY4 Q4 report due to the addition of incentive amounts for GNI NC program in Q1 and Q2 of PY4. These were incorrectly reported as 0.0 in the previously submitted quarterly reports.

Source: Navigant analysis

<sup>37</sup>The total number of PY4 GNI retrofit projects is 273. However, four projects were not verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation. These projects and the associated savings are reported in Table 7-4 and Table 7-5 as “unverified” savings. These projects were not verified as part of the PY4 evaluation because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. The projects represent two parts of one larger project installation (PECO-11-02721 & PECO-11-04675 and PECO-11-04473 & PECO-13-04676). These projects and associated savings are included in the totals for GNI retrofit projects below.

**Table 7-2. PY4 GNI Program Reported Results by Sector**

Sector	Participants (1)	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0	0	0
Low-Income	0	0	0	0	0
Commercial and Industrial	0	0	0	0	0
Government and Non-Profit (2)	325	84,856	4.9	11.3	8,149
<b>PY4 Total</b>	<b>325</b>	<b>84,856</b>	<b>4.9</b>	<b>11.3</b>	<b>8,149</b>
<b>CPITD Total</b>	<b>1,129</b>	<b>177,540</b>	<b>19.1</b>	<b>25.5</b>	<b>17,176</b>
<b>NOTES:</b>					
[1] The total participants (projects) for PY4 was 325. However, PY4 verified savings were based on 321 projects. Four project numbers (two projects) were not included in the PY4 evaluation because the savings estimates were not ready in time.					
[2] Total incentives will not match amounts reported in PY4 Q4 report due to the addition of incentive amounts for GNI NC program in Q1 and Q2 of PY4. These were incorrectly reported as 0.0 in the previously submitted quarterly reports.					

Source: Navigant analysis

### 7.2.1 M&V Methodology

The evaluation of the SEI GNI program consisted of four sub-components: GNI Retrofit projects, GNI Multi-tenant projects, GNI New Construction projects, and GNI Appliance Recycling projects. The M&V methodology for the SEI GNI Retrofit program was very similar to the PY3 methodology. The primary modification was that the multi-tenant and appliance recycling projects were not evaluated in PY4 due to the very small percentage of overall program savings. The realization rate for SEI multi-tenant projects and appliance recycling projects was deemed at 1.0 for PY4 for the purposes of evaluation. The GNI new construction projects were evaluated as part of the Smart Construction Incentives program and additional details can be found in the Smart Construction Incentives program section of this report. The remainder of this section focuses exclusively on the M&V methodology for GNI retrofit projects.

Measurement and verification in PY4 included on-site data collection for most sampled sites. The municipal lighting projects received a phone interview in addition to the desk review in accordance with the evaluation plan. One of the municipal lighting projects was a traffic signal LED replacement project and received a file review only.

Gross impacts for demand and energy were verified through different approaches for the three categories of measures in this program: 1) deemed, 2) partially deemed, and 3) custom measures. The measures in these categories are defined by the TRM<sup>38</sup> plus interim measure protocols approved by the Pennsylvania Public Utility Commission through the SWE team. If a measure was deemed, the impacts for the measure were provided in the TRM or in an approved IMP. The evaluation approach for deemed measures was to verify both the installed quantity and that the installed measure matched the TRM-required specifications.

If a measure was partially deemed, the TRM or approved IMP provided the algorithms and default assumptions for calculating impacts and the variables to be verified. Depending on the complexity of the partially deemed measure, the evaluation team applied either a Basic or Enhanced level of rigor as described in the applicable protocols and the Audit Plan.<sup>39</sup> The evaluation team conducted an application and file review and developed a site-specific M&V plan for all partially deemed projects. The team completed site visits or phone interviews (if the criteria described above were satisfied) following the activities laid out in the SSMVP, and calculated verified savings using the variables determined through the site visit or phone interview in accordance with the TRM or IMP.

For projects that included custom measures (defined as measures not included in the TRM or in an IMP, or measures that were initially reported as TRM measures, but determined through the evaluation to be custom), the evaluation team conducted an application review, developed SSMVPs, and conducted site visits. The primary difference was that there were no deemed variables and all custom measures followed an enhanced rigor level of effort. The evaluation team produced ex post engineering-based estimates of gross annual energy and summer peak demand impacts for each sampled project. The peak kW savings estimation methodology was consistent with PECO requirements for each project and utilized the approved Act 129 peak demand calculators, where applicable. The evaluation of PY4 projects included a review of program-tracking data and supporting documentation (invoices, spec sheets) before developing an SSMVP and conducting a site inspection or phone interview. The focus of the data collection for all sites at the basic and enhanced rigor levels was to verify and/or update the assumptions

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<sup>38</sup> Pennsylvania Public Utility Commission, June 2012. Technical Reference Manual (TRM) for Pennsylvania Act 129 Energy Efficiency and Conservation Program and Act 213 Alternative Energy Portfolio Standards.

<sup>39</sup> The Statewide Evaluation Team: GDS Associates, Inc., Nexant, & Mondre Energy; contracted under the Pennsylvania Public Utility Commission RFP 2009-1 for the Statewide Evaluator, Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs, November 4, 2011.

that feed into analyses of measure-level savings. Data collection included: verification of installation quantity, operating schedule, and system loading conditions; validation of baseline selection; assessment of persistence; and verification that the systems are functioning and operating as planned (and if not, how the current operation differs from planned operation, taking into account daily, weekly, and seasonal variations).

The enhanced rigor level site evaluations generally included performing on-site data collection and measurement activities, and, for several sites, obtaining participants' collected data from records or building automation systems to support downstream M&V calculations. Monitoring efforts included spot measurements, run-time hour data logging, power/amperage metering, depending on the needs of the project. Customer-supplied data from an EMS or supervisory control and data acquisition systems were used when available. In addition, the team requested billing data for all projects from PECO on a monthly or 15-minute interval basis, depending on the site.

## 7.2.2 Sample Design

The sample design for PY4 SEI retrofit projects used stratified ratio estimation similar to the method used in PY1 through PY3. Based on a combined paid annual population of 269<sup>40</sup> GNI retrofit projects, the final evaluated sample size was 36 GNI projects for the program year, with samples allocated by participation from each quarter and by stratum. The sample size was targeted to achieve an 85/15 confidence and precision level with coefficients of variation chosen to reflect the PY3 achieved relative precision targets. One of the sampled Municipal Lighting stratum projects was not able to be verified and was therefore dropped from the final savings roll-up.

The strata boundaries defined for sampling purposes were as follows:

- Stratum 1 (Large) > 1,500,000 kWh
- 500,000 kWh < Stratum 2 (Medium) ≤ 1,500,000 kWh
- 0 kWh ≤ Stratum 3 (Small) ≤ 500,000 kWh

For the GNI program, all municipal lighting projects were assigned to Stratum 4. In addition, the team also separated CHP in its own stratum due to the large and distinct nature of these

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<sup>40</sup> The total number of PY4 GNI retrofit projects is 273. However, four projects will not be verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation. See footnote 37 for more information.

projects. Due to the method used to define the strata boundaries early in the process and the influx of waitlist projects at the end of PY4, strata 1, 2, and 3 contain more or less than 33 percent of the total PY4 reported kWh savings. The sample was pulled in four stages: after Q2 using both Q1 and Q2 data, after Q3, during Q4, and after Q4. During each stage, the sample design was reviewed and adjustments were made as needed to ensure that the sample design would meet the target confidence and precision. This process included reviewing the projects in the pipeline and estimating the number of projects that would be completed prior to the end of PY4. The percentage of total sample pulled from each stage was based on the number of completed projects in that stage as a proportion of the expected number of projects for the entire program year. Lastly, the team included all projects in the sample design, but only sampled from projects representing the top 95 percent of aggregate program savings. The team determined that sampling from the smallest projects representing the bottom 5 percent of aggregate program savings would be of limited value to the program evaluation.

Table 7-3 below includes the sampling strategies for SEI GNI retrofit program gross impact analysis and the process evaluation activities: the participant survey and the participating contractor survey. The table also includes the sampling strategy for GNI NC projects.

**Table 7-3. GNI Program Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
GNI - Large	>1,500,000 kWh	1	0.6	85/15	4	1	Impact: On-site verification
GNI - Medium	<1,500,000 kWh, >500,000 kWh	18	0.9	85/15	12	12	
GNI - Small	<500,000 kWh	229	0.7	85/15	12	13	
GNI - CHP	N/A	4	0.5	85/15	3	4	
GNI - Muni Lighting	N/A	17	0.4	85/15	6	6	Impact: Desk Review and phone verification
Activity Subtotal		269		85/15	37	36	
SEI GNI - NC - Strata 1 [3]	>750,000 kWh	2	0.5	85/15	2	2	Impact: Site Visits (Strata 1, 2, WB1) and
SEI GNI - NC	200,000 -	4	0.5	85/15	2	2	

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
- Strata 2 [3]	750,000 kWh						Desk Reviews (all) Process: Participant Surveys
SEI-GNI - NC - Strata 3 [3]	<200,000 kWh	27	0.5	85/15	4	4	
SEI-GNI - NC - WB 1 [3]	>750,000 kWh	1	0.5	85/15	1	1	
SEI-GNI - NC - WB 2 [3]	<750,000 kWh	10	0.5	85/15	4	4	
Activity Subtotal		44		85/15	13	13	
GNI Lighting - Large	> 600,000 kWh	7	0.5	85/10	7	2	Process Evaluation: Participant survey and NTG research
GNI Lighting - Medium	> 100,000 and ≤ 600,000 kWh	23	0.5	85/10	7	7	
GNI Lighting - Small	> 20,000 and ≤ 100,000 kWh	54	0.5	85/10	7	7	
GNI Lighting - Municipal	> 20,000 and ≤ 200,000 kWh	13	0.5	85/10	6	2	
Activity Subtotal		97		85/10	27	18	
GNI Non-lighting - Very large	>33,000,000 kWh	1	0.5	85/10	1	1	Process Evaluation: Participant survey and NTG research
GNI Non-lighting - Large	> 800,000 and ≤ 3,500,000 kWh	9	0.5	85/10	8	2	
GNI Non-lighting - Medium	> 80,000 and ≤ 800,000 kWh	17	0.5	85/10	6	6	
GNI Non-lighting - Small	> 20,000 and ≤ 80,000 kWh	15	0.5	85/10	6	6	
Activity Subtotal		42		85/10	21	15	
Stratum 1 - Very Large	> 9,000,000 kWh	3	0.5	85/10	3	0	Process Evaluation: Participating contractor survey
Stratum 2 - Large	> 1,000,000 and ≤ 6,000,000 kWh	12	0.5	85/10	10	3	
Stratum 3 - Medium	> 300,000 and ≤ 1,000,000	48	0.5	85/10	7	7	

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
	kWh						
Stratum 4 - Small	> 60,000 and ≤ 300,000 kWh	148	0.5	85/10	8	8	
Activity Subtotal		148		85/10	8	8	
Program Total		600			106	90	

[1] GNI - Appliance Recycling and GNI - Multi-tenant projects were not sampled in PY4.  
 [2] The total number of SEI GNI projects in PY4 was 273. However, four projects were not verified in the PY4 evaluation, but they will be verified at a later date once the project files are ready for evaluation.  
 [3] Smart Equipment Incentives - New Construction sampling strategy for PY4 is for the broader Smart Construction Incentives program; the sampling plan shown above is for the GNI new construction projects only.

Source: Navigant analysis

### 7.2.3 Gross Impact Evaluation Findings

The evaluation team completed site-specific evaluations of 35 sampled projects in PY4 for the SEI GNI retrofit program. The gross impact results for the GNI retrofit projects yielded an energy realization rate of 0.93 and a peak demand realization rate of 0.98. Relative precision levels for verified gross savings were 12 percent for energy and 4 percent for demand at an 85 percent confidence interval, which are better than the targeted relative precision of 15 percent. The main reasons behind the relative precision levels (and greater accuracy) were the sampling strategy (incorporating more sample points to counteract high error ratios encountered in PY3) and the accuracy of savings estimates for several large projects.

The evaluation team found that the ex ante calculations for projects involving EMS measures utilized assumed savings values of 2 kWh per square foot and 0.0001 kW per square foot<sup>41</sup> as was common in PY3. The evaluation team believes that the deemed savings values may be a viable rule of thumb in certain cases, but they are an inaccurate way of estimating site-specific savings for impact evaluations. Use of these factors has typically caused an inaccurate

<sup>41</sup> Columns AH-AI, of the '300' tab of the EDC quarterly tracking database extracts.

estimation of energy savings and peak demand savings due to the EMS controlling a range of equipment in varying building types with diverse schedules. This resulted in widely varying project realization rates.

The evaluation team also found a range of realization rates for other retrofit project types due to the following reasons:

- Incorrect baseline classification in the ex ante estimates
- Adjustments to hours of use and equipment quantities for lighting projects
- Peak demand savings not based on the SWE-approved peak demand calculators
- Evaluation site visit findings varied from the assumptions used in the ex ante calculations.

As discussed previously, the GNI multi-tenant and appliance recycling projects were not evaluated in PY4 due to the very small percentage of overall program savings. The realization rate for SEI multi-tenant projects and appliance recycling projects was deemed at 1.0 for PY4 for the purposes of evaluation. The GNI new construction projects were evaluated under the Smart Construction Incentives program and pertinent details of this evaluation may be found under the SCI program section of this report.

The evaluation team provided PECO the site-specific M&V reports for the verified projects. These site-specific impact evaluation reports summarize the ex ante savings, the ex post M&V plan, the data collected at the site, and all of the calculations and parameters used to estimate savings. Stratum 1 (Large) energy realization rate was 64 percent with a 0 percent stratum-level relative precision. Stratum 2 (Medium) had a relative precision of 17 percent due to realization rates ranging from 35 percent to 187 percent. Stratum 3 (Small) had a relative precision of 47 percent with realization rates ranging from 34 percent to 224 percent, while the CHP and municipal lighting stratum had a very low (<1 percent) relative precision with all sampled projects at almost 100 percent realization rates. Table 7-4 presents the strata-level and program-level relative precision levels for verified gross energy savings for each of the GNI program components.

**Table 7-4. PY4 GNI Program Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh) <sup>[1][2]</sup>	Energy Realization Rate	Observed Coefficient of Variation (C.v.) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
GNI - Large	1,837	0.64	0.00	0.00	1,168	0
GNI - Medium	14,584	0.85	0.04	0.17	12,381	0
GNI - Small	18,857	0.91	0.00	0.47	17,126	0
GNI - CHP	37,719	0.98	0.00	0.00	34,510	2,677
GNI - Muni Lighting	1,044	1.00	0.00	0.01	1,041	0
GNI - Multi-tenant	11	1.00	N/A	N/A	11	0
GNI - Appliance Recycling	0	1.00	N/A	N/A	0	0
SEI GNI - NC - Strata 1 <sup>[3]</sup>	2,740	1.19	0.19	0.00	3,273	0
SEI GNI - NC - Strata 2 <sup>[3]</sup>	1,160	1.41	0.41	0.74	1,631	0
SEI GNI - NC - Strata 3 <sup>[3]</sup>	1,614	0.94	0.06	0.07	1,525	0
SEI GNI - NC - WB 1 <sup>[3]</sup>	3,045	0.95	0.00	0.00	2,893	0
SEI GNI - NC - WB 2 <sup>[3]</sup>	2,243	1.01	0.03	0.01	2,258	0
<b>Program Total</b>	<b>84,855</b>	<b>0.95</b>	<b>N/A</b>	<b>0.12</b>	<b>77,817</b>	<b>2,677</b>

**NOTES:**

[1] Reported gross energy savings includes all savings - both verified and unverified gross savings - for PY4 projects.

[2] The reported gross energy savings include two additional project numbers and associated savings that were not included in the PY4 Q4 report because the project savings were estimated after the PY4 Q4 report. The total number of PY4 GNI projects is 273. However, four projects were not verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation. These projects and the savings will be reported as "unverified" savings in the Phase I compliance report. These projects will not be verified in the PY4 evaluation and report because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. The projects represent two parts of one larger project installation (PECO-11-02721 & PECO-11-04675 and PECO-11-04473 & PECO-13-04676). Therefore, these four projects were not included in the sample design.

[3] GNI New Construction (NC) measures were evaluated under the Smart Construction Incentives program. This table only contains reported and verified savings for the PY4 GNI NC projects.

Source: Navigant analysis

Stratum 1 (Large) demand realization rate was 220 percent with a 0 percent stratum-level relative precision. Stratum 2 (Medium) had a relative precision of 13 percent, with project realization rates ranging from 48 percent to 169 percent. Stratum 3 (Small) had a relative precision of 10 percent with project realization rates ranging from 67 percent to 130 percent, while the CHP and municipal lighting stratum had a 0 percent relative precision with all sampled projects at or near 100 percent realization rates. Table 7-5 presents the strata-level and

program-level relative precision levels for verified gross demand savings for each of the GNI program components.

