PECO
An Exelon Company

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November 14, 2014

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~~ M-2012-2333992
Energy Efficiency and Conservation Program Final Annual Report
June 1, 2013 through May 31, 2014

Dear Secretary Chiavetta:

In accordance with the Commission's Secretarial Letter dated May 25, 2011, enclosed is PECO's 2014 Final Annual Energy Efficiency & Conservation Report for the program year of June 1, 2013 through May 31, 2014. .

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,

RGW

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

enclosure

Final Annual Report
to the
Pennsylvania Public Utility Commission

For the Period
June 2013 through May 2014
Program Year 5

For Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared by Navigant Consulting

For

PECO Energy Company

November 14, 2014

Table of Contents

Acronyms

C&I	Commercial and Industrial
CFL	Compact Fluorescent Lamp
Phase II Verified	Verified/ Ex Post Cumulative Program/Portfolio Phase II Inception to Date
Phase II Reported	Reported/ Ex Ante Cumulative Program/Portfolio Phase II Inception to Date
Phase II+CO	Cumulative Program/Portfolio Phase II Inception to Date including Carry Over Savings from Phase I
CSP	Conservation Service Provider or Curtailment Service Provider
DR	Demand Response
EDC	Electric Distribution Company
EE&C	Energy Efficiency and Conservation
EM&V	Evaluation, Measurement, and Verification
GNI	Government, Nonprofit, and Institutional
HVAC	Heating, Ventilating, and Air Conditioning
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light Emitting Diode
LEEP	Low-Income Energy Efficiency Program
LIURP	Low-Income Usage Reduction Program
M&V	Measurement and Verification
MW	Megawatt
MWh	Megawatt-hour
NTG	Net-to-Gross
PUC	Pennsylvania Public Utility Commission
PY5	Program Year 2013, from June 1, 2013 to May 31, 2014
PY6	Program Year 2014, from June 1, 2014 to May 31, 2015
PY7	Program Year 2015, from June 1, 2015 to May 31, 2016
PYX QX	Program Year X, Quarter X
PYTD	Program Year to Date
SEER	Seasonal Energy Efficiency Rating
SWE	Statewide Evaluator
TRC	Total Resource Cost
TRM	Technical Reference Manual

Report Definitions

Note: Definitions provided in this section are limited to terms that are critical to understanding the values presented in this report. For other definitions, please refer to the Act 129 glossary in Appendix E.

REPORTING PERIODS

Phase I

Refers to the Act 129 programs implemented prior to June 1, 2013. Phase I carryover references verified gross Phase I savings in excess of Act 129 Phase I targets.

Phase II

Refers to the period of time from the start of Phase II Act 129 programs on June 1, 2013 through May 31, 2016. Phase II savings are calculated by totaling all program year results, including the current program year-to-date results and subtracting any Phase II savings that expired during the current program year. For example, Phase II results for PY7 Q3 is the sum of Program Year (PY) 5, PY6, PY7 Q1, PY7 Q2, and PY7 Q3 results, minus any Phase II savings that expired during PY5, PY6, or PY7.

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 PY7 Q3 will include only results that occurred during PY7 Q1, PY7 Q2, and PY7 Q3; they will not include results from PY5 or PY6.

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 electric distribution company [EDC] or the program implementer). Also known as ex ante, or "before the fact" savings (using the annual evaluation activities as the reference point for the post period).

Adjusted Ex Ante Gross

References to Adjusted Ex Ante Gross (or Adjusted Ex Ante) savings in this report refer to reported gross savings from the EDC's tracking system that have been adjusted, where necessary, to reflect differences between the methods used to record and track savings and the methods in the Technical Reference Manual (TRM), or to correct data capture errors. These corrections are made to the population, prior to EM&V activities. The adjusted ex ante gross savings are then verified through EM&V activities.

Verified Gross

Refers to the verified gross savings results of the program or portfolio determined by the evaluation activities. Also known as ex post, or "after the fact" savings (using the annual evaluation activities as the reference point for the post period).

TOTAL RESOURCE COST COMPONENTS[1]

Administration, Management, and Technical Assistance Costs

Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

EDC Costs

Per the Pennsylvania PUC 2013 Total Resource Cost (TRC) Test Order, the total EDC costs refer to EDC-incurred expenditures only. This includes, but is not limited to, administration, management, technical assistance, design & development of Energy Efficiency and Conservation (EE&C) Plans and programs, marketing, evaluation, and incentives.

Participant Costs

Participant Costs as defined by the 2013 Total Resource Cost Test Order.

Total TRC Costs

Total TRC Costs as defined by the 2013 Total Resource Cost Test Order.

Total TRC Benefits

Benefits as defined by the 2013 Total Resource Cost Test Order.

[1] All Total Resource Cost definitions are subject to the Pennsylvania PUC 2013 Total Resource Cost Test Order.

1 Overview of Portfolio

Pennsylvania Act 129 of 2008 (Act 129), which was signed on October 15, 2008, mandated energy savings and demand reduction goals for the largest electric distribution companies (EDCs) in Pennsylvania for Phase I (2008 through 2013). In 2009, each EDC submitted energy efficiency and conservation (EE&C) plans pursuant to these goals, which were approved by the Pennsylvania Public Utility Commission (PUC). Each EDC filed new EE&C plans with the PUC in 2012 for Phase II (June 2013 through May 2016) of the Act 129 programs. The PUC approved these plans in 2013.

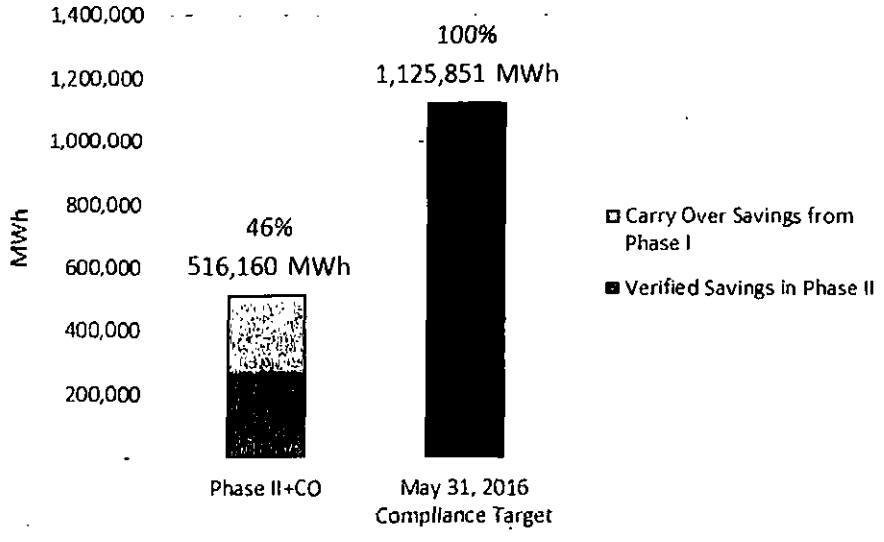
Implementation of Phase II Act 129 programs began June 1, 2013. This report documents the progress and effectiveness of the Phase II EE&C accomplishments for PECO in Program Year 5 (PY5), defined as June 1, 2013 through May 31, 2014, as well as the cumulative accomplishments of the programs since inception of Phase II. This report additionally documents the energy savings carried over from Phase I. The Phase I carry-over savings count toward EDC savings compliance targets for Phase II.

Navigant Consulting, Inc. (Navigant) evaluated the programs, which included measurement and verification of the savings.

1.1 Summary of Progress Toward Compliance Targets

PECO has achieved 46 percent of the energy savings compliance target, based on cumulative portfolio Phase II inception to date including carryover savings from Phase I ("Phase II+CO") verified gross energy savings, as shown in Figure 1-1.

Figure 1-1: Cumulative Portfolio Phase II Inception to Date Verified Gross Energy Impacts



Source: Navigant analysis

According to the Phase II Implementation Order, PECO is allowed by the PUC to "carry over" into Phase II the Phase I verified energy savings that exceeded the Phase I compliance target. Table 1-1 shows how many MWh/yr of savings from Phase I that PECO is carrying over into Phase II.

Table 1-1: Savings from PY4 Carried Into Phase II

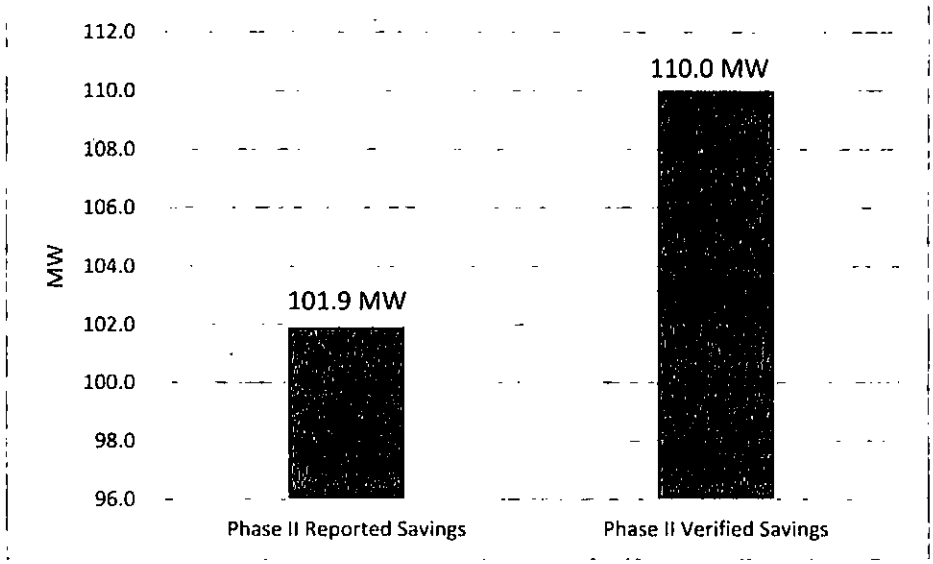
Sector	Phase II Verified Savings (MWh/Yr)	Verified Savings Carried Over from Phase 1 (MWh/Yr)	Phase II+CO Verified Savings (MWh/Yr)
Residential	119,742	109,888	229,630
Commercial and Industrial	81,159	54,944	136,103
GNI	72,467	77,961	150,428
Total	273,367	242,793	516,160

Source: Navigant analysis

PECO has achieved 110.0 megawatts (MW) of gross verified demand reduction during PY5[2].

[2] Unlike Phase I, there is no compliance target for demand reduction in Phase II.

Figure 1-2: Phase II Portfolio Reported and Verified Demand Reduction



Source: Navigant analysis

Eighteen measures are available at no cost to low-income customers. These measures offered to the low-income sector comprise 16 percent of the total measures offered. As required by the Phase II goal, this exceeds the fraction of the electric consumption of the utility's low-income households divided by the total electricity consumption in the PECO territory by (7.2 percent).[3] These values are shown in Table 1-2 and Table 1-3.

Table 1-2: Low-Income Sector Compliance (Number of Measures)

	Low-Income Sector	All Sectors	% Low-Income	Goal
# of Measures Offered	18	113	16%	8.8%

Source: Navigant analysis; PUC Staff and SWE Team, Memo Re: Act 129 Low-Income Measure Reporting – Clarification, October 10, 2012

[3] 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).

Table 1-3: Low-Income Sector Compliance (Percentage of Savings)

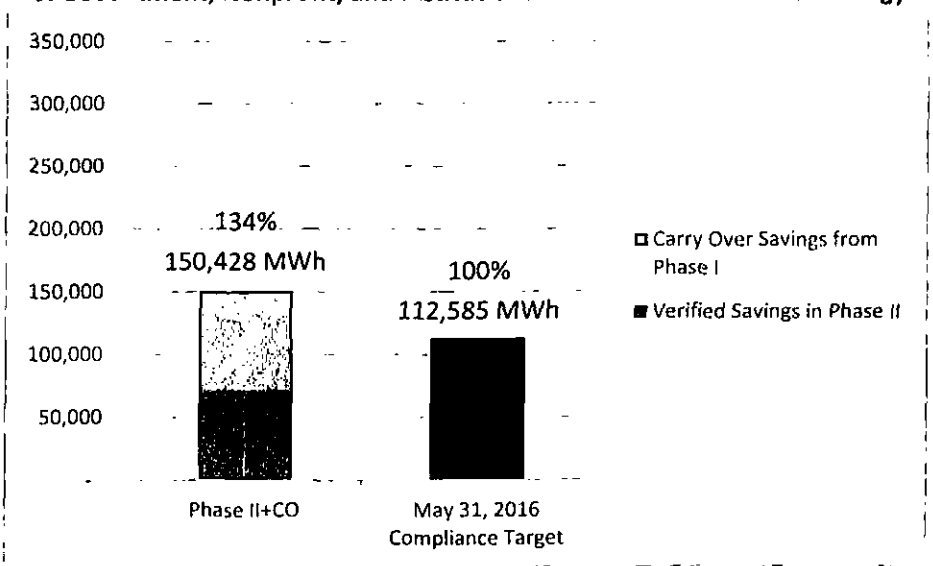
	Low-Income Verified Savings from Low-Income *Programs* (MWh/Yr)	Low-Income Verified Savings from Other Residential *Programs* (MWh/Yr)	All Low-Income Verified Savings [Sum of First *Two Columns*]	Progress Toward Low-Income Goal [Previous Column Divided by Phase II MWh Target]	Goal
Phase II Verified Gross Energy Savings	16,764	10,085	26,849	2.4%	4.5%