**Table 7-5. PY4 GNI Program Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW) <sup>[1][2][4]</sup>	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction (MW) <sup>[4]</sup>	Unverified Gross Demand Reduction (MW) <sup>[4]</sup>
GNI - Large	0.1	2.2	0.00	0.00	0.2	0
GNI - Medium	1.8	0.9	0.02	0.13	1.6	0
GNI - Small	3.4	1.0	0.00	0.10	3.3	0
GNI - CHP	4.1	1.0	0.00	0.00	3.7	0.3
GNI - Muni Lighting	0.1	1.0	0.00	0.00	0.1	0
GNI - Multi-tenant	0.002	1.0	N/A	N/A	0.002	0
GNI - Appliance Recycling	0.0	1.0	N/A	N/A	0.0	0
SEI GNI - NC - Strata 1 <sup>[3]</sup>	0.5	1.6	0.69	0.02	0.8	0
SEI GNI - NC - Strata 2 <sup>[3]</sup>	0.2	1.3	0.40	0.2	0.3	0
SEI GNI - NC - Strata 3 <sup>[3]</sup>	0.4	1.1	0.20	0.4	0.5	0
SEI GNI - NC - WB 1 <sup>[3]</sup>	0.4	1.6	0.00	0.0	0.6	0
SEI GNI - NC - WB 2 <sup>[3]</sup>	0.4	1.8	0.28	0.2	0.7	0
<b>Program Total</b>	<b>11.3</b>	<b>1.1</b>		<b>0.04</b>	<b>11.7</b>	<b>0.3</b>

**NOTES:**

- [1] Reported gross energy savings includes all savings - both verified and unverified gross savings - for PY4 projects.
- [2] The reported gross energy savings include two additional project numbers and associated savings that were not included in the PY4Q4 report because the project savings were estimated after the PY4Q4 report. The total number of PY4 GNI projects is 273. However, four projects were not verified in the PY4 evaluation and report, but will instead be verified at a later date once the project files are ready for evaluation. These projects and the savings will be reported as "unverified" savings in the Phase I compliance report. These projects will not be verified in the PY4 evaluation and report because the applications were received at the end of Phase I and there was insufficient time to assign savings to these projects. The projects represent two parts of one larger project installation (PECO-11-02721 & PECO-11-04675 and PECO-11-04473 & PECO-13-04676). Therefore, these four projects were not included in the sample design.
- [3] GNI New Construction (NC) measures were evaluated under the Smart Construction Incentives program. This table only contains reported and verified savings for the PY4 GNI NC projects.
- [4] The reported gross demand reduction, verified gross demand reduction, and unverified gross demand reduction include the line loss factor.

Source: Navigant analysis

### 7.3 Impact Evaluation Net Savings

The primary objective of the net savings analysis was to determine the program's net effect on the program savings. After gross program impacts have been assessed, net program impacts are

derived by estimating an NTG ratio that quantifies the percentage of the gross program impacts that can reliably be attributed to the program.

Once free ridership and spillover have been estimated, the NTG ratio is calculated as follows:

$$\text{NTG Ratio} = 1 - \text{Free-ridership Rate} + \text{Spillover Rate}$$

Free ridership was assessed using a customer self-report approach following a framework that was developed for evaluating net savings of California's 2006-2008 non-residential energy efficiency programs. This method calculates free ridership using data collected during participant phone surveys concerning the following three items:

1. A Timing and Selection score that reflects the influence of the most important various program and program-related elements in the customer's decision to implement the specific program measure at this time.
2. A Program Influence score that reveals the perceived importance of the program (whether rebate, recommendation, or other program intervention) relative to non-program factors in the customers' decision to implement the specific program measure. This score is cut in half if they learned about the program after they decided to implement the measures.
3. A No-Program score that captures the likelihood of various actions the customer might have taken at this time and in the future if the program had not been available. This score accounts for deferred free ridership by incorporating the likelihood that the customer would have installed program qualifying measures at a later date if the program had not been available.

Each of these scores represents the highest response or the average of several responses given to one or more questions about the decision to install a program measure. The rationale for using the maximum value is to capture the most important element in the participant's decision-making process. The calculation of free ridership for the program is a multi-step process. The participant survey covered a battery of questions used to assess free ridership for a specific end use and project. The evaluation team uses survey responses to calculate a Timing and Selection score, a Program Influence score, and a No-Program score for each project covered through the survey. These three scores can be given values of 0 to 10 where a lower score indicates a higher level of free ridership. The calculation then averages those three scores to come up with a measure-level free-ridership score. If the customer has additional measures at the same site as part of the same project, the survey asked whether the customer's responses also apply to the

other measures. If that is the case, the entire project is given the same score. In addition, the survey asked if the responses apply to other PY4 projects, if applicable.

The evaluation team used a separate ratio estimation statistical method to combine the participant net of free-ridership ratios for the C&I and GNI sampled projects up to the program-level net of free-ridership ratios. In this method, a separate ratio is calculated for each stratum and then applied to the population savings in each stratum. The sum of the verified net savings for each stratum is calculated and is compared to the sum of the verified gross savings resulting in a program-level net of free-ridership ratio.

The evaluation team asked program participants a battery of questions to quantitatively assess spillover. Below are examples of the spillover questions:

1. Since your participation in the program, did you install any additional energy efficiency measures at this facility that did not receive incentives through any utility or government program?
2. Could you describe the energy efficiency measure installed?
3. Thinking of the additional measure(s) you installed on your own at this same facility; How does the energy savings compare to what you installed through the program? Were the savings lower, about the same or higher? (Probe for percentage as compared to all incented projects)
4. How significant was your experience in PECO's program in your decision to install this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?
5. Since participating in the program, have you installed any energy-efficient measures in other facilities within PECO's territory?
6. Thinking of these additional measure(s) you installed on your own at other facilities, how does the quantity compare to what you installed through the program? Did you install more, less or the same amount of measures? (Probe for percentage as compared to all incented projects)
7. Have or will these measures receive incentives through the program?
8. What were the reasons that they did not receive an incentive?

Additionally, the evaluation team asked participating contractors whether they were seeing more customers within PECO's service territory purchase energy-efficient equipment without program incentives.

Spillover was calculated by asking participants how the energy savings of the un-incented measures compared, as a percentage saved (e.g., 10%, 20%, and 30%), to the savings of all of their incented projects. This self-reported percentage was then multiplied by the amount of influence PECO's program had on the decision to install the additional measures (Program Influence Score for spillover). The program spillover percentage was determined by dividing the total self-reported kWh described above by the total of all incented kWh savings obtained by the program in PY4. All spillover estimates were calculated by Navigant using customer self-reported data and no follow-up interviews or site visits were conducted.

For GNI customers, the evaluation team found a combined kWh-weighted NTG ratio at the program level of 0.64 and a combined kW-weighted NTG ratio at the program level of 0.65. NTG ratios were based on free ridership and spillover.

## **7.4 Process Evaluation**

The evaluation team conducted process evaluation activities jointly for the SEI C&I and the SEI GNI programs, as many of the administrators and contractors were common. The evaluation team conducted three primary research activities to perform the process evaluation. These activities consisted of in-depth phone interviews with PECO program management and KEMA implementation staff (6), CATI surveys with participating contractors (18 contractors), and CATI surveys with program participants (30 C&I customers).

Table 7-3 provides a summary of the evaluation activities and the sampling strategy. The tracking data for the sample frame was extracted from a copy of the PECO online database delivered electronically to the evaluation team on a quarterly basis. The activities conducted during the process evaluation are further described in the following sections.

### **7.4.1 PECO Program Management Staff and KEMA Staff Interviews**

The evaluation team conducted three in-depth interviews with PECO staff and three in-depth interviews with key members of the Smart Equipment Incentives program implementation contractor team, KEMA, during the months of February and March 2013. The interviews were designed to enable the evaluation team to ask closed-ended questions about the program's administration and delivery during PY4 and also to obtain "real-time" information about current program activity through asking open-ended questions that created a "free-flowing" conversation. To inform these interviews, the evaluation team reviewed current program reporting documents, marketing materials, and customer materials, such as the Wait-list Policies and Procedures document.

The evaluation team found the following information during the in-depth interviews:

- PECO and KEMA staff both reported the waitlist continued to have an effect on the program in PY4. In anticipation of the waitlist being lifted in PY4, PECO and KEMA staff were proactive in reaching out to customers with waitlisted projects to aide them in moving the project forward or making the decision to cancel them.
- Of the projects that remained in the pipeline and were accepted before the waitlist was instituted, program staff reported that the majority were large projects, such as CHP projects accounting for sizable savings. The complexity of these projects continued to challenge both PECO and KEMA staff. While PECO staff was confident that up to 450 projects from the waitlist would be moved to fill the pipeline, there was concern that a “phantom” rush of applications could be encountered when the waitlist was ultimately lifted.
- Both PECO and KEMA staff commented there is a renewed focus on Quality Assurance and Quality Control. For instance, PECO now documents gold quality inspections, silver quality inspections, and inspections of unacceptable quality. In the future, PECO plans to have iPads to take on-site visits, enabling more pictures and real-time uploads of new data.

#### **7.4.2 Program Participating Customer Survey**

The evaluation team conducted a participating customer CATI survey for the PY4 Smart Equipment Incentives program. The survey assessed all of the parameters necessary to calculate free ridership and NTG. Additional data was collected to support the process evaluation (such as program design and implementation, program marketing and awareness, and customer satisfaction), a qualitative assessment of spillover, and business demographics for the process component of the evaluation.

The sampling unit for the process evaluation was the unique participating customers; it did not include projects where the primary contact person in the database was a contractor or the project did not have contact information.<sup>42</sup> The rationale for contacting unique participating customers was to get project information from the final decision maker. Overall, 139 unique participant contacts completed 236 GNI retrofit projects in PY4.

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<sup>42</sup> There were 212 projects with a contractor as the primary contact person in the database. There were 6 projects without contact information. These were not included in the sample. The 3 project numbers that were not included in the PY4 impact evaluation were included in the process evaluation sampling population. At the time of the process evaluation sample design, the team only had information on 3 of the 6 project numbers that were not included in the PY4 impact evaluation.

The evaluation team targeted 90 completed surveys for the SEI retrofit program, 42 C&I surveys and 48 GNI surveys. The samples were designed to achieve 85/10 confidence/precision individually and exceed that when combined to the program level. The evaluation team completed 33 SEI GNI surveys (18 lighting project participants and 15 non-lighting/custom project participants). A large number of SEI program participants (40) were not interviewed due to the maximum number of contact attempts being reached.

The analysis of the participant survey data showed customer satisfaction was high across the various program processes and sectors. Eighty-six percent of GNI participants were satisfied<sup>43</sup> with the SEI program and 88 percent were satisfied with PECO. Satisfaction with the SEI program was similar between lighting and non-lighting GNI participants. Seventy-five percent of GNI participants also reported satisfaction with the incentive amount. The evaluation team found 90 percent of GNI participants were satisfied with their interaction with program staff. Eighty-two percent of GNI program participants were satisfied with the measures offered, and 94 percent of GNI program participants were satisfied with the contractor used to complete their project.

#### **7.4.3 Participating Contractor Survey**

A Computer-Aided Telephone Interview survey was conducted at the contractor level; thus, the sample covered both SEI C&I retrofit and SEI GNI retrofit projects. In total, 211 contractors completed 639 SEI projects<sup>44</sup> in PY4. The contractor database was first sorted to reflect unique participating contractors. After the data cleaning process, the design resulted in a target of 28 interviews with participating contractors. The evaluation team completed a total of 18 contractor interviews in July 2013. The evaluation team did not meet the target due to a large number of refusals, disconnected phone numbers, and maximum attempts reached.

The analysis of the data collected through the participating contractor survey showed there was somewhat less satisfaction among participating contractors than participants. In general, about three-quarters of participating contractors were satisfied with PECO and two-thirds were satisfied with the SEI program. Contractors suggested to PECO that it more effectively

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<sup>43</sup> Survey respondents are considered satisfied if they answered 7 or greater, on a scale of 0 to 10 where 0 is "extremely dissatisfied" and 10 is "extremely satisfied."

<sup>44</sup> Total number of projects does not include projects without contractor contact information. Navigant eliminated 290 projects that did not have complete contractor contact information in the database. The 3 project numbers that were not included in the PY4 impact evaluation were included in the process evaluation sampling population. At the time of the process evaluation sample design, the team only had information on 3 of the 6 project numbers that were not included in the PY4 impact evaluation.

communicate changes to the program now that funds were again available, including any rule changes. Additionally, contractors suggested shortening the amount of time it takes to get the rebate, expanding the types of measures that are eligible through the program such as induction lighting and LEDs, and increasing the amount of the rebates.

**Table 7-6. Status Report for SEI GNI Program Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
<p>PECO should increase communication with contractors and more closely manage relationships to improve the contractor and participant experience with the program. Contractors indicated that increased communication from PECO was desired. In addition, program participants expressed that contractors were a main source of information about the program. PECO should leverage contractor relationships to communicate program goals to customers and use contractor training and communication as a way to scale up or ratchet down program participation.</p>	<p>Implemented:</p> <ul style="list-style-type: none"> <li>• PECO has increased the frequency of the Trade Ally newsletter and already sent first edition for phase II.</li> <li>• PECO has conducted 3 seminars in October with attendance of 50-100 at each event.</li> <li>• PECO is holding trade ally certification seminars (First one Oct. 15).</li> <li>• PECO is holding a trade ally webinar series.</li> </ul> <p>PECO launched an online trade ally portal for materials and live online project tracking.</p>
<p>PECO should consider a sliding scale for incentive payments, rather than reaching program targets and abruptly throttling the program with a waitlist. Incentive amounts could be reduced when certain program sub-goals are met (e.g., 50% of program goal, 75% of program goal, 90% of program goal).</p>	<p>Being considered: Incentives were filed as a range, and thus PECO can adjust the rates without re-filing.</p>
<p>PECO should continue to review the program measure list to ensure that the latest proven technologies are being incented by the program. For example, PECO has expanded the prescriptive program LED offerings. This review of measures should be an ongoing process.</p>	<p>Implemented: KEMA is under contract to evaluate new technologies from potential suppliers; leverage KEMA's national technology group to keep us up to date.</p>
<p>PECO and/or the implementation team should develop a completed application example for both lighting and custom projects that can be utilized as a guide for prospective participants in the program.</p>	<p>Being Considered</p>

Source: Navigant analysis

## 7.5 Financial Reporting

A breakdown of the program finances is presented in Table 7-7. The TRC ratio for PY4 (1.38) is lower than the TRC ratios in PY3 (1.85) and PY2 (2.08), but is higher than the TRC ratio for PY1 (0.78). The overall Phase I TRC ratio for the SEI GNI program is 1.60 and thus the SEI GNI program was a cost-effective offering from PECO.

**Table 7-7. Summary of GNI Program Finances**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	2,876	8,043	16,974
EDC Incentives to Trade Allies	57	131	226
<b>Subtotal EDC Incentive Costs</b>	<b>2,934</b>	<b>8,174</b>	<b>17,200</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	788	2,456	6,139
Management <sup>[2]</sup>	69	255	1,283
Marketing <sup>[3]</sup>	41	100	488
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>899</b>	<b>2,811</b>	<b>7,910</b>
EDC Evaluation Costs	275	512	1,184
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>4,108</b>	<b>11,498</b>	<b>26,295</b>
Participant Costs <sup>[5]</sup>	N/A	48,822	80,688
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>52,145</b>	<b>89,782</b>
Total Lifetime Energy Benefits	N/A	64,285	128,693
Total Lifetime Capacity Benefits	N/A	7,462	14,942
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>71,780</b>	<b>143,412</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>1.38</b>	<b>1.60</b>

### NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 8 Smart Construction Incentives Program

The purpose of the SCI program is to greatly improve the energy efficiency of newly constructed facilities and facilities that are completely renovated or reconstructed in the PECO service territory. The program covers both C&I and GNI projects.<sup>45</sup> The SCI program provides facility designers and builders with training, design assistance, and prescriptive and custom incentives to incorporate energy-efficient systems and construction practices in facilities that surpass the requirements of state and local energy codes<sup>46</sup> or meet the requirements set forth in application material.<sup>47</sup>

### 8.1 Program Updates

This program launched in February 2011, during the second half of PY2. Four projects were completed in PY2. In PY3 PECO paid incentives for 65 projects. PY4 saw the program's largest participation yet with 101 paid projects. Program activities through PY4 included some marketing and training offerings in conjunction with the SEI program. PECO had planned to launch additional recruiting and training activities to attract market actors such as developers, engineers, and architects; however, these recruitment events were postponed due to the establishment of the program waitlist starting October 1, 2011 for the remainder of PY3 and PY4. The program also provides technical assistance, technical review, and incentive processing for participants.

### 8.2 Impact Evaluation Gross Savings

The impact evaluation consisted of a combination of desk review and on-site inspections for a sample of projects. Although the program is small, it encompasses an extensive range of measures and has many complex whole-building and custom projects. Prescriptive projects range from lighting improvements above code lighting power density allowances to HVAC, variable frequency drive, and refrigeration measures. Whole-building projects claim modeled savings for all building systems (with the exception of process equipment) from a code reference building. The program also offers custom incentives for new construction measures

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<sup>45</sup> GNI projects are paid and claimed through the SEI GNI program but implemented through the SCI program.

<sup>46</sup> ASHRAE Standard 90.1-2007 applies, in general, and is the baseline for savings comparisons.