Source: Navigant analysis; PUC Staff and SWE Team, Memo Re: Act 129 Low-Income Measure Reporting – Clarification, October 10, 2012

The Phase II verified gross energy savings achieved through programs specifically designed for income-eligible customers are 16,764 megawatt-hours per year (MWh/yr) and 10,085 MWh/yr through other programs; this is 2.4 percent against the 4.5 percent Phase II total portfolio verified gross energy savings target for the low-income sector.

PECO achieved 134 percent of the May 31, 2016 energy reduction compliance target for the government, nonprofit, and institutional sector based on cumulative program/portfolio savings from Phase II+CO verified gross energy savings achieved from the inception of Phase II through PY5 and including carry-over savings from Phase I, as shown in Figure 1-3.

Figure 1-3: Government, Nonprofit, and Institutional Sector Phase II Verified Energy Impacts



Source: Navigant analysis

A summary of number of participants, Phase II verified gross energy savings (MWh/yr), Phase II demand reduction (MW), and incentives paid ($1,000) are shown in Table 1-4.

Table 1-4: Summary of Phase II Performance by Sector

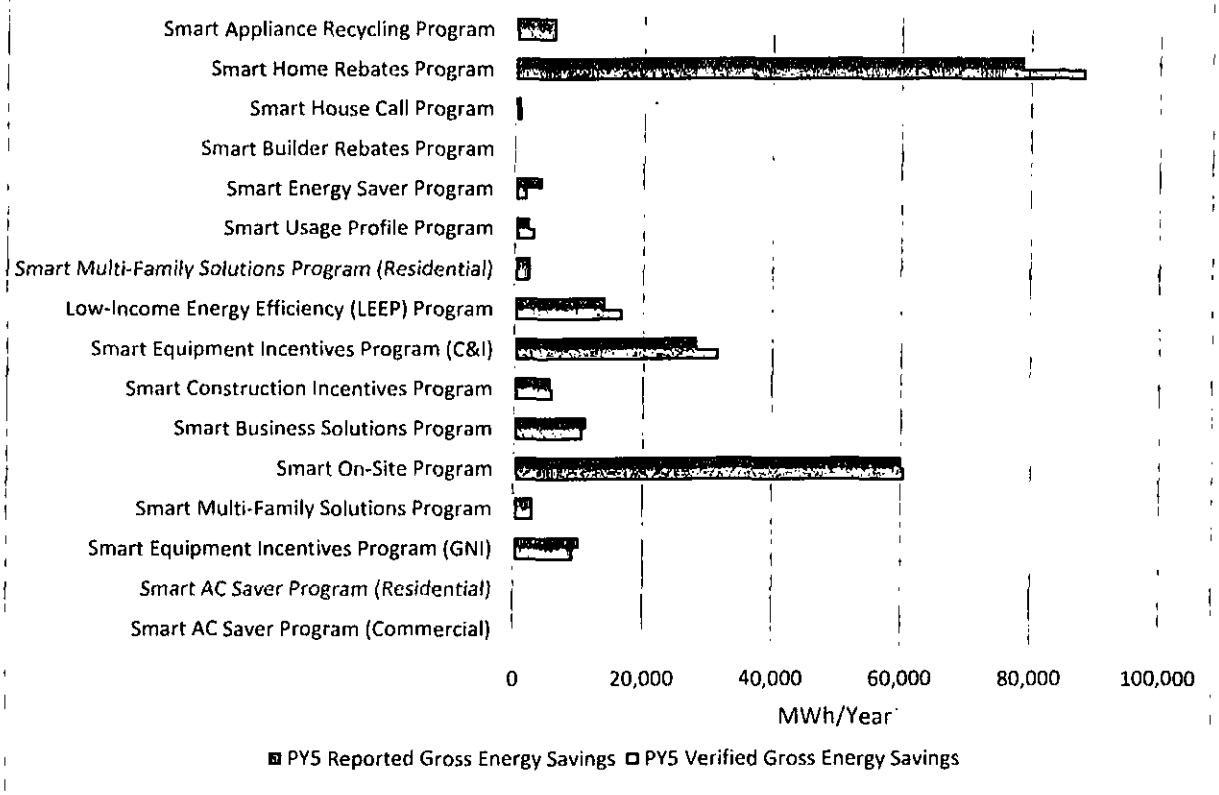
Sector	Participants	Phase II Gross Verified Energy Savings (MWh/yr)	Phase II Gross Verified Demand Reduction (MW)	Incentives ($1,000)
Residential	155,257	92,892	79.0	$ 13,280
Low-Income	34,828	26,849	2.2	$ 746
Small Commercial and Industrial	408	10,200	2.7	$ 1,421
Large Commercial and Industrial	2,606	70,958	16.7	$ 3,067
Government, Nonprofit, and Institutional	134	72,467	9.5	$ 60,895
Program Year 5 Total	193,233	273,367	110.0	$ 24,827
Phase II Total	193,233	273,367	110.0	$ 24,827
Note: Totals may not equal the sum of the sectors due to rounding. All demand values include a line loss factor.				

Source: Navigant analysis

1.2 Summary of Energy Impacts

A summary of the reported and verified energy savings by program for PY5 is presented in Figure 1-4.