<sup>47</sup> For lighting projects the installed lighting power density must be lower than code lighting power density limits by at least 10%.

not covered by the Pennsylvania TRM. Navigant used three main approaches for evaluating sampled projects:

- **Desk Review.** Navigant used this approach for all projects in the “low” savings stratum (projects smaller than 200 MWh) and all projects in the “whole building-low” stratum (whole building projects smaller than 750 MWh).
- **Whole-Building Verification and Modeling.** Navigant conducted verification-only site visits for all large whole building projects (more than 750 gross reported MWh). Subsequent analysis included comparing model inputs to parameters verified on-site and making adjustments to modeled savings if needed. The team also compared model outputs to actual historical billing data when at least one year of electric billing data was available. *This ensured that the modeled results were reasonably representative of actual consumption in the efficient case.*
- **Prescriptive and Non-whole Building Custom M&V.** Navigant conducted on-site verification at several non-whole building sites in the “medium” stratum (200-750 MWh of gross reported savings). Navigant verified the type and quantity of measures installed at these sites. Where possible, Navigant also collected trend data and/or metered data.

For all projects, Navigant paid close attention to baseline choices, which are not always obvious for new construction measures.

Table 8-1 presents the reported savings, participation, and incentives by quarter for the SCI program. Note that the GNI projects in the SCI program are processed in the SEI GNI program and are not reflected in the Table 8-1 and Table 8-2 totals.

**Table 8-1. PY4 SCI Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	2	768	0.7	0.15	86
PY4 Q2	4	818	0	0.15	131
PY4 Q3	1	15	0	0.00	1
PY4 Q4	50	6,721	0	1.20	877
<b>PY4 Total</b>	<b>57</b>	<b>8,323</b>	<b>0.7</b>	<b>1.50</b>	<b>1,095</b>
<b>CPITD Total</b>	<b>103</b>	<b>13,554</b>	<b>0.7</b>	<b>2.38</b>	<b>2,011</b>

Source: Navigant analysis

**Table 8-2: PY4 SCI Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0	0	0
Low-Income	0	0	0	0	0
Commercial and Industrial	57	8,323	0.7	1.5	1,095
Government and Nonprofit	0	0	0	0	0
<b>PY4 Total</b>	<b>57</b>	<b>8323</b>	<b>0.7</b>	<b>1.5</b>	<b>1,095</b>
<b>CPITD Total</b>	<b>103</b>	<b>13554</b>	<b>0.7</b>	<b>2.4</b>	<b>2,011</b>

Source: Navigant analysis

Due to the small size of the program relative to PECO's portfolio, Navigant combined the C&I and GNI projects into a single sample frame for the impact evaluation. This resulted in a total of 101 projects in the sample frame. Navigant used a stratified sample design based on project size (gross reported kWh) and project type: in addition to three strata for non-whole building projects, Navigant created two strata for whole building (WB) projects only. The sample was conservatively designed to meet 85 percent confidence and 10 percent precision at the program level. Navigant was able to achieve the impact target sample sizes for all strata as shown in Table 8-3. Table 8-3 also shows the sampling strategies for two components of the process evaluation (trade ally interviews and participant surveys).

Navigant conducted site visits for all sampled “high” and “medium” strata projects with the exception of one medium stratum project where the participant did not respond to requests for a site visit. For whole-building projects, which encompassed a wide variety of measures, the visits served to verify at least a sample of the installations for each measure. Navigant metered one large project but was unable to gather trend data for any projects. Navigant conducted a file review of the ex ante calculations for all projects in the “low” stratum.

**Table 8-3. SCI Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
High	>750 MWh	2	0.5	85/15	2	2	Gross Impact Evaluation: Site Visits (High, Medium, Whole Building High strata) and Desk Reviews (all)
Medium	200 - 750 MWh	10	0.5	85/15	5	5*	
Low	<200 MWh	73	0.5	85/15	7	7	
Whole Building High	>750 MWh	2	0.5	85/15	2	2	
Whole Building Low	<750 MWh	14	0.5	85/15	6	6	
Activity Subtotal		101		85/15	22	22	
Trade Allies	N/A	18	N/A	N/A	8	4	Trade Ally In-depth Interviews
Activity Subtotal		18		N/A	8	4	
High	>750 MWh	4	0.5	85/15	4	2	Participant Surveys (confidence and precision targets for NTG results)
Medium	200 - 750 MWh	24	0.5	85/15	11	6	
Low	<200 MWh	73	0.5	85/15	7	8	
Activity Subtotal		101		85/15	22	16	
Program Total		220		85/15	52	42	

\* One site in this stratum could not be reached for an on-site visit, and results represent a desk review instead.

Source: Navigant analysis

Table 8-4 and Table 8-5 present the results of the SCI program for both energy and demand for C&I projects only. Again, savings from new construction projects in the GNI sector are reported with savings from the SEI GNI program. The program achieved gross realization rates of 1.02 for energy and 1.20 for demand for these projects.

**Table 8-4. PY4 SCI Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Medium	2,772	1.05	0.23	23.5%	2,898	0
Low	2,175	0.91	0.05	2.3%	1,968	0
Whole Building High	1,685	1.15	0.00	0%	1,936	0
Whole Building Low	1,691	1.00	0.02	0.0%	1,691	0
<b>Program Total</b>	<b>8,323</b>	<b>1.02</b>	<b>N/A</b>	<b>5.6%</b>	<b>8,494</b>	<b>0</b>

Source: Navigant analysis

**Table 8-5. PY4 SCI Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Medium	0.67	0.86	0.32	1.9%	0.57	0
Low	0.61	0.91	0.18	4.6%	0.56	0
Whole Building High	0.00	0.00	0.00	0%	0.44	0
Whole Building Low	0.21	1.06	0.39	21.7%	0.23	0
<b>Program Total</b>	<b>1.50</b>	<b>1.20</b>	<b>N/A</b>	<b>1.5%</b>	<b>1.80</b>	<b>0</b>

Source: Navigant analysis

### 8.3 Impact Evaluation Net Savings

Navigant used a self-report approach to determine the NTG ratio for this program. In new construction projects, design firms are often key decision makers for projects and can provide insight into project decision making. Because of this and the fact that some projects only listed trade-ally contact information, Navigant relied on both participant surveys and trade ally interviews to inform the NTG calculation.

In total, Navigant collected attribution data from one trade ally representing 1 project and 14 participants representing 16 projects. Thus, the evaluation collected NTG inputs for a total of 17 of the program's 101 PY4 projects.

For each participant, the survey focused on a single project. For participants with multiple projects, Navigant asked about the project with the greatest savings. The attribution questions first asked about the largest measure installed (as quantified by gross reported kWh). At the end of the battery, participants were asked if the decision-making process was different for the other measures installed, if any. If participants indicated that their decision-making process was different for any of the remaining measures, the interviewer repeated the key attribution questions.

Navigant calculated the NTG ratio for the program as:

$$NTG = 1 - FR + SO$$

where FR = Free ridership and SO = spillover. The survey respondents did not indicate any spillover and this factor was set to zero.

The free-ridership battery asked questions designed to inform three program scores, described in Table 8-6.

**Table 8-6. Components of Free-Ridership Score**

Component	Description	Scoring	Number of Questions
Influence	Rating influence of program on decision	0-10	1
Program Components	Influence of program components on decision	0-10	1
Quantity and Efficiency	Likelihood same quantity and efficiency level of measures installed	0-10 0-100%	4

*Source: Navigant analysis*

For national retailer participants (chain stores), where decision making often occurs at a national scale, the interviewer asked about both the direct influence of the PECO program as well as PECO's indirect influence as one of many utility rebate programs offered across the country. This is reflected in the Influence scores for these participants.

For PY4, Navigant also added questions for participants who submitted Leadership in Energy and Environmental Design (LEED) projects to determine whether the program was able to help participants achieve their LEED goals. While these participants may not have given high influence scores to the program directly due to their preexisting LEED goals, the program may have enhanced their ability to meet those goals. Navigant deducted 5 percent from the free-ridership score (increasing the NTG score) for a positive answer to each of the following questions:

- Was the program important in helping to refine an existing energy model?
- Was the program’s staff or technical assistance important in highlighting ways to achieve LEED design plans?
- Were program incentives or technical assistance important in improving energy efficiency levels to meet a higher level of LEED?

Navigant normalized each score to a percentage scale and calculated free ridership as follows:

$$FR = 1/3 * ((1-\text{Influence}) + (1-\text{Program Components}) + (\text{Quantity and Efficiency}))$$

Navigant found an NTG value of 0.44 for both energy and demand savings. While this value improved from 0.39 in PY3, it remains low. Several process recommendations for PY3 and PY4 are designed to improve this result.

## 8.4 Process Evaluation

Navigant used several data collection activities to inform the process evaluation. In-depth qualitative interviews with program managers and implementation contractors and review of relevant program-tracking databases, documents, and other materials were central to this portion of the evaluation. Navigant used a CATI survey to interview participating customers to better understand customer satisfaction and perceptions related to the program. The data from this survey also supported the NTG analysis. Finally, the Navigant team conducted several interviews with program trade allies to identify outreach effectiveness and barriers to participation.

Navigant analyzed process data to triangulate between these data sources to identify the most defensible conclusions and recommendations in relation to key process questions in the following areas:

- Marketing and Participation
- Program Characteristics and Barriers
- Administration and Delivery

Through the in-depth interviews with program staff, Navigant confirmed that the implementation strategy for PY4 was nearly identical to that of PY3. Several PY3 recommendations have been taken into account for the Phase II program design, but could not be implemented in time for PY4. For this reason, many PY3 findings and recommendations are also applicable to the PY4 evaluation.

In addition to the findings from PY3, Navigant made the following observations through the process evaluation activities in each of the three research areas.

### **Marketing and Participation**

- The percentage of respondents who heard about the program before beginning their projects increased from PY3 to PY4, indicating that the program may be beginning to reach participants earlier in the design phase.
- Although the program is effectively reaching participants through email and account managers, respondents did not identify trade allies or contractors as key sources of program information. This indicates that design firms, who are often the primary “trade allies” for new construction firms, may not be branding themselves as program allies yet. This reflects the fact that the SCI program has not yet been able to direct outreach to this group; PECO is already making progress on increasing this outreach in PY5.

### **Program Characteristics and Barriers**

- Participants showed high satisfaction with the program, and were especially satisfied with their interaction with program staff (average score of 9.31 out of 10).
- Participants identified lack of awareness as the largest barrier to program participation for other firms. This again reflects the fact that PECO has not been able to promote the program due to the waitlist status that was in place for most of PY4.

### **Program Administration and Delivery**

- Trade allies suggested streamlining the application process by using an online application. PECO is in the process of implementing a new online application for PY5.
- Trade allies also suggested creating differentiation between trade allies by implementing more stringent guidelines for becoming a trade ally, or by encouraging customers to work with more active allies.

Table 8-7 shows Navigant’s process recommendations for PY4. PECO is considering or implementing all recommendations.

**Table 8-7. Status Report for SCI Process Evaluations**

Process Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Try to reach participants earlier in the design phase.	Implementation in Progress
Increase advertisement of technical assistance to help participants incorporate more measures.	Being Considered
Prioritize shift to online applications if implementation of this tool has not yet been completed.	Implementation in Progress
Promote the SCI program more aggressively, especially the whole building track.	Implementation is a goal for Phase II.
Consider promoting highly active trade allies through the program website.	Being Considered

Source: Navigant analysis

## 8.5 Financial Reporting

The SCI program achieved TRC results of 1.96 for C&I projects, 2.07 for GNI projects, and 2.03 overall. These results show that the program remains cost effective and can afford to invest in the process recommendations above of increasing outreach, technical assistance, and educational offerings. A breakdown of the program finances, for C&I projects only, is presented in Table 8-8. SCI GNI projects are included in the SEI GNI program finances.

**Table 8-8. Summary of SCI Program Finances**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	770	962	1,575
EDC Incentives to Trade Allies	107	132	251
<b>Subtotal EDC Incentive Costs</b>	<b>877</b>	<b>1,095</b>	<b>1,827</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	158	300	701
Management <sup>[2]</sup>	13	47	160
Marketing <sup>[3]</sup>	0	11	65
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>170</b>	<b>357</b>	<b>925</b>
EDC Evaluation Costs	13	22	85
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>1,060</b>	<b>1,474</b>	<b>2,837</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>4,291</b>	<b>6,762</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>4,670</b>	<b>7,772</b>
Total Lifetime Energy Benefits	N/A	7,632	12,115
Total Lifetime Capacity Benefits	N/A	1,533	2,676
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>9,165</b>	<b>14,791</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>1.96</b>	<b>1.90</b>

**NOTES**

*Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.*

- [1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.
- [2] Includes EDC program management, CSP program management, general management oversight, and major accounts.
- [3] Includes the marketing CSP and marketing costs by program CSPs.
- [4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.
- [5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.
- [6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.
- [7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.
- [8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.
- [9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 9 Conservation Voltage Reduction Program

The Conservation Voltage Reduction (CVR) program achieves load reductions through changes in voltage regulation parameters at the substation/transformer level. This change involves a *physical adjustment* in transformer settings governing voltage at the substation. By adjusting substation voltage, the program impacts hourly energy flows and capacity, including demand coincident with the system peak period(s), included within the top 100 (peak demand) hours on the system load duration curve. Changes to voltage settings at substation/feeder locations were completed during a four-month period from February through May 2010 in PECO's CVR program.

### 9.1 Program Updates

The CVR program was fully implemented by the end of PY2. There was no incremental program activity in PY4, so there are no energy or demand savings attributed to the program in PY4.

### 9.2 Impact Evaluation Gross Savings

Table 9-1 presents cumulative savings from the CVR program activity in PY2. Note that as this program is implemented at PECO's substations, none of PECO's customers actively participate directly in the program, but all ratepayers are its beneficiaries.

**Table 9-1. CPITD Conservation Voltage Reduction Program Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	105,723	0	0
Low-Income	0	25,630	0	0
Commercial and Industrial	0	150,575	0	0
Government and Non-Profit	0	38,445	0	0
CPITD Total	0	320,372	89.3	0

Source: Navigant analysis

### 9.3 Impact Evaluation Net Savings

As there is no opportunity for PECO customers to undertake the distribution system modifications implemented for this program, and PECO implemented the program in direct

response to Act 129, there is no opportunity for free riders or spillover. Therefore, the NTG ratio for this program is 1.0.

#### **9.4 Financial Reporting**

A breakdown of the program finances is presented in Table 9-2. As there was no incremental activity in the program in PY4, there are no incremental lifetime benefits.

**Table 9-2. Summary of Conservation Voltage Reduction Program Finances**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	0	239	1,950
Management <sup>[2]</sup>	5	-20	139
Marketing <sup>[3]</sup>	0	0	0
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>5</b>	<b>219</b>	<b>2,089</b>
EDC Evaluation Costs	47	91	231
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>52</b>	<b>310</b>	<b>2,320</b>
Participant Costs <sup>[5]</sup>	N/A	0	0
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>310</b>	<b>2,320</b>
Total Lifetime Energy Benefits	N/A	0	335,970
Total Lifetime Capacity Benefits	N/A	0	63,414
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>0</b>	<b>399,384</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.00</b>	<b>172.12</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 10 Residential Smart A/C Saver Program

The Smart A/C Saver Program is a direct load control program for residential customers based on the installation of digital cycling units (DCUs) on qualified central air conditioners. Participants are incented at the rate of \$120/year (\$30 per four summer months per installed device). During peak summer hours, control signals can be sent to reduce air-conditioning load by cycling (i.e., cutting power to) the compressor 50 percent of the time for the duration of the event. The program was designed to provide demand response during PECO's Top 100 Hours of system peak loads. DCUs have been installed in participant homes, and 15 conservation events were called in PY4.

### 10.1 Program Updates

The Residential A/C Saver Program lost a total of 1,675 participants in PY4, bringing total participation to 76,976 participants by PY4 year end. PY4 was the second year the Smart A/C Saver Program called system-wide events, with a total of 14 system-wide events and one M&V group only event being called by the end of the program year. The residential M&V group is a statistically valid sample of residential sites that have logging equipment installed to capture 5-minute load profile data used to calculate the load impact estimate for the entire enrolled population.

### 10.2 Impact Evaluation Gross Savings

Navigant applied a deemed savings value to determine residential Smart A/C Saver program impacts during event hours. PJM Manual 19, Attachment B<sup>48</sup> provides that curtailment service providers with direct load control programs which employ a radio signal may elect to either submit a load research study supporting base per-participant impacts for their program, or utilize the base per-participant impacts contained in the *Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region* report. The deemed savings value was based on the results in Table 13 of this report, prepared by RLW Analytics for Lawrence Berkeley National Laboratory (LBNL) in April 2007.<sup>49</sup> Table 13 specifies two sets of

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<sup>48</sup> PJM, Manual 19: Load Forecasting and Analysis, Attachment B: Direct Load Control Load Research Guidelines, Revision 23, Effective Date: 6/1/2013.

<sup>49</sup> In a guidance memo dated 8/22/2012, the SWE confirmed that Pennsylvania EDCs could use the appropriate values from Table 13 as verified, deemed savings for DLC programs for PY4.

savings, one for a connected demand under 3.5 kW and one for a connected demand over 3.5 kW.

Since connected demand is not recorded in the program-tracking database, Navigant conducted research to determine the distribution of connected demand amongst residential air conditioners. To do so, Navigant pulled a stratified random sample of participants and researched the connected demand based on the unit make and model information. This research indicated that an estimated 52 percent of the program units have a connected load less than 3.5 kW. For PY4, PECO's base savings value was for a weighted temperature-humidity index (WTHI) of 83.2 and the hour from 4-5 p.m., as specified by PJM. The deemed savings values corresponding to these conditions are 0.66 kW for units with a connected load < 3.5 kW and 1.15 kW for units with connected load  $\geq$  3.5 kW. The weighted deemed savings value for the PECO residential program is 0.90 kW/unit.

Program impacts for each hour were calculated as the product of the weighted deemed savings value, switch operability rate (0.97),<sup>50</sup> line-loss factor (1.1916), and the number of units cycled (ranging from 91,823 to 92,715 over the course of the summer of 2012).

To maintain consistency with the evaluation methodology applied to the DRA and DER programs, Navigant researched program impacts in the hour prior to and the two hours following the called event period. Navigant used hourly interval data for a sample of 100 M&V participating sites to quantify program impacts. Navigant followed the protocols specified in sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012, to calculate the program impacts during these hours. Navigant then estimated a regression model to predict how the impacts in the hour before and two hours following an event vary with the event length and the maximum WTHI during the event period.

None of the regression coefficients are statistically significant at the 90 percent confidence level. A visual inspection of the event-day load curves and baselines indicated that participants did not pre-cool and snapback generally did not occur after the events. The regression indicates no statistical evidence that the calling of events affected the customer load in the one hour before and two hours following an event. Nevertheless, Navigant applied the results of the regression analysis to the extended event hours to maintain consistency with the DRA and DER

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<sup>50</sup> Residential switch operability rate study was completed by Converge in PY3.

evaluations, per the SWE's recommendation. The regression indicated that the average load reduction in the hour before the event period was 0.03 kW/unit, 0.37 kW/unit in the first hour following the event period, and 0.24 kW/unit in the second hour following the event period. Table 10-1 shows reported results by quarter and Table 10-2 shows reported results by sector.

**Table 10-1. PY4 Residential Smart A/C Saver Program Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	1126	0	51.3	51.3	\$5,555
PY4 Q2	-802	0	0	0	\$5,601
PY4 Q3	-902	0	0	0	\$0
PY4 Q4	-1097	0	0	0	\$0
<b>PY4 Total</b>	<b>-1675</b>	<b>0</b>	<b>51.3</b>	<b>51.3</b>	<b>\$11,157</b>
<b>CPITD Total</b>	<b>76976</b>	<b>0</b>	<b>51.3</b>	<b>51.3</b>	<b>\$19,784</b>

Source: Navigant analysis

**Table 10-2. PY4 Residential Smart A/C Saver Program Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	76,976	0	51.3	51.3	\$11,157
Low-income	0	0	0	0	\$0
Commercial and Industrial	0	0	0	0	\$0
Government and Nonprofit	0	0	0	0	\$0
<b>PY4 Total</b>	<b>76,976</b>	<b>0</b>	<b>51.3</b>	<b>51.3</b>	<b>\$19,784</b>
<b>CPITD Total</b>	<b>76,976</b>	<b>0</b>	<b>51.3</b>	<b>51.3</b>	<b>\$11,157</b>

Source: Navigant analysis

The sampling strategies utilized by the Navigant team for PY4 impact and process analysis activities can be seen in Table 10-3.

**Table 10-3. Residential Smart A/C Saver Program Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Stratum 1	<3 tons	17,095	0	90/10	19	19	Impact: Deemed Savings Sample
Stratum 2	=3 tons	46,305	1	90/10	44	44	
Stratum 3	>3 tons	26,541	0	90/10	22	22	
Activity Subtotal		89,941		90/10	85	85	
M&V Sample	N/A	91,644	1	90/10	100	100	Impact: Extended Event Analysis
Activity Subtotal		91,644		90/10	100	100	
Residential	N/A	92,530	0.5	90/10	70	74	Process: Post Event Survey #1
Residential	N/A	91,644	0.5	90/10	70	76	Process: Post Event Survey #2
Residential	N/A	90,630	0.85	90/10	200	200	Process: Willingness to

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
							accept Survey
Residential	N/A	88053	0.5	90/10	70	71	Process: Post Season Survey
Activity Subtotal		92,530		90/10	410	421	
Residential	N/A	88053	0.2	90/10	13	13	On-site Verification Visits
Activity Subtotal		88053		90/10	13	13	
<b>Program Total</b>		<b>92,530</b>		<b>90/10</b>	<b>608</b>	<b>619</b>	

Source: Navigant analysis

A summary of energy and demand results can be found in Table 10-4 and Table 10-5, respectively.

**Table 10-4. PY4 Residential Smart A/C Saver Program Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Residential Smart A/C Saver	0	N/A	N/A	0	0	0
<b>Program Total</b>	<b>0</b>	<b>N/A</b>	<b>N/A</b>	<b>0</b>	<b>0</b>	<b>0</b>

Source: Navigant analysis

**Table 10-5. PY4 Residential Smart A/C Saver Program Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Residential Smart A/C Saver	51.3	1	0.51	8.4%	51.3	0
<b>Program Total</b>	51.3	1	0.51	8.4%	51.3	0

*Source: Navigant analysis*

### 10.3 Impact Evaluation Net Savings

Navigant assumed an NTG ratio of 1.0. Navigant did not conduct research to determine free ridership for this program. Navigant’s assumption is that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives that the CSPs paid to them for their load curtailment.

### 10.4 Process Evaluation

Four separate CATI surveys were utilized during PY4 to understand residential customer perspectives. Two of these surveys were conducted immediately following the control events of June 21, 2012 (Event #1) and August 31, 2012 (Event #2), and sought to better understand commercial customers’ awareness and satisfaction with conservation events. A third CATI survey was conducted following the end of the program year. This participant survey was used to understand customer demographics, how customers learned of the program, if customers were satisfied with the program and PECO, whether customers noticed load control events, and what customers had heard about the future of PECO’s Residential Smart A/C Saver program.

During PY4 Q3 when there was uncertainty about the future of the Smart A/C Saver program, Navigant developed and conducted a Willingness to Accept (WTA) survey. This survey sought to understand how many residential program participants were likely to remain in the program if the incentive were to be reduced. Additionally, residential participants were asked if they would allow PECO to keep the load control equipment on their homes if the program went into hiatus and if so would an additional incentive be necessary.

#### **10.4.1 Satisfaction with the Residential Smart A/C Saver Program**

Residential program participant satisfaction with:

- The overall program (86%)
- The technician who installed the switch (92%)
- The installation of the device/prompt installation (98%)
- The four bill credits (86%)
- The amount of energy saved (67%)
- PECO (68%)

Residential participants were asked why they chose to participate in the Smart A/C Saver Program:

- Reducing the electric bill was the main selling point of the program for almost all residential customers (87%).
- No residential customers said the bill credit was a reason for participating in the program (down from 25% the previous year).

Other major findings included:

- Residential program participants reported high levels of satisfaction with the sign-up process regardless of sign-up channel.
- Residential customers are likely to recommend the program to others (65%).
- Residential customers are very likely to say they plan to stay in the program (81%).
- Generally, about three-fourths of residential survey respondents said they did not know how many control days they experienced in either 2011 or 2012.
- When asked what respondents had heard or read about the future of the PECO Smart A/C Saver program, most survey respondents reported they had not heard anything. Eleven percent heard or read that the rebate and/or the number of events would be reduced. About 10 percent heard that PECO was planning to stop the program.
- Residential customers participating in the PECO Smart A/C Saver Program are educated, higher income customers.

#### **10.4.2 Satisfaction and Awareness of Conservation Events**

When surveyed immediately following two control events, about three-fourths of residential Smart A/C Saver program participants were satisfied with the comfort of their home during the control event. They answered 7 or higher on the 0 to 10 satisfaction scale. The exception was when participants were surveyed immediately following the June 21, 2012 control event when program participants were somewhat more likely to remain neutral on the issue of home comfort.

Awareness of control events remained low in .PY4. Only about 15 percent of program participants were aware of the control events, surprisingly similar to the percentage who believed there was an event (11%) when they were not controlled.

In the first post-event survey conducted immediately following the control event on June 21, 2012, only about 16 percent of residential customers noticed they were uncomfortable. Only two survey respondents reported noticing the load control event on August 31, 2012, when surveyed immediately following the event.

### **10.4.3 Residential Customer Willingness to Accept a Change in Program Incentive**

The Navigant team developed a WTA survey addressing the issue of how much customers would have to be paid to accept a change in program design and incentive levels. Major findings of this study are presented below:

- Over one-third did not remember what incentive they received for their participation in the Smart A/C Saver program.
- Twenty-five percent believed the payment was less than \$120 for the four months.
- A similar percentage, about one-fourth, knew the correct amount of the incentive (\$120).
- Eighty-seven percent of survey participants would leave the device installed if the program went into a hiatus.
- About half of the remaining participants (7%) would accept a one-time payment of \$45 or less to leave the device on their air conditioner in a program hiatus.
- Five percent would want a one-time payment of \$120 or more to keep the device on the HVAC unit.
- Older respondents and younger respondents are more likely than baby boomers to agree to leave the device on their air conditioner if the program was dormant.

Process recommendations and their current status for the Residential Smart A/C Saver report can be found in Table 10-6.

**Table 10-6. Status Report for Residential Smart A/C Saver Program Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
<p>Only about one in seven survey respondents were aware of the control events and most survey respondents were satisfied with the comfort of their homes. Satisfaction with the program remained high during the PY4 load control season. The Navigant team concludes that PECO should not hesitate to call the A/C Saver program multiple days during a heat wave. There may be some limits, however, that customers will not accept that were outside of our research experience.</p>	<p>Under consideration</p>
<p>The largest change from last year was residential customers' evaluation of PECO. Satisfaction scores dropped from 82% in PY3 to 68% in PY4. The Navigant team felt this may be a result of uncertainty about the program in PY5 and recommends that changes to incentive levels, program cycling strategies, and pay by event strategies could all be utilized to regulate program activity and eliminate the need for canceling the program in future years.</p>	<p>Under consideration</p>
<p>The largest challenge in PY4 was determining how to communicate the status of the program without a clear plan for the direction of the program during the current program cycle. Navigant suggests that PECO develop strategies to communicate changes to the program ahead of Phase III, anticipating that the program may or may not be part of Act 129 at that time.</p>	<p>Under consideration</p>
<p>Bill inserts and direct mail flyers were still the most effective methods of marketing the program. However, residential customers were most likely to have remembered the bill insert. PECO should continue to utilize this channel as conduits of information during the maintenance phase of the program.</p>	<p>Under consideration</p>
<p>The program was well run and well liked by customers during PY4. At the time of the post-season survey, the PY5 program year was underway and many (but not all) customers realized the monthly rebate was reduced. Customer satisfaction was still very high for the program</p>	<p>Under consideration</p>

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
<p>attributes – excluding the energy savings during events. Most residential and commercial customers participate in the program to reduce their energy usage. Navigant suggests that PECO downplay the idea that the program saves energy during program events. Previous Navigant research findings suggest that, for most customers, the snap back in energy usage after an event is 100% or more than the energy saved during an event. Participants are unlikely to see reductions in their bill other than the rebate.</p>	
<p>The summer events have a strong and positive influence on satisfaction with the Smart A/C Saver Program. PECO may want to recommend the program to customers with high bill complaints.</p>	<p>Under consideration</p>

Source: Navigant analysis

## 10.5 Financial Reporting

A breakdown of the program finances is presented in Table 10-7. The residential Smart A/C Saver program was not cost effective in Phase I, using PECO’s avoided capacity costs expressed as dollars per kWh, as used in PECO’s Phase I EE&C Plan. In Phase II, these benefits will be calculated using avoided capacity costs expressed as dollars per kW-year, as used in PECO’s Revised Phase II EE&C Plan and discussed in PECO direct testimony in Docket P-2012-23203441.<sup>51</sup> Had this methodology been applied to this program for PY4, the benefit-cost ratio would have been 1.09 for the residential program.

<sup>51</sup> Direct testimony, Frank Jiruska, September 5, 2012.

**Table 10-7. Summary of Residential Smart A/C Saver Program Finances**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	246	2,211	9,599
Management <sup>[2]</sup>	631	1,480	14,082
Marketing <sup>[3]</sup>	19	11,313	20,246
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>897</b>	<b>15,004</b>	<b>43,927</b>
EDC Evaluation Costs	168	290	714
<b>SWE Audit Costs</b>		<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>1,065</b>	<b>15,294</b>	<b>44,641</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>0</b>	<b>8,628</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>15,294</b>	<b>53,269</b>
Total Lifetime Energy Benefits	N/A	0	0
Total Lifetime Capacity Benefits	N/A	2,618	2,618
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>2,618</b>	<b>2,618</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.17</b>	<b>0.05</b>

**NOTES**

*Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.*

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs includes EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## **11 Commercial Smart A/C Saver Program**

The Smart A/C Saver Program is a direct load control program for commercial customers based on the installation of programmable communicating thermostats (PCTs) on qualified central-air conditioners. Participants are incented at the rate of \$120/year (\$30 per four summer months per installed device). During peak summer hours, control signals can be sent to reduce air-conditioning load by cycling (i.e., cutting power to) the compressor 50 percent of the time for the duration of the event. The program was designed to provide demand response during PECO's Top 100 Hours of system peak loads. PCTs have been installed in participant businesses, and 15 conservation events were called in PY4.

### **11.1 Program Updates**

The Commercial A/C Saver Program lost a total of 277 participants in PY4, bringing total participation to 2,169 participants by PY4 year end. PY4 was the second year the Smart A/C Saver Program called system-wide events, with a total of 14 system-wide events and one M&V group only event being called by the end of the program year. The commercial M&V group is a statistically valid sample of commercial sites that have logging equipment installed to capture 5-minute load profile data used to calculate the load impact estimate for the entire enrolled population.

### **11.2 Impact Evaluation Gross Savings**

Navigant employed baseline calculations and regression analysis to quantify commercial Smart A/C Saver program impacts during event hours. Navigant used hourly interval data for a sample of 75 M&V sites to quantify program impacts during program event hours. Navigant followed the protocols specified in sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012, to calculate the program impacts during these hours. Navigant estimated a regression model to predict how the

event impacts vary with hour of the day and with the WTHI. Program impacts were calculated based on the PJM-specified WTHI value of 83.2 and the hour from 4-5 pm.<sup>52</sup>

To maintain consistency with the evaluation methodology for the DRA and DER programs, Navigant researched program impacts in the hour prior to and the two hours following the called event period. Navigant used hourly interval data for the M&V sample to quantify program impacts. Navigant followed the protocols specified in sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012, to calculate the program impacts during these hours. Navigant then estimated a regression model to predict how the impacts in the hour before and two hours following an event vary with the event length and the maximum WTHI during the event period.

Although most of the regression coefficients are statistically significant at the 90 percent confidence level, the estimated load reductions during the hour before and two hours following each event are relatively small. A visual inspection of the event-day load curves and baselines indicated that participants did not pre-cool and snapback generally did not occur after the events. Nevertheless, Navigant applied the results of the regression analysis to the extended event hours to maintain consistency with the DRA and DER evaluations, per the SWE's recommendation. The regression indicated that the average load reduction in the hour before the event period was -0.07 kW/unit, 0.03 kW/unit in the first hour following the event period, and 0.07 kW/unit in the second hour following the event period. Table 11-1 shows reported results by quarter and Table 11-2 shows reported results by sector.

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<sup>52</sup> PJM Manual 18 section 4.3.7 states: "The nominated value for a Direct Load Control (DLC) program will be based on load research and customer subscription. The value of the program is equal to the PJM-approved per-participant load reduction (evaluated at average peak day weather conditions and adjusted for the switch operability rate) multiplied by the number of active participants, adjusted for system losses."

**Table 11-1. PY4 Commercial Smart A/C Saver Program Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	-180	0	1.6	1.8	\$252
PY4 Q2	-19	0	0	0	\$252
PY4 Q3	-41	0	0	0	\$0
PY4 Q4	-37	0	0	0	\$0
<b>PY4 Total</b>	<b>-277</b>	<b>0</b>	<b>1.6</b>	<b>1.8</b>	<b>\$504</b>
<b>CPITD Total</b>	<b>2,169</b>	<b>0</b>	<b>1.6</b>	<b>1.8</b>	<b>\$649</b>

Source: Navigant analysis

**Table 11-2. PY4 Commercial Smart A/C Saver Program Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0.0	0.0	0
Low-Income	0	0	0.0	0.0	0
Commercial and Industrial	2,169	0	1.6	1.8	\$504
Government and Nonprofit	0	0	0	0	0
<b>PY4 Total</b>	<b>2,169</b>	<b>0</b>	<b>1.6</b>	<b>1.8</b>	<b>\$504</b>
<b>CPITD Total</b>	<b>2,169</b>	<b>0</b>	<b>1.6</b>	<b>1.8</b>	<b>\$649</b>

Source: Navigant analysis

The sampling strategies utilized by the Navigant team for PY4 impact and process analysis activities can be seen in Table 11-3.

**Table 11-3. Commercial Smart A/C Saver Program Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C <sub>v</sub> ) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
M&V	N/A	3,924	1	90/10	100	100	Impact: Control Event Analysis
Activity Subtotal		3,924		90/10	100	100	
Commercial	N/A	3,949	0.5	90/10	70	70	Process: Post Event Survey #1
Commercial	N/A	3,924	0.5	90/10	70	69	Process: Post Event Survey #2
Commercial	N/A	3,730	0.5	90/10	70	70	Process: Post Season Survey
Activity Subtotal		3,949		90/10	210	209	
Commercial	N/A	3,730	0.2	90/10	13	13	On-site Verification Visits
Activity Subtotal		3,730		90/10	13	13	
<b>Program Total</b>		<b>3,949</b>		<b>90/10</b>	<b>323</b>	<b>322</b>	

Source: Navigant analysis

A summary of energy and demand results can be found in Table 11-4 and Table 11-5, respectively.