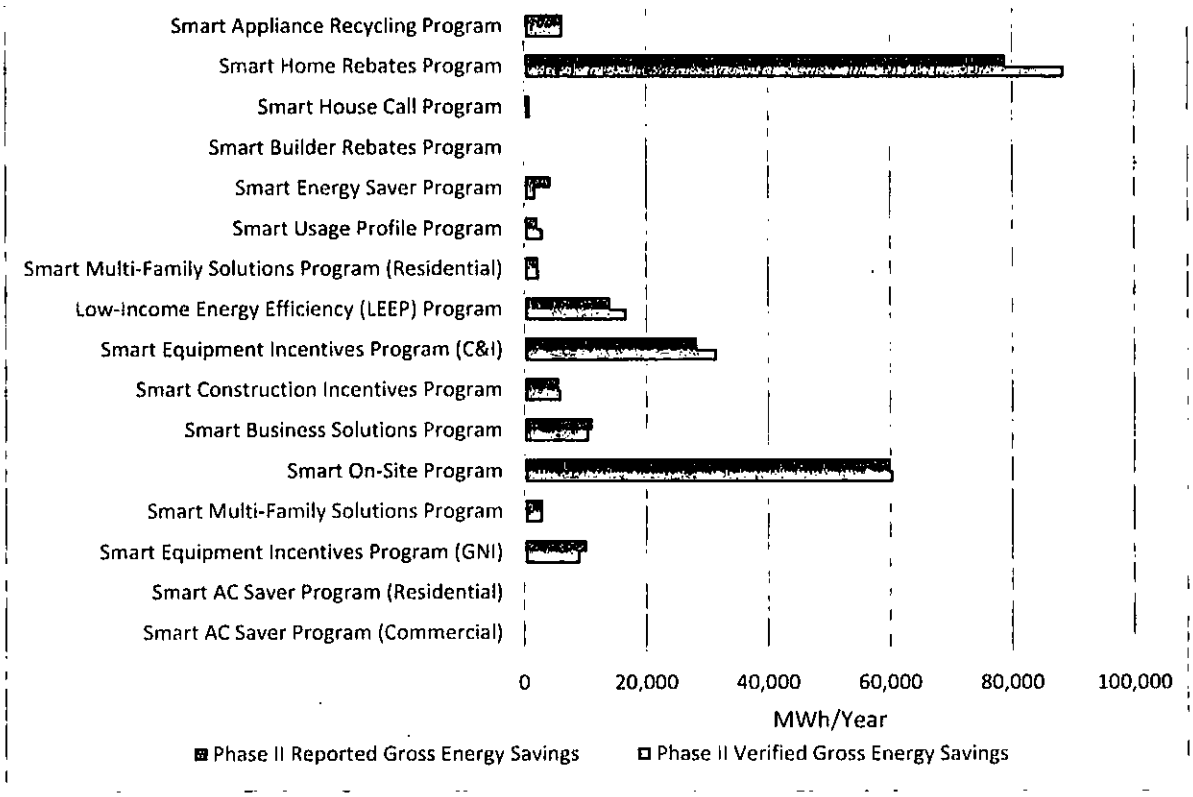
Figure 1-4: PY5 Reported and Verified Gross Energy Savings by Program (MWh/ yr)



Source: Navigant Analysis

A summary of the Phase II reported and verified energy savings by program is presented in Figure 1-5. It should be noted that PY5 is currently the only completed PY in Phase II, and thus Figure 1-4 and Figure 1-5 match exactly.

Figure 1-5: Phase II Reported and Verified Gross Energy Savings by Program (MWh/ yr)



Source: Navigant analysis

Summaries of energy impacts by program through PY5 are presented in Table 1-5 and Table 1-6 .

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

Program	Participants		Reported Gross Impact (MWh/Yr)	
	PYTD	Phase II	PYTD	Phase II
Residential	**112,518**	**112,518**	**109,185**	**109,185**
Smart Appliance Recycling Program	7,109	7,109	6,337	6,337
Smart Home Rebates Program [1]	12,109	12,109	78,840	78,840
Smart House Call Program	1,182	1,182	954	954
Smart Builder Rebates Program	2	2	5	5
Smart Energy Saver Program	12,584	12,584	4,300	4,300
Smart Usage Profile Program	40,000	40,000	2,247	2,247
Smart Multi-Family Solutions Program (Residential)	6,445	6,445	2,374	2,374
Low-Income Energy Efficiency (LEEP) Program [2]	33,087	33,087	14,127	14,127
Non-Residential (Commercial and Industrial)	**1,021**	**1,021**	**51,168**	**51,168**
Smart Equipment Incentives Program (C&I) – Retrofit	329	329	28,225	28,225
Smart Equipment Incentives Program (C&I) - Appliance Recycling	43	43	43	43
Smart Construction Incentives Program (C&I)	22	22	3,538	3,538
Smart Business Solutions Program (C&I)	408	408	10,688	10,688
Smart On-Site Program (C&I)	0	0	0	0
Smart Multi-Family Solutions Program (C&I)	219	219	2,801	2,801
Nonresidential Participation in Smart Home Rebates [3]	0	0	5,874	5,874
Non-Residential (Government, Nonprofit, Institutional) [4]	**134**	**134**	**72,845**	**72,845**
Smart Equipment Incentives Program (GNI)	*101*	*101*	*10,173*	*10,173*
Smart Construction Incentives Program (GNI)	7	7	2,127	2,127
Smart Business Solutions Program (GNI)	9	9	439	439
Smart On-Site Program (GNI)	2	2	59,945	59,945
Smart Multi-Family Solutions Program (GNI)	15	15	160	160
Demand Reduction	**74,759**	**74,759**	**0**	**0**
Smart AC Saver Program (Residential) [5]	*72,766*	*72,766*	*0*	*0*
Smart AC Saver Program (Commercial) [5]	1,993	1,993	0	0
TOTAL PORTFOLIO [6]	**118,432**	**118,432**	**233,197**	**233,197**
Carry Over Savings from Phase I			**242,793**	**242,793**
Total Phase II+Q+CO			**475,990**	**475,990**

[1] Smart Home Rebate program participant values exclude sales of CFLs, ENERGY STAR lighting fixtures, and LED lamps, for which upstream rebates are provided.
[2] The LEEP participation numbers do not match the Q4 report because the Q4 report only includes component 1 participants; this LEEP value includes all four components for participation.
[3] Nonresidential participation in Smart Home Rebates has reported gross impact based on store intercept surveys, but no participation because participation was tracked in the Smart Home Rebates program.
[4] Certain programs have been separated into the GNI and C&I sectors.
[5] Smart AC Saver Program participation does not match Q4 report because Q4 report was incorrect.
[6] Summing the participants at the portfolio level may not make sense based on how participation is defined in each program; however, it is shown here based on the template.