**Table 11-4. PY4 Commercial Smart A/C Saver Program Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Commercial Smart A/C Saver	0	N/A	N/A	0	0	0
<b>Program Total</b>	<b>0</b>	<b>N/A</b>	<b>N/A</b>	<b>0</b>	<b>0</b>	<b>0</b>

Source: Navigant analysis

**Table 11-5. PY4 Commercial Smart A/C Saver Program Summary of Evaluation Results for Demand**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Commercial Smart A/C Saver	1.8	1	0.2	3.0%	1.8	0
<b>Program Total</b>	<b>1.8</b>	<b>1</b>	<b>0.2</b>	<b>3.0%</b>	<b>1.8</b>	<b>0</b>

Source: Navigant analysis

### 11.3 Impact Evaluation Net Savings

Navigant assumed a NTG ratio of 1.0. Navigant did not conduct research to determine free ridership for this program. Navigant’s assumption is that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives that the CSPs paid to them for their load curtailment.

### 11.4 Process Evaluation

Three separate CATI surveys were utilized during PY4 to understand commercial customer perspectives. Two of these surveys were conducted immediately following the control events of June 21, 2012 (Event #1) and August 31, 2012 (Event #2) and sought to better understand commercial customers’ awareness and satisfaction with conservation events. A third CATI survey was conducted following the end of the program year. This participant survey was used to understand customer demographics, how customers learned of the program, if customers were satisfied with the program and PECO, whether customers noticed load control events, and what customers had heard about the future of PECO’s Commercial Smart A/C Saver program.

#### 11.4.1 Satisfaction with the Commercial Smart A/C Saver Program

Commercial program participant satisfaction with:

- The overall program (82%)
- The technician who installed the thermostat (93%)
- The installation of the device/prompt installation (90%)
- The four bill credits (85%)

- The amount of energy saved (68%)
- PECO (73%)

Commercial participants were asked why they chose to participate in the Smart A/C Saver Program:

- Reducing the electric bill was the main selling point of the program for almost all residential customers (87%); it was still the main selling point for commercial customers but for significantly fewer customers (59%).
- Fourteen percent of commercial customers mentioned bill credit as a reason for participating in the program (down from 34% the previous year).

Other major findings included:

- Commercial program participants reported high levels of satisfaction with the sign-up process regardless of sign-up channel.
- Commercial customers are somewhat likely to recommend the program to others (50%).
- Commercial customers are very likely to stay in the program (81%).
- Three out of four commercial survey participants also did not know how many load control days they experienced in 2011 and almost two-thirds did not know the number of control days in 2012.
- Commercial customers participating in the program tend to be very small business customers with less than ten employees that are located in older buildings less than 5,000 square feet in size.

#### **11.4.2 Satisfaction and Awareness of Conservation Events**

When surveyed immediately following two control events, commercial customers were slightly more aware of the June 21, 2012 control event (event #1) than they were of the August 31, 2012 event (event #2), although these differences are not statistically significant. On average, about one-fourth of commercial customers were aware of the control events.

Overall, commercial customers were more uncomfortable than usual when surveyed immediately following the event of June 21, 2012, than following the event of August 31, 2012. Event #1 was during a heat wave and buildings heat up and are harder to cool after a couple of days of very hot weather. Four times as many commercial customers in our study said they were more uncomfortable than usual during the event when surveyed following Event #1 than Event #2. These differences are significant at the 0.001 level of significance.

Most respondents did not remember discomfort from either control event for which they were surveyed. However, significantly more commercial customers reported that everyone in the building was uncomfortable during Event #1, the heat wave, compared to Event #2. Most telling was that 90 percent of survey respondents did not remember their comfort level during Event

#2 compared to 60 percent who had no memory of their comfort level during Event #1. Event #2 had just occurred, suggesting that Event #1, during the heat wave, was much more memorable than Event #2.

Process recommendations and their current status for the Commercial Smart A/C Saver report can be found in Table 11-6.

**Table 11-6. Status Report for Commercial Smart A/C Saver Program Process Evaluations**

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
<p>Only about one in seven survey respondents were aware of the control events and most survey respondents were satisfied with the comfort of their businesses. Satisfaction with the program remained high during the PY4 load control season. The Navigant team concludes that PECO should not hesitate to call the A/C Saver program multiple days during a heat wave. There may be some limits, however, that customers will not accept that were outside of our research experience.</p>	<p>Under consideration</p>
<p>The Navigant team recommends that changes to incentive levels, program cycling strategies, and pay by event strategies could all be utilized to regulate program activity and eliminate the need for canceling the program in future years.</p>	<p>Under consideration</p>
<p>The largest challenge in PY4 was determining how to communicate the status of the program without a clear plan for the direction of the program during the current program cycle. Navigant suggests that PECO develop strategies to communicate changes to the program ahead of Phase III, anticipating that the program may or may not be part of Act 129 at that time.</p>	<p>Under consideration</p>
<p>Bill inserts and direct mail flyers were still the most effective methods of marketing the program. However, commercial customers were most likely to have remembered a program flyer. PECO should continue to utilize this channel as conduits of information during the maintenance phase of the program.</p>	<p>Under consideration</p>
<p>The program was well run and well liked by customers during PY4. At the time of the post-season survey, the</p>	<p>Under consideration</p>

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
<p>PY5 program year was underway and many (but not all) customers realized the monthly rebate was reduced. Customer satisfaction was still very high for the program attributes – excluding the energy savings during events. Most residential and commercial customers participate in the program to reduce their energy usage. Navigant suggests that PECO downplay the idea that the program saves energy during program events. Previous Navigant research findings suggest that, for most customers, the snapback in energy usage after an event is 100% or more than the energy saved during an event. Participants are unlikely to see reductions in their bill other than the rebate.</p>	
<p>The summer events have a strong and positive influence on satisfaction with the Smart A/C Saver Program. PECO may want to recommend the program to customers with high bill complaints.</p>	Under consideration

Source: Navigant analysis

## 11.5 Financial Reporting

A breakdown of the program finances is presented in Table 11-7. The commercial Smart A/C Saver program was not cost effective in Phase I, using PECO’s avoided capacity costs expressed as dollars per kWh, as used in PECO’s Phase I EE&C Plan. In Phase II, these benefits will be calculated using avoided capacity costs expressed as dollars per kW-year, as used in PECO’s Revised Phase II EE&C Plan and discussed in PECO direct testimony in Docket P-2012-23203441.<sup>53</sup> Had this methodology been applied to this program for PY4, the benefit-cost ratio would have been 0.19 for the commercial program.

<sup>53</sup> Direct testimony, Frank Jiruska. September 5, 2012.

**Table 11-7. Summary of Commercial Smart A/C Saver Program Finances**

	<b>IQ<sup>[9]</sup></b> <b>(\$1,000)</b>	<b>PY4</b> <b>(\$1,000)</b>	<b>CPITD</b> <b>(\$1,000)</b>
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	66	440	3,453
Management <sup>[2]</sup>	25	139	847
Marketing <sup>[3]</sup>	184	792	1,113
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>275</b>	<b>1,371</b>	<b>5,413</b>
<b>EDC Evaluation Costs</b>	<b>58</b>	<b>99</b>	<b>262</b>
<b>SWE Audit Costs</b>		<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>332</b>	<b>1,470</b>	<b>5,675</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>0</b>	<b>145</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>1,470</b>	<b>5,820</b>
Total Lifetime Energy Benefits	N/A	0	0
Total Lifetime Capacity Benefits	N/A	82	82
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>82</b>	<b>82</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.06</b>	<b>0.01</b>
<b>NOTES</b>			
Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.			
[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.			
[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.			
[3] Includes the marketing CSP and marketing costs by program CSPs.			
[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.			
[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.			
[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.			
[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.			
[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.			
[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.			

Source: Navigant analysis

## **12 Permanent Load Reduction**

The purpose of the PECO Permanent Load Reduction (PLR) program was to encourage commercial and industrial customers to permanently shift electricity usage from peak periods to off-peak periods on an ongoing basis. The PLR program was implemented by KEMA and ICF International. Measures eligible for incentives under the PLR program included gas absorption chillers, energy storage systems, and any other technologies that permanently shift or eliminate peak loads. As of the end of PY4, only one project had been completed in the PLR program. This low level of participation is due to the fact that most efficiency measures available to eligible customers were processed through PECO's SEI program. For example, even though absorption chillers were eligible for incentives through the PLR program, the incentives available from the SEI program were more attractive, so most customers chose to submit their application to that program.

### **12.1 Program Updates**

The PLR program was intended primarily to encourage adoption of technologies that would reduce customers' loads during PECO's peak load hours. As noted above, only one customer installed a technology qualifying for incentives under this program during Phase I. Due to low participation, the fact that the program was not cost-effective during Phase I, and the fact that the PA PUC decided not to establish demand reduction goals for Phase II, PECO has discontinued this program.

### **12.2 Impact Evaluation Gross Savings**

This section describes the methodology and results of the gross impact evaluation.

#### **12.2.1 Evaluation Methodology**

Navigant conducted on-site M&V for the sole PLR project, which installed new cooling equipment, including a gas-engine-driven chiller, on the campus of a private school. Navigant requested and received the complete file for the project, including applications, drawings, invoices, and a description of the project and its operating sequences. The project file also included a spreadsheet presenting the calculations used to determine ex ante demand savings. Following file review, Navigant conducted a telephone interview to clarify details about installed equipment and to determine the proper baseline for the project.

Navigant developed a monitoring and verification plan for the project and arranged for the site visit. The on-site M&V, conducted July 23, 2013, included visual verification and spot measurements to validate measurements being recorded by the facility’s building automation system (BAS) and to validate the assumptions used to develop the ex ante savings estimate. During the site visit, Navigant collected data recorded by the BAS necessary for the ex post evaluation and completed an additional in-person interview with site personnel to validate information about the completed project.

**12.2.2 Reported Savings**

Table 12-1 presents program participation, energy savings, demand reduction during PECO’s Top 100 Hours during the summer of 2012 and throughout PY4, and the incentive paid to the participant.

**Table 12-1. PY4 PLR Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	1	201.1	0.1	0.1	35
PY4 Q2	0	0	0.0	0.0	0
PY4 Q3	0	0	0.0	0.0	0
PY4 Q4	0	0	0.0	0.0	0
<b>PY4 Total</b>	1	201	0.1	0.1	35
<b>CPITD Total</b>	1	201	0.1	0.1	35

*Source: Navigant analysis*

The one project completed was for a private college preparatory school. As Table 12-2 indicates, the savings from this project were therefore in the GNI sector.

**Table 12-2: PLR Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0	0	0
Low-Income	0	0	0	0	0
Commercial and Industrial	0	0	0	0	0
Government and Nonprofit	1	201	0.1	0.1	35
<b>PY4 Total</b>	<b>1</b>	<b>201</b>	<b>0.1</b>	<b>0.1</b>	<b>35</b>
<b>CPITD Total</b>	<b>1</b>	<b>201</b>	<b>0.1</b>	<b>0.1</b>	<b>35</b>

Source: Navigant analysis

### 12.2.3 Verified Savings

The evaluation team found the equipment installed almost precisely as indicated in the project file, but found certain problems with the ex ante analysis. Four factors contributed to differences between the ex ante and ex post savings estimates.

- » The cooling water pump is operated at constant, not variable speed, as had been assumed in the ex ante calculations.
- » The cooling tower fan speed was miscalibrated such that a 100 percent speed control signal resulted in 70 percent actual fan speed.
- » The ex ante analysis used an invalid baseline efficiency.
- » To be consistent with all other efficiency measures installed in the C&I sector through PECO's Smart Equipment Incentives program, Navigant calculated demand savings using the PA Act 129 PECO weather dependent Peak Demand Savings Calculator rather than assessing savings only during PECO's Top 100 Hours.

Some of the factors listed above resulted in increases to energy or demand savings, while others reduced estimated savings. For example, the baseline error resulted in excessive energy savings and demand reduction in the ex ante estimate. On the other hand, demand reduction was underestimated in the ex ante calculation by failing to use the weather-dependent Peak Demand Savings Calculator. The overall results are presented in Table 12-3 and Table 12-4. Since there was only one project in the population for this program, there is no sampling uncertainty—relative precision is 0 percent.

**Table 12-3. PY4 PLR Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings	Unverified Gross Energy Savings
Population	201	44%	0	0%	88	0
<b>Program Total</b>	201	44%	0	0%	88	0

Source: Navigant analysis

**Table 12-4. PY4 PLR Summary of Evaluation Results for Demand (Top 100 Hours)**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (C <sub>v</sub> ) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Population	0.1	167%	0	0%	0.2	0
<b>Program Total</b>	0.1	167%	0	0%	0.2	0

Source: Navigant analysis

### 12.3 Impact Evaluation Net Savings

Navigant did not conduct a net savings analysis for this program.

### 12.4 Process Evaluation

Due to low participation, no process evaluation was conducted for this program.

### 12.5 Financial Reporting

A breakdown of the program finances is presented in Table 12-5. As the table indicates, the PLR program was not cost effective. This is not surprising for a program with just one participant. Although the program was inactive prior to PY4, it was available to customers, and was therefore allocated its share of portfolio-level costs throughout Phase I.

**Table 12-5. Summary of Permanent Load Reduction Program Finances**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	35	35
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>35</b>	<b>35</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	44	159	465
Management <sup>[2]</sup>	6	32	283
Marketing <sup>[3]</sup>	0	0	0
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>50</b>	<b>191</b>	<b>748</b>
EDC Evaluation Costs	28	50	120
SWE Audit Costs	0	0	
<b>Total EDC Costs<sup>[4]</sup></b>	<b>78</b>	<b>277</b>	<b>903</b>
Participant Costs <sup>[5]</sup>	N/A	1,826	1,826
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>2,067</b>	<b>2,694</b>
Total Lifetime Energy Benefits	N/A	80	80
Total Lifetime Capacity Benefits	N/A	141	141
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>221</b>	<b>221</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.11</b>	<b>0.08</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 13 Demand Response Aggregators

The DRA program was a demand response load curtailment program for large commercial and industrial customers that operated only during the summer of 2012. It was based on DR performance contracts established between PECO and three third-party service providers (DR aggregators). The three DR aggregators were EnerNOC, EnergyConnect, and Comverge. The DR aggregators were responsible for recruiting customers willing to curtail their demand and delivering the demand reductions to PECO on a dispatchable basis. The program was designed to provide demand response during PECO's Top 100 Hours of system peak loads during the summer of 2012. The contracted MW and number of dispatchable hours that PECO contracted for with each aggregator are presented in Table 13-1.

**Table 13-1. DRA Contracted MW and Hours**

Aggregator	Contract MW	Dispatchable Hours
EnergyConnect	100	125
Comverge	31	125
EnerNOC	40	60
<b>Total</b>	<b>171</b>	

*Source: DR Aggregator contracts*

### 13.1 Program Updates

Because the Pennsylvania PUC decided not to establish peak demand reduction goals for PA utilities in Phase II, PECO has discontinued the DRA program.

### 13.2 Impact Evaluation Gross Savings

This section describes the methodology and results of the gross impact evaluation.

#### 13.2.1 Evaluation Methodology

Program impacts were calculated as the difference between each participant's hourly load and the baseline, developed in accordance with sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.* dated May 8, 2012. Use of the symmetric additive adjustment (SAA) was designated for each participant.

## **PJM Baseline Protocol**

Sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012, describe the methodology used to estimate the customer baseline. The baseline load is calculated as the average of the highest four out of five eligible baseline days with an optional symmetric additive adjustment. Days are not eligible for inclusion in the baseline if the day is an event day, a North American Electric Reliability Corporation (NERC) holiday, or weekend (PECO call events only on weekdays). Otherwise eligible days are excluded if the average daily event period usage is less than 25 percent of the average event period for the five days; this criterion eliminates outlier days in which the load was extremely low.

The optional SAA affects the level of the baseline load, but not the shape. The SAA shifts the baseline up or down so that the average baseline loads during the three consecutive hours beginning four hours prior to the event period is equal to the average load during this same period.

## **Line Losses**

The line loss varies by the participant's rate class. Occasionally, multiple accounts are grouped in a single registration. To account for instances in which the rate class varied by account, Navigant calculated a weighted line-loss factor for each registration, with the weights based on the registered load reduction for each account.

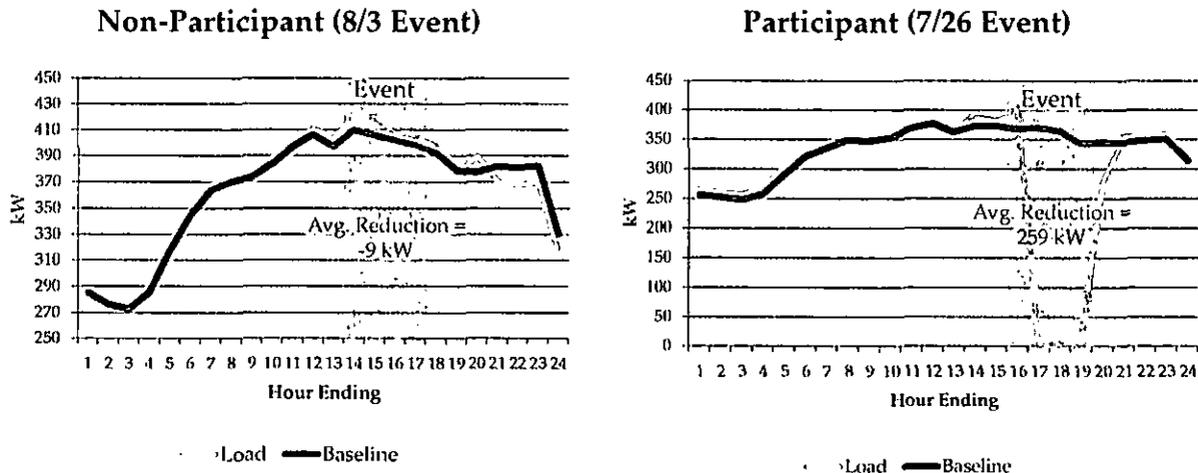
## **Treatment of Negative Load Reductions**

Program reductions may be either positive (the load is less than the baseline) or negative (the load is greater than the baseline). Occasionally, the negative load reductions outweigh the positive load reductions for a customer on a specific event day, resulting in an average load reduction during the event period that is less than zero. Navigant flagged customers with negative average load reductions as non-participants for that event, and the load impact during the entire event period was recorded as zero. Otherwise, both positive and negative hourly load reductions are recorded.

The left panel of Figure 13-1 shows a customer flagged as a non-participant during one event. The customer's average load reduction during the event period was -9 kW, indicating an increase in energy usage during the event. Navigant assigned a load reduction value of 0 kW for this customer during the entire event period. The right panel of Figure 13-1 shows a customer flagged as a participant during an event. Note that the load was above the baseline in

the first hour of the event (corresponding to a negative load reduction) and below the baseline during the remainder of the event. Because the average load reduction was positive 259 kW, Navigant recorded both the negative (first event hour) and positive (remaining event hours) load reductions during the event hours.

**Figure 13-1. Example of a Non-Participant (left panel) and Participant (right panel) During an Event Period**



Source: Navigant analysis

### Participants with Generators or Input/Output Meters

One program participant used a generator when reducing load in response to an Act 129 event; however, the generator was used outside Act 129 event hours as well. The generator data contained the amount of energy generated and the amount of energy exported. Navigant calculated the net generator energy by subtracting the exports. The net generator data was then multiplied by negative one to convert the data from supply to demand and the baseline was calculated following the protocol.

Another program participant had several input and output meters. Navigant calculated the net load by summing the input load data and subtracting the output load data. The net load was used in the baseline calculation.

Additional details on the evaluation methodology are documented in PECO's Preliminary Demand Reduction report.<sup>54</sup>

### 13.2.2 Reported Savings

Table 13-2 presents program participation, energy savings, demand reduction during PECO's Top 100 Hours during the summer of 2012 and throughout PY4, and program incentives to participants. As it was intended as a load shifting program, PECO is not claiming energy savings from the DRA program. Furthermore, as PECO called curtailment events only during Q1 (there were none called in September 2012), there is no difference between total demand reduction and that in the Top 100 Hours. Finally, although the DR aggregators paid participants to curtail load when PECO called curtailment events, PECO did not provide incentives directly to participants. Hence, no incentives are presented in the table. Note that the reported demand reduction presented in this table is 7.4 MW higher than the value presented in PECO's Preliminary Demand Response report. In the process of preparing this report, the evaluator identified an error in the application of line loss factors, which resulted in the increased estimate of demand reduction reported here.

**Table 13-2. PY4 DRA Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	193	0	113.4	113.4	N/A
PY4 Q2	0	0	0.0	0.0	N/A
PY4 Q3	0	0	0.0	0.0	N/A
PY4 Q4	0	0	0.0	0.0	N/A
<b>PY4 Total</b>	<b>193</b>	<b>0</b>	<b>113.4</b>	<b>113.4</b>	<b>N/A</b>
<b>CPITD Total</b>	<b>193</b>	<b>0</b>	<b>113.4</b>	<b>113.4</b>	<b>N/A</b>

Source: Navigant analysis

<sup>54</sup> PECO, *Phase I Demand Reduction*, memo to the PA PUC, March 1, 2013.

Table 13-3 presents the distribution of participation and savings across the sectors.

**Table 13-3. DRA Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0.0	0.0	N/A
Low-Income	0	0	0.0	0.0	N/A
Commercial and Industrial	99	0	79.9	79.9	N/A
Government and Non-Profit	94	0	33.5	33.5	N/A
<b>PY4 Total</b>	<b>193</b>	<b>0</b>	<b>113.4</b>	<b>113.4</b>	<b>N/A</b>
<b>CPITD Total</b>	<b>193</b>	<b>0</b>	<b>113.4</b>	<b>113.4</b>	<b>N/A</b>

Source: Navigant analysis

### 13.2.3 Sampling

As Table 13-4 indicates, Navigant analyzed data from all participants for the impact analysis. No samples were drawn, so there was no sampling uncertainty in the results.

**Table 13-4. DRA Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Total Population	N/A	193	N/A	90% ± 0%	193	193	Calculation of customer baseline and load reduction during DR event hours
Program Total	N/A	193	N/A	90% ± 0%	193	193	

Source: Navigant analysis

### 13.2.4 Verified Savings

Table 13-5 and Table 13-6 present reported and verified energy savings and demand reduction, respectively. As DRA was a load shifting program, PECO is not claiming energy savings from the program.

**Table 13-5. PY4 DRA Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Population	0	N/A	N/A	0	0	0
<b>Program Total</b>	<b>0</b>	<b>N/A</b>	<b>N/A</b>	<b>0</b>	<b>0</b>	<b>0</b>

Source: Navigant analysis

The impact evaluation for this program utilized the PJM protocols for establishing load baselines for each participating customer. Navigant calculated load reduction for each participant in each hour during the summer of 2012 by subtracting actual load from the customer baseline. In order to determine demand impacts of the program over PECO's Top 100 Hours during the summer of 2012, it was necessary to first reconstruct PECO's gross baseline load, by adding the demand reduction from all EE and DR programs to PECO's measured (net) load. With the gross baseline load reconstructed, Navigant was able to identify the Top 100 Hours. The program's impact was then calculated as the average of the program-wide hourly impacts over the Top 100 Hours.

Because PECO's top 100 load hours were unknown prior to the end of September 2012, and because participation in any given DR event was voluntary, PECO did not require and the aggregators did not develop ex ante estimates of demand reduction. This being the case, it was not possible to calculate realization rates on a participant-by-participant basis, or therefore for the program as a whole. For this reason, Table 13-6 presents neither a demand realization rate nor a coefficient of variation. As the analysis was conducted for all participants in the population, there is no sampling uncertainty in this value. Therefore, the relative precision is zero percent.

**Table 13-6. PY4 DRA Summary of Evaluation Results for Demand (Top 100 Hours)**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Population	113.4	N/A	N/A	0	113.4	0
Program Total	113.4	N/A	N/A	0	113.4	0

Source: Navigant analysis

### 13.3 Impact Evaluation Net Savings

Navigant did not conduct research to determine free ridership for this program. Navigant’s assumption is that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives that the CSPs paid to them for their load curtailment.

The PA PUC’s 2011 TRC Order makes it clear that utilities are to use an NTG factor of 1.0 in determining program cost-effectiveness. Navigant notes that the statewide evaluator conducted research to estimate the relative importance of payments from PJM and those from the EDCs in DR program participants’ decisions to curtail load or turn on generators. The report on that research and its conclusions can be found on the PA PUC website at [http://www.puc.state.pa.us/filing\\_resources/issues\\_laws\\_regulations/act\\_129\\_information/act\\_129\\_statewide\\_evaluator\\_swe.aspx](http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe.aspx).

### 13.4 Process Evaluation

Navigant did not conduct a process evaluation for this program because PECO’s plan was to terminate the program following the summer of 2012 (PY4); therefore, any findings from a process evaluation could not be applied to improve performance in a subsequent program year.

### 13.5 Financial Reporting

A breakdown of the program finances is presented in Table 13-7. With a benefit-cost ratio of 0.69 for PY4 and 0.31 for Phase I, the program was not cost effective. Note that benefits for this report were calculated using PECO’s avoided T&D costs expressed in dollars per kWh and valued based on the energy shifted during event hours. Since PECO claims no energy savings from this program, there are no T&D benefits. Although this program will not be implemented beyond PY4, in Phase II, T&D benefits will be calculated using avoided costs expressed in

dollars per kW. Had this methodology been applied to the DRA program for PY4, the benefit-cost ratio would have been 1.63.

**Table 13-7. Summary of Demand Response Aggregators Program Finances**

	<b>IQ<sup>[9]</sup></b>	<b>PY4</b>	<b>CPITD</b>
	<b>(\$1,000)</b>	<b>(\$1,000)</b>	<b>(\$1,000)</b>
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	0	7,417	16,162
Management <sup>[2]</sup>	26	244	1,136
Marketing <sup>[3]</sup>	0	0	0
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>26</b>	<b>7,661</b>	<b>17,298</b>
EDC Evaluation Costs	76	130	401
SWE Audit Costs		0	0
<b>Total EDC Costs<sup>[4]</sup></b>	<b>102</b>	<b>7,791</b>	<b>17,699</b>
Participant Costs <sup>[5]</sup>	N/A	0	0
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>7,791</b>	<b>17,699</b>
Total Lifetime Energy Benefits	N/A	0	0
Total Lifetime Capacity Benefits	N/A	5,409	5,409
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>5,409</b>	<b>5,409</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.69</b>	<b>0.31</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## 14 Distributed Energy Resources

The DER program was designed to realize peak demand reductions during PECO's Top 100 Hours from eligible commercial and industrial customers in the utility's service territory by providing incentives for customers to run standby generators when requested by PECO. PECO contracted with Comverge to provide 16.5 MW of distributed generation during PECO's Top 100 Hours by recruiting and registering PECO customers for this program who were willing to run their generators for up to 125 hours during the months June through September 2012.

### 14.1 Program Updates

Because the Pennsylvania PUC decided not to establish peak demand reduction goals for PA utilities in Phase II, PECO has discontinued the DER program.

### 14.2 Impact Evaluation Gross Savings

This section describes the methodology and results of the gross impact evaluation.

#### 14.2.1 Evaluation Methodology

Program impacts were calculated as the difference between each participant's net hourly load (consumption minus generation) and the baseline (described below), developed in accordance with sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012. Use of the SAA was designated for each participant.

#### PJM Baseline Protocol

Sections 3.3A.2, 3.3A.2.01, and 3.3A.3 of the *Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.*, dated May 8, 2012, describe the methodology used to estimate the customer baseline. The baseline load is calculated as the average of the highest four out of five eligible baseline days with an optional symmetric additive adjustment. Days are not eligible for inclusion in the baseline if the day is an event day, NERC holiday, or weekend (PECO call events only on weekdays). Otherwise eligible days are excluded if the average daily event period usage is less than 25 percent of the average event period for the five days; this criterion eliminates outlier days in which the load was extremely low. Baseline load calculations utilized net load—the difference between hourly consumption and on-site generation.

The optional SAA affects the level of the baseline load, but not the shape. The SAA shifts the baseline up or down so that the average baseline loads during the three consecutive hours beginning four hours prior to the event period is equal to the average load during this same period.

### **Line Losses**

The line loss varies by the participant's rate class. Occasionally multiple accounts are grouped in a single registration. To account for instances in which the rate class varied by account, Navigant calculated a weighted line-loss factor for each registration, with the weights based on the registered load reduction for each account.

### **Participants with Generators or Input/Output Meters**

One program participant used a generator when reducing load in response to an Act 129 event; however, the generator was used outside Act 129 event hours as well. The generator data contained the amount of energy generated and the amount of energy exported. Navigant calculated the net generator energy by subtracting the exports. The net generator data was then multiplied by negative one to convert the data from supply to demand and the baseline was calculated following the protocol.

Another program participant had several input and output meters. Navigant calculated the net load by summing the input load data and subtracting the output load data. The net load was used in the baseline calculation.

Additional details on the evaluation methodology are documented in PECO's Preliminary Demand Reduction report.<sup>55</sup>

### **14.2.2 Reported Savings**

Table 13-2 presents program participation, energy savings, demand reduction during PECO's Top 100 Hours during the summer of 2012 and throughout PY4, and program incentives to participants. As the DER program did not curtail consumption, but merely shifted it to customer-owned generation, PECO is not claiming energy savings from the program. Furthermore, as PECO dispatched the program only during Q1 (there were no events in

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<sup>55</sup> PECO, *Phase I Demand Reduction*, memo to the PA PUC, March 1, 2013.

September 2012), there is no difference between total demand reduction and that in the Top 100 Hours. Finally, although Comverge paid participants to start or ramp up their generators when PECO dispatched the program, PECO did not provide incentives directly to participants. Hence, no incentives are presented in the table. Note that the reported demand reduction presented in this table is 1.0 MW higher than the value presented in PECO's Preliminary Demand Response report. In the process of preparing this report, the evaluator identified an error in the application of line loss factors, which resulted in the increased estimate of demand reduction reported here.

**Table 14-1. PY4 DER Reported Results by Quarter**

Reporting Period	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
PY4 Q1	2	0	16.4	16.4	N/A
PY4 Q2	0	0	0.0	0.0	N/A
PY4 Q3	0	0	0.0	0.0	N/A
PY4 Q4	0	0	0.0	0.0	N/A
<b>PY4 Total</b>	<b>2</b>	<b>0</b>	<b>16.4</b>	<b>16.4</b>	<b>N/A</b>
<b>CPITD Total</b>	<b>2</b>	<b>0</b>	<b>16.4</b>	<b>16.4</b>	<b>N/A</b>

Source: Navigant analysis

Table 14-2 presents the distribution of participation and savings across the sectors.

**Table 14-2. DER Reported Results by Sector**

Sector	Participants	Reported Gross Energy Savings (MWh)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	0	0	0	0	N/A
Low-Income	0	0	0	0	N/A
Commercial and Industrial	1	0	13.6	13.6	N/A
Government and Non-Profit	1	0	2.8	2.8	N/A
<b>PY4 Total</b>	<b>2</b>	<b>0</b>	<b>16.4</b>	<b>16.4</b>	<b>N/A</b>
<b>CPITD Total</b>	<b>2</b>	<b>0</b>	<b>16.4</b>	<b>16.4</b>	<b>N/A</b>

Source: Navigant analysis

### 14.2.3 Sampling

As Table 14-3 indicates, Navigant analyzed data from all participants for the impact analysis. No samples were drawn, so there was no sampling uncertainty in the results.

**Table 14-3. DER Sampling Strategy for PY4**

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Total Population	N/A	2	N/A	90% ± 0%	2	2	Calculation of customer baseline and load reduction during DR event hours
<b>Program Total</b>	<b>N/A</b>	<b>2</b>	<b>N/A</b>	<b>90% ± 0%</b>	<b>2</b>	<b>2</b>	

Source: Navigant analysis

#### 14.2.4 Verified Savings

Table 14-4 and Table 14-5 present reported and verified energy savings and demand reduction, respectively. As DER merely shifted consumption to customer-owned generation, PECO is not claiming energy savings from the program.

**Table 14-4. PY4 DER Summary of Evaluation Results for Energy**

Stratum	Reported Gross Energy Savings (MWh)	Energy Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Energy Savings (MWh)	Unverified Gross Energy Savings (MWh)
Population	0	N/A	N/A	0	0	0
<b>Program Total</b>	<b>0</b>	<b>N/A</b>	<b>N/A</b>	<b>0</b>	<b>0</b>	<b>0</b>

Source: Navigant analysis

The impact evaluation for this program utilized the PJM protocols for establishing load baselines for each participating customer. Navigant calculated load reduction for each participant in each hour during the summer of 2012 by subtracting actual load from the customer baseline. In order to determine demand impacts of the program over PECO's Top 100 Hours during the summer of 2012, it was necessary to first reconstruct PECO's gross baseline load, by adding the demand reduction from all EE and DR programs to PECO's measured (net) load. With the gross baseline load reconstructed, Navigant was able to identify the Top 100 Hours. The program's impact was then calculated as the average of the program-wide hourly impacts over the Top 100 Hours.

Because PECO's top 100 load hours were unknown prior to the end of September 2012, and because participation in any given DR event was voluntary, PECO did not require and Comverge did not develop ex ante estimates of power production by DER participants during event hours. This being the case, it was not possible to calculate realization rates on a participant-by-participant basis, or therefore, for the program as a whole. For this reason, Table 13-6 presents neither a demand realization rate nor a coefficient of variation. Since the analysis was conducted for all participants in the population, there is no sampling uncertainty. Therefore, the relative precision is zero percent.

**Table 14-5. PY4 DER Summary of Evaluation Results for Demand (Top 100 Hours)**

Stratum	Reported Gross Demand Reduction (MW)	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision at 85% Confidence	Verified Gross Demand Reduction Savings (MW)	Unverified Gross Demand Reduction (MW)
Population	16.4	N/A	N/A	0	16.4	0
<b>Program Total</b>	<b>16.4</b>	<b>N/A</b>	<b>N/A</b>	<b>0</b>	<b>16.4</b>	<b>0</b>

Source: Navigant analysis

### 14.3 Impact Evaluation Net Savings

Navigant did not conduct research to determine free ridership for this program. Navigant’s assumption is that none of the program participants would have dispatched or increased power production from their generators at the times PECO dispatched the program without the incentives that Converge paid to them for their load curtailment.