Source: Navigant analysis

Table 1-6: Verified Gross Energy Savings by Program

Program	PY5 Reported Gross Energy Savings (MWh/Year)	PY5 Energy Realization Rate	PY5 Verified Gross Energy Savings (MWh/Year)	PY5 Achieved Precision[1]	Phase II Verified Gross Energy Savings (MWh/Year)	Phase II Achieved Precision [2]
Residential	***109,184***		***119,742***		***119,742***	
Smart Appliance Recycling Program	6,337	0.99	6,268	0%	6,268	0%
Smart Home Rebates Program	78,840	1.12	88,426	7%	88,426	9%
Smart House Call Program	954	1.03	987	0%	987	0%
Smart Builder Rebates Program	5	0.99	5	0%	5	0%
Smart Energy Saver Program	4,300	0.43	1,848	2%	1,848	2%
Smart Usage Profile Program [3]	2,247	N/A	3,068	0%	3,068	0%
Smart Multi-Family Solutions Program (Residential)	2,374	1.00	2,374	0%	2,374	0%
Low-Income Energy Efficiency (LEEP) Program	14,127	1.19	16,764	0.2%	16,764	0.2%
Non-Residential (Commercial and Industrial)	**51,168**		**81,159**		**81,159**	
Smart Equipment Incentives Program (C&I) - Retrofit	28,225	1.12	31,504	16%	31,504	18%
Smart Equipment Incentives Program (C&I) - Appliance Recycling	43	1.00	43	N/A	43	N/A
Smart Construction Incentives Program (C&I)	3,538	1.06	3,741	14%	3,741	16%
Smart Business Solutions Program (C&I)	10,688	0.95	10,200	6%	10,200	8%
Smart On-Site Program (C&I)	0	1.01	0	0%	0	0%
Smart Multi-Family Solutions Program (C&I)	2,801	1.00	2,801	0%	2,801	0%
Nonresidential Participation in Smart Home Rebates	5,874	5.60	32,870	N/A	32,870	N/A
Non-Residential (Government, Nonprofit, Institutional) [4]	**72,845**		**72,467**		**72,467**	
Smart Equipment Incentives Program (GNI)	10,173	0.90	9,174	6%	9,174	7%
Smart Construction Incentives Program (GNI)	2,127	1.06	2,286	14%	2,286	16%
Smart Business Solutions Program (GNI)	439	0.95	419	6%	419	8%
Smart On-Site Program (GNI)	59,945	1.01	60,427	0%	60,427	0%

Program	PY5 Reported Gross Energy Savings (MWh/Year)	PY5 Energy Realization Rate	PY5 Verified Gross Energy Savings (MWh/Year)	PY5 Achieved Precision[1]	Phase II Verified Gross Energy Savings (MWh/Year)	Phase II Achieved Precision [2]
Smart Multi-Family Solutions Program (GNI)	160	1.00	160	0%	160	0%
Demand Reduction	**N/A**		**N/A**		**N/A**	
Smart AC Saver Program (Residential)	N/A	N/A	N/A	N/A	N/A	N/A
Smart AC Saver Program (Commercial)	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL PORTFOLIO	**233,197**	**1.17**	**273,367**	**N/A**	**273,367**	**2.1%**
Phase I Carryover	**N/A**	**N/A**	**N/A**	**N/A**	**242,793**	**N/A**
Total Phase II+CO	**N/A**	**N/A**	**N/A**	**N/A**	**516,160**	**N/A**

[1] At the 85% confidence level

[2] At the 90% confidence level

[3] For the SUP program, no ex ante savings estimate is produced during program implementation. Both reported savings and verified savings are determined via an ex post billing analysis performed by the implementation contractor (OPower) and evaluator (Navigant), respectively. Therefore, no realization rate is calculated or presented.

[4] Certain programs have been separated into the GNI and C&I sectors.

Source: Navigant analysis

1.3 Summary of Fuel-Switching Impacts

PECO customers conducted a small number of projects in PY5 in which services originally provided by electricity were converted to run on natural gas. Table 1-7 summarizes the numbers and electricity savings resulting from these projects. The fuel switching projects were conducted in PECO's Smart Home Rebates (SHR) and Smart On-Site (SOS) programs.

Table 1-7. Summary of Fuel-switching Impacts

Program Name	Technology	Number of Projects	Electric Consumption Savings (MWh)	Rebates Paid ($1,000)	Percentage of Fuel Switching Participants/Total Participants
Smart Home Rebates Program	Electric Furnace High-Efficiency Gas Furnaces	127	2,449	$127	1.34%
	Air Source Heat Pump to Gas	15	160	$8	
	Domestic Hot Water to Gas	5	16	$1	
	Electric to Natural Gas Clothes Dryer	15	14	$2	
Smart On-Site Program	Combined Heat and Power	2	60,427	$4,993	100%

Source: Navigant analysis

Smart Home Rebates

The SHR program offers four types of fuel-switching residential measures:

- Electric heat to gas heat (furnace)
- Electric heat to gas/propane or oil heat (air source heat pump to gas)
- Domestic hot water heater to gas
- Electric to natural gas clothes dryer

About one percent of total SHR participants installed a fuel-switching measure. However, the majority of these participants were residents of a single multi-family facility. The owner of the latter facility worked directly with SHR program staff to develop this project. This single facility constituted approximately 25 percent of non-lighting savings for this program.

Total energy savings for SHR fuel-switching measures was 2,639 MWh in PY5. None of the fuel-switching measures yielded demand savings. The ex ante and verified savings were based on the 2013 TRM[4] algorithms. The total value of SHR rebates for fuel-switching measures was $138,000.

Smart On-Site

PECO's SOS program provides incentives for customers to install combined heat and power (CHP) systems. These systems primarily shift electrical loads from the power grid to an on-site generator. However, to the degree that the heat recovered from these systems displaces thermal loads previously served by

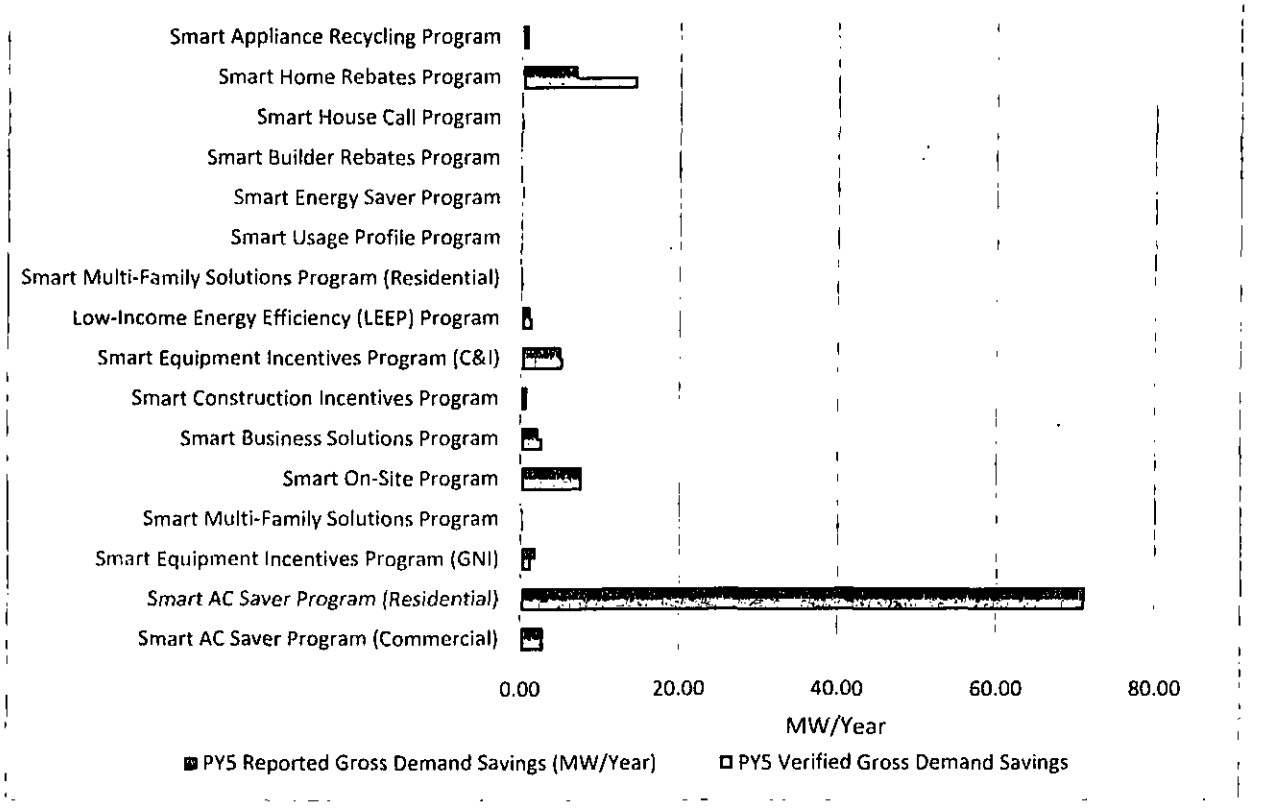
[4] Pennsylvania Public Utility Commission, "Technical Reference Manual," June 2013.

electricity, they can be considered to be fuel-switching projects. The SOS program completed two projects in PY5, one at a hospital and one at a municipal wastewater processing plant. Neither system displaced thermal loads previously served by electricity. The projects were evaluated using custom methods.

1.4 Summary of Demand Impacts

A summary of the reported and verified demand reduction by program for PY5 is presented in Figure 1-6. The impacts below reflect the line loss factors shown in Table 1-12. All demand values include a line loss factor.

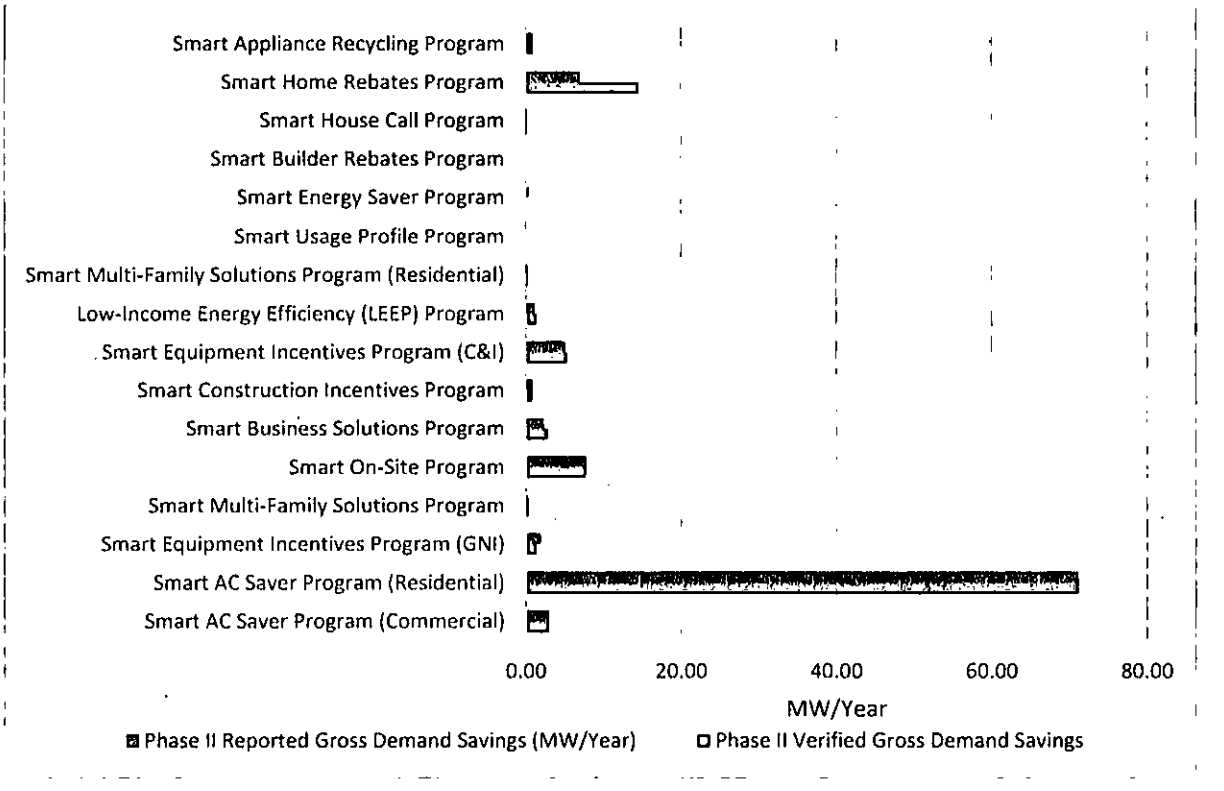
Figure 1-6: PY5 Reported and Verified Demand Reduction by Program



Source: Navigant analysis

A summary of the cumulative reported and verified demand reduction by program is presented in Figure 1-7.

Figure 1-7: Phase II Reported and Verified Demand Reduction by Program



Source: Navigant analysis

A summary of demand reduction impacts by program through PY5 is presented in Table 1-8 and Table 1-9.