The PA PUC’s 2011 TRC Order makes it clear that utilities are to use an NTG factor of 1.0 in determining program cost-effectiveness. Navigant notes that the statewide evaluator conducted research to estimate the relative importance of payments from PJM and those from the EDCs in DR program participants’ decisions to curtail load or turn on generators. The report on that research and its conclusions can be found on the PA PUC website at [http://www.puc.state.pa.us/filing\\_resources/issues\\_laws\\_regulations/act\\_129\\_information/act\\_129\\_statewide\\_evaluator\\_swe.aspx](http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe.aspx).

### 14.4 Process Evaluation

Navigant did not conduct a process evaluation for this program because PECO’s plan was to terminate the program following the summer of 2012 (PY4); therefore, any findings from a process evaluation could not be applied to improve performance in a subsequent program year.

### 14.5 Financial Reporting

A breakdown of the program finances is presented in Table 14-6. The benefit-cost ratio was 0.41 for PY4 and 0.22 for Phase I. Note that benefits for this report were calculated using PECO’s avoided T&D costs expressed in dollars per kWh-year and valued based on the energy shifted during event hours. Since PECO claims no energy savings from this program, there are no T&D benefits. Although this program will not be implemented beyond PY4, in Phase II, T&D benefits

will be calculated using avoided costs expressed in dollars per kW-year. Had this methodology been applied to the DRA program for PY4, the benefit-cost ratio would have been 0.99.

**Table 14-6. Summary of Distributed Energy Resources Program Finances**

	IQ <sup>[9]</sup> (\$1,000)	PY4 (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	0	0	0
EDC Incentives to Trade Allies	0	0	0
<b>Subtotal EDC Incentive Costs</b>	<b>0</b>	<b>0</b>	<b>0</b>
Design & Development	0	0	0
Administration <sup>[1]</sup>	0	1,325	1,738
Management <sup>[2]</sup>	46	401	1,464
Marketing <sup>[3]</sup>	0	0	0
Technical Assistance	0	0	0
<b>Subtotal EDC Implementation Costs</b>	<b>46</b>	<b>1,726</b>	<b>3,202</b>
<b>EDC Evaluation Costs</b>	<b>103</b>	<b>189</b>	<b>463</b>
<b>SWE Audit Costs</b>		<b>0</b>	<b>0</b>
<b>Total EDC Costs<sup>[4]</sup></b>	<b>149</b>	<b>1,915</b>	<b>3,665</b>
<b>Participant Costs<sup>[5]</sup></b>	<b>N/A</b>	<b>0</b>	<b>0</b>
<b>Total TRC Costs<sup>[6]</sup></b>	<b>N/A</b>	<b>1,915</b>	<b>3,665</b>
Total Lifetime Energy Benefits	N/A	0	0
Total Lifetime Capacity Benefits	N/A	788	788
<b>Total TRC Benefits<sup>[7]</sup></b>	<b>N/A</b>	<b>788</b>	<b>788</b>
<b>TRC Ratio<sup>[8]</sup></b>	<b>N/A</b>	<b>0.41</b>	<b>0.22</b>

**NOTES**

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

[3] Includes the marketing CSP and marketing costs by program CSPs.

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer or program costs that are proxies for participant costs. These include incentives paid to appliance recycling and Demand Response participants.

[6] Total TRC Costs include EDC Evaluation Costs, EDC Implementation Costs, and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits plus any benefit associated with avoided incandescent purchases made due to the longer useful life of energy-efficient lighting as compared to the baseline measure. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[8] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

[9] Post PY4 costs and benefits are included in IQ, PY4, and CPITD numbers.

Source: Navigant analysis

## Appendix A Selection of Residential Lighting Coincidence Factor

Prior to the PY4 Q3 report, demand reduction impacts for residential lighting measures had been calculated using the peak load coincidence factor of 5 percent in the 2012 Pennsylvania TRM. This value comes from a 2007 report by RLW Analytics, entitled "Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market (FCM)".<sup>56</sup> As the 5 percent CF has been acknowledged by both the SWE and the TUS to be erroneous,<sup>57</sup> Navigant Consulting, Inc. (Navigant) has used a residential lighting load shape developed through the 2009 Northeast residential lighting logger study conducted by Nexus Market Research, RLW Analytics, and GDS Associates (the NMR 2009 study) to calculate a revised CF of 11.7 percent over PECO's Top 100 Hours during the summer of 2012.<sup>58</sup> Navigant has used this value to recalculate CPITD-verified demand reduction for all residential lighting measures subsidized through its Smart Lighting Discounts program and Component 1 (installation of "extra CFLs") of its Low-Income Energy Efficiency Program.

Navigant's decision to adopt this value comes from a review of lighting logger studies based on *sample size, geographic relevance, availability of load shape data for summer peak demand savings calculations, and the date of the study.* Specifically, the 2009 Northeast study had a sample size of 657 lighting loggers spread across 157 homes. Homes were randomly selected from among a large recruitment pool, and loggers were all in place for June, July, and August of 2008, as well as spring and fall months. It is noteworthy that this is the study that is cited for annual hours of use in the 2013 PA TRM.

Other lighting logger studies Navigant reviewed for the purpose of updating the peak load coincidence factor included: EmPOWER Maryland 2010-2011, 2006-2008 California Upstream Lighting Program, 2005 California Residential CFL Metering, and the 2008 Database for Energy-Efficient Resources (DEER) CFL load shape. The EmPOWER Maryland 2010-2011 study featured fewer loggers than the 2009 Northeast study, with a total of 377 loggers across 131 homes. In the Maryland study, there was not a large pool of recruited homes from which the

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<sup>56</sup> RLW Analytics, "Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market (FCM)", prepared for the New England State Program Working Group (SPWG), March 25, 2007, p. IV.

<sup>57</sup> See the minutes of the Program Evaluation Group meeting from March 20, 2013 (forwarded to all EDCs and evaluators on March 29, 2013).

<sup>58</sup> Nexus Market Research, Inc., RLW Analytics, Inc., and GDS Associates, 2009. Residential Lighting Markdown Impact Evaluation. Prepared for Markdown and Buydown Program Sponsors in Connecticut, Massachusetts, Rhode Island, and Vermont. January 20, 2009.

sample could be selected at random. The Maryland study also yielded a modeled seasonal curve of CF values with a distinctly greater amplitude than that seen in other studies. The 2006-2008 California Upstream Lighting Program study included loggers in more than 1,200 homes. However, the report does not include an hourly load shape and cannot be adapted for the calculation of demand reduction in the Top 100 Hours. The 2005 California Residential CFL Metering Study installed meters on 983 CFLs in 375 homes. This study includes a large sample size and excellent study methodology; however, the data are comparatively old and from a geographic location further removed from Pennsylvania than the 2009 Northeast study. The 2008 DEER CFL load shape is based on the same data from the 2005 Residential CFL Metering Study, but also incorporates the impact of lighting-HVAC interactive effects on summer peak load shapes. Because these interactive effects are influenced by climate and other considerations, these adjusted load shapes do not represent a best fit for Pennsylvania.

To create better fitting load shapes, Navigant is undertaking an analysis of HVAC interactive effects. The PY4 Annual Report will include this analysis.

For the foregoing reasons, the 2009 Nexus Market Research (NMR) study provides the best match to Pennsylvania conditions of the available residential lighting load studies.

Navigant used the NMR 2009 residential lighting load shape to calculate hourly coincidence factors for every hour of the year. The average of these hourly CFs during PECO's Top 100 Hours during the summer of 2012 is 11.7 percent.

## Appendix B Residential CFL/LED Interactive Effects/Waste Heat Factor Analysis

This appendix details the methodology and results of Navigant’s HVAC interaction effects factor (waste heat factor) study for PECO. Navigant constructed building energy computer simulation models to determine the heating, ventilation, and air conditioning (HVAC) impacts from efficient lighting installations in the PECO service territory. Navigant used these models to calculate energy and demand interactive effects factors (IEF), which are used to adjust the program lighting savings to account for the additional impacts on HVAC energy and demand. The Navigant Consulting, Inc. (Navigant) team has not applied energy and demand interactive effects in previous evaluations of PECO’s residential programs because these were not included in the TRM. However, the evaluation team believes that by not including this factor, the TRM is significantly underestimating demand savings from efficient lighting installations.

The energy and demand interactive effects factors define the secondary impacts on HVAC energy caused by the primary energy savings from reduced-wattage lighting installations. The efficient lighting equipment emits less “waste heat” to the conditioned building space, which in turn increases the need for heating from the HVAC system during winter months and decreases the need for cooling in air-conditioned spaces during summer months. This modeling analysis calculated the impacts on heating and cooling energy use from installation of reduced-wattage lighting equipment, and the reduction in peak demand for the utility summer peak period.

The interactive effects are defined as the ratios between the total savings (primary lighting and secondary HVAC impacts) and the primary, lighting-only savings. Navigant used the following equations to calculate energy and demand interactive effects. The energy IEF is calculated using annual energy savings, while demand IEF is calculated using the kW savings for lighting and HVAC end uses during the PECO summer peak periods.

Energy: 
$$IEF_e = \frac{(kWh\ Savings_{Lighting} + kWh\ Savings_{HVAC})}{kWh\ Savings_{Lighting}}$$

Demand: 
$$IEF_d = \frac{(kW\ Savings_{Lighting} + kW\ Savings_{HVAC})}{kW\ Savings_{Lighting}}$$

### B.1 Methodology

The following section describes Navigant’s methodology for calculating energy and demand interactive effects for PECO. In general, Navigant performed these steps:

- » Developed hourly residential building models with EnergyPlus 8.0 simulation software:
  - Inputs were derived from the 2011 PECO Baseline Study conducted by Navigant.
  - Models were calibrated to PECO-specific monthly billing data from U.S. Energy Information Administration (EIA) Form 826.
  - Models used Building America Benchmark hourly lighting profiles.
  - Performed simulations using weather data from Philadelphia International Airport
- » Calculated IEF<sub>a</sub> using two specifications for peak period:
  - 2012 actual meteorological year (AMY) weather data used to calculate a PECO-specific IEF<sub>a</sub> for PECO's actual Top 100 Hours for the period of June 1, 2012 through May 31, 2013 (effectively June through September 2012)
  - 2012 typical meteorological year (TMY) weather data used to calculate an IEF<sub>a</sub> for the statewide Technical Reference Manual using PJM's definition of the peak period (2-6 p.m. on all non-holiday weekdays between June and August)
- » Calculated annual IEF<sub>c</sub> using all 8,760 hours of the year
- » Results analyzed as a weighted average of home type (single family and multifamily) heating type (gas, heat pump, electric resistance) and AC type (central AC and room AC) as observed in the PECO Baseline Study

The following sections describe each process in more detail.

## **B.2 EnergyPlus Simulation**

Navigant performed hourly building energy simulation modeling with the EnergyPlus 8.0 software package, a well-established and vetted whole building simulation software developed by the U.S. Department of Energy. EnergyPlus allows for hourly building simulation to calculate the hourly demand for all major end uses in the building (including lighting and HVAC). Navigant chose to use hourly simulation modeling because the software calculates the complex and dynamic interactions between the building components, thermal mass, weather, and HVAC equipment. Navigant used the lighting and HVAC hourly end-use demand profiles from EnergyPlus to calculate the energy and demand interactive effects for this study. More details on the calculation methodology are provided in the Calculations/Analysis section.

## **B.3 BEopt Model Inputs and Calibration Process**

Building Energy Optimization (BEopt) software is a platform developed by the National Renewable Energy Laboratory (NREL) to use as a front-end to the EnergyPlus software engine. PECO-specific models were developed in BEopt according to housing characteristics determined by the 2011 PECO baseline study conducted by Navigant. Analysis of the baseline

data and segmentation by home type and heating system yielded eight specific models with their respective weightings in parentheses:

- Single family – gas furnace (59%)
- Single family – heat pump (11%)
- Multifamily – gas furnace (2 orientations; 24%)
- Multifamily – electric resistance (2 orientations; 4%)
- Multifamily – heat pump (2 orientations; 2%)

Each model differed in terms of envelope inputs according to the data in the baseline study. For a complete listing of the inputs present in each model, see Table B-5. The multifamily homes were modeled as townhouses with shared walls on two sides, so two models were built for each home at perpendicular orientations to match data that indicated there is no predominant orientation of townhomes within PECO service territory.

A weighted calibration of all models was performed using the average monthly consumption of a residential PECO customer derived from EIA 826 billing data. Due to the limitations of the baseline study building attributes and billing data, it was determined that the modeling outputs would only be valid using a weighted average rather than developing IEF for each individual building model.

Certain parameters of the model were adjusted in order to match the billing data, including thermostat set points, natural ventilation behavior, and thermal mass of the building.<sup>59</sup> Area-specific Building America Benchmark defaults built into BEopt were used for lighting and domestic hot water schedules. The models were calibrated as a group to the billing data using the weighted average results, rather than calibrating each model to the billing data on an individual basis.

## **B.4 Calculations/Analysis**

In order to calculate energy and demand interactive effects, Navigant first ran all of the models with the baseline lighting profiles and respective weather files. Next, Navigant modeled “efficient” building models by “upgrading” 100% of screw-in fixtures in the house to compact fluorescent (CFL) bulbs. Navigant performed trial models upgrading 25%, 50%, and 75% of the fixtures to CFLs, and noted that the interaction factor results are independent of the number of lights replaced. Each of the simulations was performed a total of four times: with the baseline and efficient cases, using 2012 AMY weather data and TMY weather data.

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<sup>59</sup> These calibration parameters were chosen because they are largely independent of the physical structure of the house. Thermostat set points and natural ventilation are determined by the behavior of the house occupants, and the thermal mass of the house is affected by the amount of furniture etc. present inside the house.

### Demand Interaction Effects Factor

Navigant used the following methodology to calculate the IEF<sub>a</sub> during the summer and winter utility peak periods:

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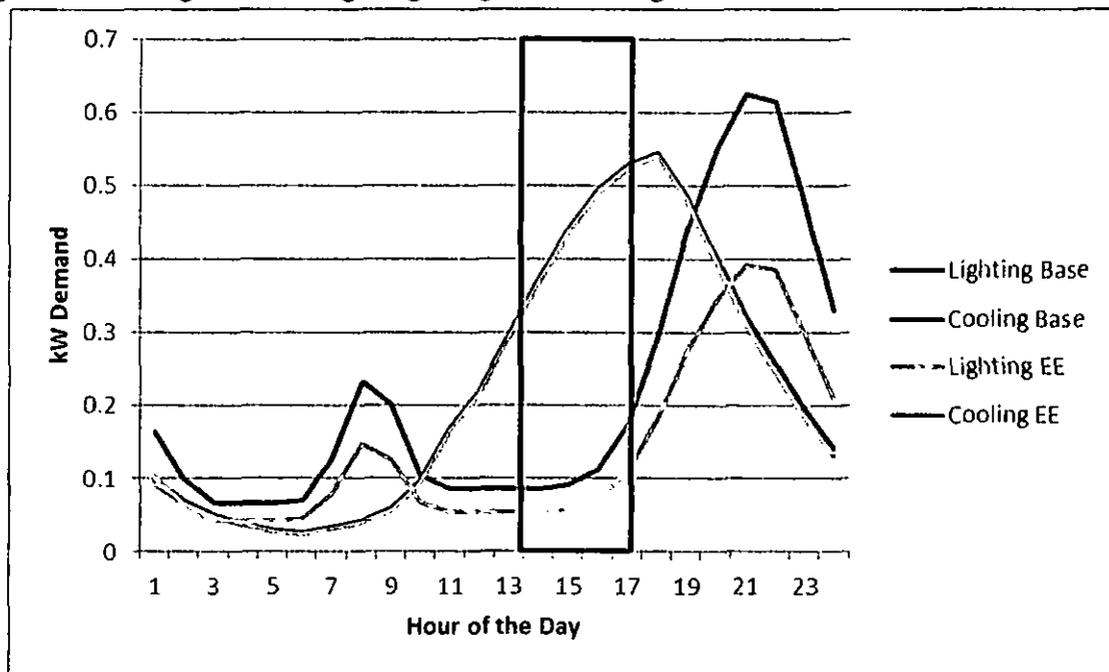
To determine a PECO-specific IEF<sub>a</sub> for calculating PECO's Act 129 Phase I verified demand savings in the summer of 2012, Navigant averaged the lighting and HVAC savings over the peak 100 hours for PECO in 2012.

To determine a PECO-specific IEF<sub>a</sub> for the Act 129 Phase II statewide Technical Reference Manual, Navigant averaged the lighting and HVAC savings over the utility peak period as defined by PJM. The utility peak period is defined as:

- » Summer Peak Period: weekday, non-holiday, June through August, 2:00– 6:00 p.m.

Navigant used the hourly simulation output from EnergyPlus to calculate the average hourly demand during both peak periods. Figure B-1 shows the weighted average summer hourly demand profiles for the baseline and reduced-wattage models. The shaded box indicates the peak period as defined by PJM.