Table 1-8: Reported Participation and Gross Demand Reduction by Program

Program	Participants		Reported Gross Impact (MW)	
	PY5	Phase II	PY5	Phase II
Residential	**112,518**	**112,518**	**9.6**	**9.6**
Smart Appliance Recycling Program [1]	7,109	7,109	0.9	0.9
Smart Home Rebates Program [2]	12,109	12,109	7.0	7.0
Smart House Call Program	1,182	1,182	0.1	0.1
Smart Builder Rebates Program	2	2	0.0	0.0
Smart Energy Saver Program	12,584	12,584	0.3	0.3
Smart Usage Profile Program	40,000	40,000	0.0	0.0
Smart Multi-Family Solutions Program (Residential)	6,445	6,445	0.2	0.2
Low-Income Energy Efficiency (LEEP) Program [3]	33,087	33,087	1.1	1.1
Non-Residential (Commercial and Industrial)	**1,021**	**1,021**	**8.3**	**8.3**
Smart Equipment Incentives Program (C&I) - Retrofit	329	329	5.0	5.0
Smart Equipment Incentives Program (C&I) - Appliance Recycling	43	43	0.0	0.0
Smart Construction Incentives Program (C&I)	22	22	0.6	0.6
Smart Business Solutions Program (C&I)	408	408	2.2	2.2
Smart On-Site Program (C&I)	0	0	0.0	0.0
Smart Multi-Family Solutions Program (C&I)	219	219	0.2	0.2
Nonresidential Participation in Smart Home Rebates [4]	0	0	0.3	0.3
Non-Residential (Government, Nonprofit, Institutional) [5]	**134**	**134**	**10.0**	**10.0**
Smart Equipment Incentives Program (GNI)	101	101	1.9	1.9
Smart Construction Incentives Program (GNI)	7	7	0.3	0.3
Smart Business Solutions Program (GNI)	9	9	0.1	0.1
Smart On-Site Program (GNI)	2	2	7.8	7.8
Smart Multi-Family Solutions Program (GNI)	15	15	0.0	0.0
Demand Reduction	**74,759**	**74,759**	**74.0**	**74.0**
Smart AC Saver Program (Residential) [6]	72,766	72,766	71.1	71.1
Smart AC Saver Program (Commercial) [6]	1,993	1,993	2.9	2.9
TOTAL PORTFOLIO [7]	188,432	188,432	101.9	101.9

[1] Smart Home Rebate program participants are counted as JACO Orders & = Q4 report. For sampling and other purposes Participation counted as 7,484 units recycled.
[2] SHR participant values exclude sales of CFLs, ENERGY STAR lighting fixtures, and LED lamps, for which upstream rebates are provided.
[3] The reported gross impact value for the Low-Income Energy Efficiency Program does not match the value in the Q4 report because the Q4 report did not include the line loss factor for LEEP.
[4] Nonresidential participation in Smart Home Rebates has reported gross impact based on store intercept surveys, but no participation because participation was tracked in the Smart Home Rebates program.
[5] Certain programs have been separated into the GNI and C&I sectors.
[6] Smart AC Saver Program participation does not match Q4 report because Q4 report was incorrect.
[7] Summing the participants at the portfolio level may not make sense based on how participation is defined in each program; however, it is shown here based on the template.
All demand values include a line loss factor.

Source: Navigant analysis

Table 1-9: Verified Gross Demand Reduction by Program

Program	PY5 Reported Gross Demand Savings (MW/Yr)	PY5 Demand Realization Rate	PY5 Verified Gross Demand Savings (MW/Yr)	PY5 Achieved Precision[1]	Phase II Verified Gross Demand Savings (MW/Yr)	Phase II Achieved Precision[2]
Residential	**9.6**	**N/A**	**17.2**	**N/A**	**17.2**	**N/A**
Smart Appliance Recycling Program	0.9	0.99	0.8	0.0%	0.8	0.0%
Smart Home Rebates Program	7.0	2.09	14.6	12.5%	14.6	14.3%
Smart House Call Program	0.1	1.11	0.1	0.0%	0.1	0.0%
Smart Builder Rebates Program	0.0	1.08	0.0	0.0%	0.0	0.0%
Smart Energy Saver Program	0.3	0.27	0.1	4.2%	0.1	N/A
Smart Usage Profile Program	0.0	0.00	0.0	0.0%	0.0	N/A
Smart Multi-Family Solutions Program (Residential)	0.2	1.00	0.2	0.0%	0.2	0.0%
Low-Income Energy Efficiency (LEEP) Program	1.1	1.22	1.4	0.2%	1.4	0.2%
Non-Residential (Commercial and Industrial)	**8.3**	**N/A**	**9.4**	**N/A**	**9.4**	**N/A**
Smart Equipment Incentives Program (C&I) - Retrofit	5.0	1.05	5.3	15.1%	5.3	18.3%
Smart Equipment Incentives Program (C&I) - Appliance Recycling	0.0	1.00	0.0	N/A	0.0	N/A
Smart Construction Incentives Program (C&I)	0.6	1.01	0.5	34.9%	0.5	40.5%
Smart Business Solutions Program (C&I)	2.2	1.24	2.7	7.0%	2.7	8.2%
Smart On-Site Program (C&I)	0.0	0.99	0.0	0	0.0	0.0%
Smart Multi-Family Solutions Program (C&I)	0.2	1.00	0.2	0.0%	0.2	0.0%
Nonresidential Participation in Smart Home Rebates	0.3	2.09	0.7	12.5%	0.7	N/A
Non-Residential (Government, Nonprofit, Institutional)	**10.0**	**N/A**	**9.4**	**N/A**	**9.4**	**N/A**
Smart Equipment Incentives Program (GNI)	1.9	0.70	1.3	38.4%	1.3	44.2%
Smart Construction Incentives Program (GNI)	0.3	1.01	0.3	34.9%	0.3	40.5%
Smart Business Solutions Program (GNI)	0.1	1.24	0.1	7.0%	0.1	8.2%
Smart On-Site Program (GNI)	7.8	0.99	7.7	0.0%	7.7	0.0%
Smart Multi-Family Solutions Program (GNI)	0.0	1.00	0.0	0.0%	0.0	0.0%
Demand Reduction	**74.0**	**N/A**	**74.0**	**N/A**	**74.0**	**N/A**
Smart AC Saver Program (Residential)	71.1	1.00	71.1	0.0%	71.1	N/A
Smart AC Saver Program (Commercial)	2.9	1.00	2.9	0.0%	2.9	N/A
TOTAL PORTFOLIO	**101.9**	**1.08**	**110.0**	**N/A**	**110.0**	**1.1%**
Phase I Carryover	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Total Phase II+CO	**101.9**	**1.08**	**110.0**	**N/A**	**110.0**	**N/A**

[1] At the 85% confidence level
[2] At the 90% confidence level
All demand values include a line loss factor.