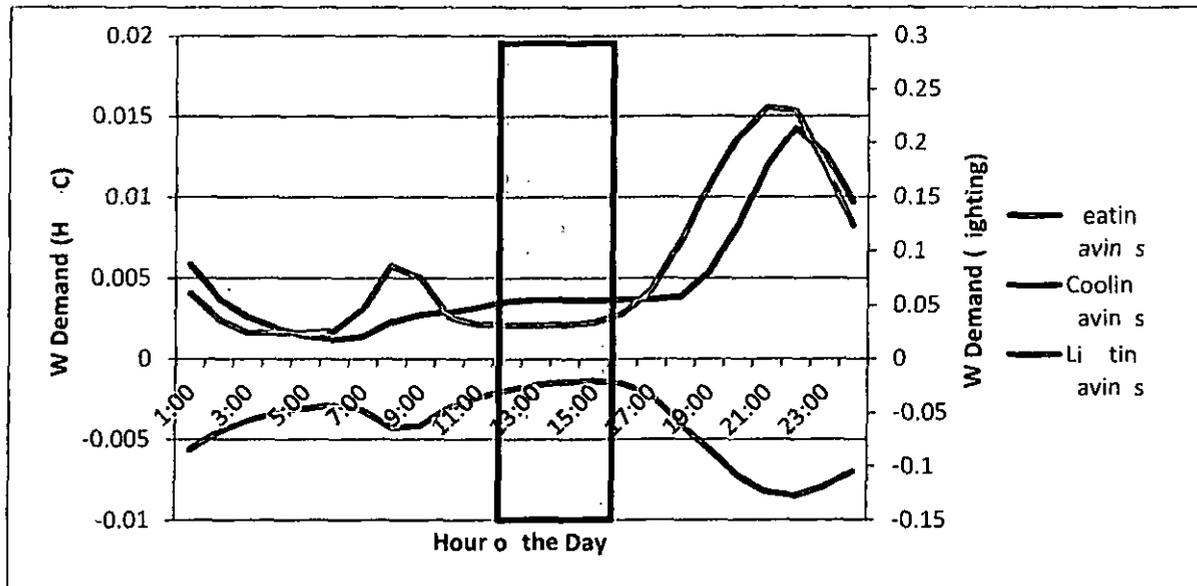
**Figure B-1. Weighted Average Lighting and Cooling Demand for Baseline and EE Models**



Source: Navigant analysis

Figure B-2 displays the hourly demand savings from the baseline for lighting and HVAC end-uses for the weighted average of all models. The IEF<sub>d</sub> quantifies the additional reduction in HVAC demand due to lighting demand savings during the utility peak period indicated by the shaded box. Heating savings are negative, reflecting an increase in heating demand between the incandescent (Baseline) and CFL (EE) cases. This increase in heating demand is a result of lower heat emissions from lighting fixtures in the EE case.

**Figure B-2. Weighted Average Lighting and HVAC Demand Savings between Baseline and EE Models**



Source: Navigant analysis

The following is an example IEF<sub>d</sub> calculation using the modeling results shown in Figure B-2. Lighting and HVAC demand savings are averaged during the summer peak period.

$$IEF_d = \frac{[(0.0239 \text{ kW}) + (0.0055 \text{ kW})]}{0.0239 \text{ kW}} = 1.228$$

Navigant calculated IEF<sub>d</sub> for all building models for both the summer peak periods as defined by PJM and PECO's actual 2012 top 100 demand hours.

**Energy Interaction Effects Factor**

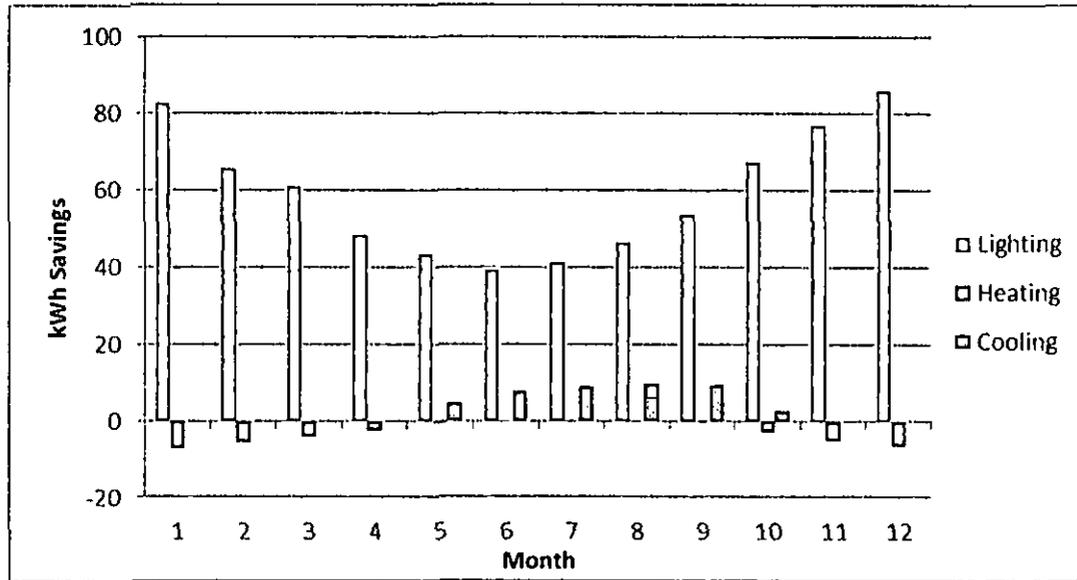
Navigant used the following methodology to calculate the IEF<sub>e</sub>:

$$IEF_e = \frac{[(\text{Annual Lighting Energy Savings}) + (\text{Annual HVAC Energy Savings})]}{\text{Annual Lighting Energy Savings}}$$

Figure B-3 shows the monthly kWh savings for lighting and HVAC equipment for the weighted average of all building models. HVAC savings are negative during the winter and positive during the summer because of the increased need for heating from the HVAC system during

winter months and the decreased need for cooling in the summer months to maintain temperature set points.

**Figure B-3. Monthly Lighting and HVAC Energy Savings for a Weighted Average of All Models (TMY)**



Source: Navigant analysis

The following is an example IEF<sub>e</sub> calculation for the weighted average of all models using the results shown in Figure B-3.

**Results**

Table B-1 through Table B-3 show the results of Navigant’s energy and demand interactive effects factor study. The results of this study are shown for each individual HVAC type, and then weighted appropriately using weightings from the PECO Baseline Study. Each result is reported as an Act 129 Phase I 2012-specific value using AMY weather data from 2012, and a general Act 129 Phase II value using TMY weather data.

Navigant calculated an IEF<sub>e</sub> above 1.0 for gas-heated homes, and an IEF<sub>e</sub> below 1.0 for electrically heated homes. This is because the HVAC heating penalty is higher than the cooling benefit provided in electrically heated homes with efficient lighting installations. Navigant weighted these results based on HVAC type, for a weighted IEF<sub>e</sub> of 1.010 (TMY) and 1.020 (2012 AMY), shown in Table B-1.

**Table B-1. Energy Interactive Effects Factor Results**

<b>HVAC and Home Type</b>	<b>IEF<sub>a</sub> (TMY)</b>	<b>IEF<sub>a</sub> (2012 AMY)</b>	<b>Weighting %</b>
Single Family – Gas	1.046	1.058	59%
Single Family – Heat Pump	0.865	0.903	11%
Multifamily – Gas	1.042	1.053	24%
Multifamily – Electric Resistance	0.620	0.660	4%
Multifamily – Heat Pump	0.868	0.904	1%
<b>Weighted Average</b>	<b>1.010</b>	<b>1.020</b>	<b>100%</b>

Source: Navigant analysis

Navigant calculated a weighted average summer IEF<sub>a</sub> for all homes. The presence of central and room AC was determined from the baseline study data shown in Table B-2.

**Table B-2. PECO Baseline Study Air Conditioning Prevalence Weightings**

<b>Air Conditioning Prevalence</b>	<b>Single Family % AC</b>	<b>Multifamily % AC</b>
Central AC	76%	45%
Room AC	13%	41%
Unknown	11%	14%

Source: Navigant analysis

Because BEopt is unable to accurately model the presence of room AC units, all homes were modeled with central AC. To account for the presence of room AC, one-third of the model output was used as a conservative estimate of the consumption of a room AC unit relative to a central unit. The model outputs were therefore adjusted according to the following formula:

$$\text{Adjusted Output} = \text{Modeled AC} - (\% \text{ of each model that is room AC} * \text{Modeled AC}) * (2/3)$$

Application of this adjustment yielded a weighted summer IEF<sub>a</sub> of 1.228 (TMY) and 1.194 (2012 AMY), as shown in Table B-3.

**Table B-3. Summer Demand Interactive Effects Factor Results**

HVAC and Home Type	IEF <sub>a</sub> (TRM)	IEF <sub>a</sub> (2012 AMY)	Weighting %
Single Family – Gas	1.239	1.205	59%
Single Family – Heat Pump	1.241	1.202	11%
Multifamily – Gas	1.176	1.169	24%
Multifamily – Electric Resistance	1.170	1.168	4%
Multifamily – Heat Pump	1.171	1.167	1%
<b>Weighted</b>	<b>1.228</b>	<b>1.194</b>	<b>100%</b>

Source: Navigant analysis

### Recommendations

Based on the results of this analysis of the PECO residential CFL/LED lighting HVAC interactive effects factors, the Navigant evaluation team recommends use of the following interactive effects factors when determining PECO’s verified savings for Act 129 compliance for Phase I and Phase II.

**Table B-4. PECO-Verified Residential CFL/LED Lighting HVAC Interactive Effects Factors**

PECO’s Act 129 Phase	IEF <sub>a</sub>	IEF <sub>b</sub>
Phase I (June 1, 2012–May 31, 2013) (Based on 2012 AMY weather file)	1.020	1.194
Phase II (June 1, 2015–May 31, 2016) (Based on TMY weather file)	1.010	1.228

Source: Navigant analysis

Navigant also recommends the next version of the PA TRM be updated to use the above listed Phase II IEF<sub>b</sub> and IEF<sub>a</sub> values for PECO.

Table B-5. List of PECO Model Inputs

Characteristic	Single-Family Gas	Single-Family Heat Pump	Multifamily Gas	Multifamily Electric Resistance	Multifamily Heat Pump
Baseline Weight	59%	11%	24%	4%	1%
Size (sq. ft.)	2,504		1,423		
Floors	1.5		1.5		
Wall Height (ft)	8		8		
Age	45		61		
Beds	3		2		
Heating Set Point (F)	66				
Cooling Set Point	71.8				
Wall Insulation	R-8.2		R-6.9		
Attic Insulation	R-19		R-12.6		
Crawlspace Insulation	Uninsulated, Vented				
Window Area (F/B/L/R sq. ft.)	16, 16, 18, 19		50, 50, 0, 0		
Window Characteristics (U-value, SHGC)	.53, .55				
Infiltration	8 ACH50		10 ACH50		
Lighting (%CFL, %LED, %LFL)	0.19, 0.0, 0.08		0.34, 0.0, 0.05		
Air Conditioning	Central AC, SEER 12	Heat Pump, SEER 12	Central AC, SEER 12	Central AC, SEER 12	Heat Pump, SEER 12
Heating	Furnace, 78% AFUE	ASHP, 7.7 HSPF	Furnace, 78% AFUE	Electric Baseboard	ASHP, 7.7 HSPF
Duct Location	Crawlspace				
Duct Leakage	15%				
DHW	Electric, 0.92 EF				

Additional notes:

- All homes were modeled with a partial finished basement and partial crawlspace.
- All appliances are Building America Benchmark Standards.
- Twenty-eight percent of all homes had electric water heating; all models were created using 100% electric water heating and adjusted accordingly

*Source: PECO 2011 Baseline Study*

## **Appendix C Demand Reduction from Smart Lighting Discount Lamps Installed in Non-residential Facilities**

In accordance with the requirements in Section 2.A.11 of Act 129, which precludes cross-subsidization of measure incentives across customer classes, the evaluation team recognizes the need to account for the non-residential installations of CFL bulbs rebated through PECO's SLD program.

*Based on in-store surveys of customers at the time of purchases ("in-store intercepts") during the PY2 evaluation, the evaluation determined a significant portion of SLD bulbs have been installed in commercial and industrial settings. Bulbs used in nonresidential settings have a substantially higher peak load coincidence factor and hours of use than bulbs used in residential settings. CPITD-verified peak demand reduction as of the end of PY3 has been adjusted to reflect this fact.*

In previous compliance reporting, peak demand reduction from all program bulbs was calculated per the applicable Pennsylvania TRM using the deemed residential peak load coincidence factor of 5 percent and demand in-service rate (ISR<sub>CFL</sub>) of 84 percent for PY3. The data collected from the in-store intercept customer surveys in PY2 indicated that approximately 12.2 percent of SLD program bulbs were installed in commercial settings. Note that this 12.2 percent represents the mean estimate of C&I installations using a weighted average of number of bulbs installed in commercial applications and not the percentage of customers purchasing bulbs. This proportion was relatively consistent across standard CFL and specialty CFL installations.

The evaluation team developed verified savings estimates of savings, addressing comments by the Pennsylvania SWE that, using the 12.2 percent mean estimate of the C&I installations, could overestimate savings.

### **C.1 Magnitude of Percent of Installation**

The estimates of installations in C&I applications are based on findings from the in-store intercept surveys that were completed in PY2. Of the 144 respondents that purchased CFLs and confirmed they would be installed in PECO's service territory, 9 indicated they would be installing at least some of them in a commercial application. Of these nine, three indicated that all purchased CFLs would be installed in a commercial facility and six indicated some would be installed in their residence and some in a commercial facility. Of these six customers, for those that purchased up to twice the average number of bulbs purchased by residential customers,

calculations assume 50 percent of bulbs would be installed in the commercial facility and 50 percent would be installed in the residence. For the commercial customers purchasing more than twice the average number of CFLs purchased by residential only customers (5.14 CFLs), calculations assume that only 5.14 CFLs would be installed in their residence, and the rest would be installed in the commercial facility. Findings yield an estimated mean installation rate in C&I applications of 12.2 percent.

The SWE noted that other studies have shown a lower percentage of utility upstream buy-down program bulbs are installed in commercial or industrial applications. The evaluation team conducted a literature review to compare what the installations in C&I applications are in other jurisdictions. Typical findings showed C&I installation rates closer to 6 percent.

Although it is industry standard practice to apply the mean estimate of evaluation findings to determine verified savings, in this case the evaluation team agrees with the SWE that the 12.2 percent may overestimate the percentage of bulbs being installed in C&I applications. At a 90 percent confidence, the 12.2 percent estimate has an interval of plus or minus 4.5 percent, resulting in a range of 7.7 percent up to 16.7 percent C&I installations. The evaluation team believes the 7.7 percent is likely closer to the real value or at least provides a conservative estimate of the real value. Final verified demand reductions are based on the lower bound of 7.7 percent C&I installation rate.

## **C.2 Determining C&I EFLH and CF**

The SWE commented that installation rates and effective full-load hours (EFLH) and CF should be calculated using a weighted average approach. The evaluation team agrees, and this method was used to calculate C&I EFLH and CF values. C&I EFLH and CF were determined using a weighted average based on number of CFL purchases and the stipulated values from the TRM. For the three customers indicating all CFLs would be installed in a commercial facility, the one customer with the largest purchase of these three did not provide a business type that could be easily mapped to the TRM business types. This customer was included in the calculations for determining total C&I bulb installation percentages, but was excluded from the calculations for average building hours of use and CF so as not to skew the results with information that is based on an unknown building type. Using peak load coincidence factors for CFLs by commercial building type from the TRM, and weighting these coincidence factors by the reported proportions of installation in restaurants, offices, industrial/agricultural, and health care buildings, yielded a C&I peak load coincidence factor of 79 percent and EFLH of 4,532.

### **C.3 Verified Demand Reductions**

To provide verified program savings for PECO's SLD program and accounting for all C&I installations while addressing the SWE comments, the evaluation team applied these PY2 findings using the lower bound of 7.7 % for proportion of bulbs going into C&I facilities and the associated peak load coincidence factor to program bulb sales from PY1-PY3. The residential peak period line loss factor of 1.1916 was applied to the residential proportion of installations, while the small C&I peak line loss factor of 1.111 was applied to the C&I installations. Further, because the C&I algorithms do not include an ISR factor, the evaluation team applied the verified PECO Smart Equipment Incentives (SEI) C&I program realization rates for each program year to the savings calculations for the C&I portion of the rebated CFLs.

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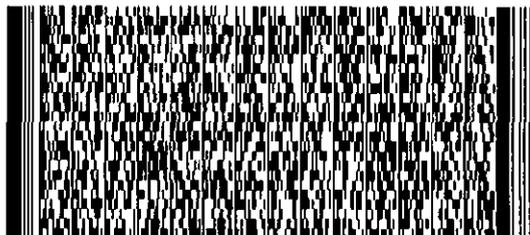


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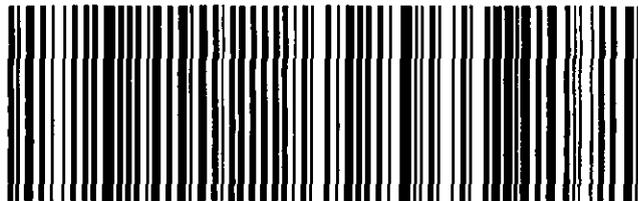
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