Source: Navigant analysis

1.5 Summary of Program Year 5 Net-to-Gross Ratios

Per the 2013 TRC Order, EDCs are required to conduct net-to-gross (NTG) research. NTG ratios are not applied to gross savings and are not used for compliance purposes, but are used for cost effectiveness reporting and future program planning purposes. Table 1-10 presents a summary of NTG ratios by program.

Table 1-10: Program Year 5 NTG Ratios by Program

Program Name	Free Ridership	Spillover	Net To Gross Ratio PY5	NTG Categories Included[1]
Residential				
Smart Appliance Recycling Program	0.7	N/A	0.3	FR
Smart Home Rebates Program	0.6	0.05	0.5	FR, PS, NPS
Smart House Call Program	0.2	0.13	0.9	FR, PS, NPS
Smart Builder Rebates Program	N/A	N/A	N/A	N/A
Smart Energy Saver Program	N/A	N/A	N/A	N/A
Smart Usage Profile Program	N/A	N/A	N/A	N/A
Smart Multi-Family Solutions Program (Residential)	N/A	N/A	N/A	N/A
Low-Income Energy Efficiency (LEEP) Program	0	0	1.0	N/A
Non-Residential				
Smart Equipment Incentives Program (C&I)	0.3	0.03	0.7	FR, PS
Smart Construction Incentives Program[2]	N/A	N/A	N/A	N/A
Smart Business Solutions Program	0.1	0.00	0.9	FR, PS
Smart On-Site Program	0.2	0.00	0.8	FR, PS
Smart Multi-Family Solutions Program	N/A	N/A	N/A	N/A
Non-Residential (Government, Nonprofit, Institutional)				
Smart Equipment Incentives Program (GNI)	0.7	0.03	0.4	FR, PS
Demand Reduction				
Smart AC Saver Program (Residential)	N/A	N/A	N/A	N/A
Smart AC Saver Program (Commercial)	N/A	N/A	N/A	N/A
PORTFOLIO (weighted by program savings for programs reporting NTG ratios)	0.4	0.03	0.7	**FR, PS, NPS**

[1] For example, free ridership, nonparticipant spillover, and participant spillover.
[2] Navigant did not evaluate free ridership or spillover for the Smart Construction Incentives program in PY5.

Source: Navigant analysis

1.6 Summary of Portfolio Finances and Cost-Effectiveness

A breakdown of the portfolio finances is presented in Table 1-11.

Table 1-11: Summary of Portfolio Finances

	Actual PY5 Costs ($1,000)	Actual Phase II Costs ($1,000)
EDC Incentives to Participants	$24,762	$24,762
EDC Incentives to Trade Allies	$65	$65
Subtotal EDC Incentive Costs	$24,827	$24,827
Design & Development	$0	$0
Administration, Management, and Technical Assistance[1]	$27,930	$27,930
Marketing[2]	$4,084	$4,084
Subtotal EDC Implementation Costs	$32,014	$32,014
EDC Evaluation Costs	$2,410	$2,410
SWE Audit Costs	$0	$0
Total EDC Costs[3]	$59,251	$59,251
Participant Costs[4]	$106,460	$106,460
Total NPV TRC Costs[5]	**$140,885**	**$140,885**
Total NPV Lifetime Energy Benefits	$175,355	$175,355
Total NPV Lifetime Capacity Benefits	$21,299	$21,299
Total NPV TRC Benefits[6]	**$207,526**	**$207,526**
TRC Ratio[7]	**1.47**	**1.47**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer. For the SOS program, Participant Costs include the net present value of 15 years of increased fuel consumption costs. This cost amounts to $13.04 million for the two projects completed in PY5.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
Note that the values in this table are not always the summation of the corresponding program-level values due to some overall costs applied only at the portfolio level.

Source: Navigant analysis

1.7 Summary of Cost-Effectiveness by Program

TRC benefit-cost ratios are calculated by comparing the total NPV TRC benefits and the total NPV TRC costs. Table 1-12 shows the TRC ratios by program and other key factors used in the TRC ratio calculation for Phase II programs.

Table 1-12: PYTD TRC Ratios by Program

Program	TRC NPV Benefits ($1000)	TRC NPV Costs ($1000)	TRC Benefit-Cost Ratio	Discount Rate	Energy Line Loss Factor	Demand Line Loss Factor
Residential						
Smart Appliance Recycling Program	$ 4,503	$ 947	4.8	7.60%	1.076	1.1916
Smart Home Rebates Program	$ 73,982	$ 32,949	2.3	7.60%	1.076	1.1916
Smart House Call Program	$ 815	$ 2,139	0.4	7.60%	1.076	1.1916
Smart Builder Rebates Program	$ 6	$ 252	0.0	7.60%	1.076	1.1916
Smart Energy Saver Program	$ 1,508	$ 417	3.6	7.60%	1.076	1.1916
Smart Usage Profile Program	$ 319	$ 583	0.6	7.60%	1.076	1.1916
Smart Multi-Family Solutions Program (Residential)	$ 1,786	$ 976	1.8	7.60%	1.076	1.1916
Low-Income Energy Efficiency (LEEP) Program	$ 12,019	$ 5,971	2.0	7.60%	1.076	1.1916
Non-Residential						
Smart Equipment Incentives Program (C&I)	$ 22,914	$ 10,848	2.1	7.60%	1.076	1.111
Smart Construction Incentives Program	$ 4,979	$ 3,304	1.5	7.60%	1.076	1.111 (C&I)/1.117 (GNI)
Smart Business Solutions Program	$ 9,773	$ 3,191	3.1	7.60%	1.076	1.111 (C&I)/1.117 (GNI)
Smart On-Site Program	$ 42,523	$ 62,706	0.7	7.60%	1.076	1.111 (C&I)/1.117 (GNI)
Smart Multi-Family Solutions Program	$ 1,365	$ 1,218	1.1	7.60%	1.076	1.111 (C&I)/1.117 (GNI)
Non-Residential (Government, Nonprofit, Institutional)						
Smart Equipment Incentives Program (GNI)	$ 6,363	$ 5,032	1.3	7.60%	1.076	1.117
Demand Reduction						
Smart AC Saver Program (Residential)	$ 24,104	$ 6,923	3.5	7.60%	1.076	1.1916
Smart AC Saver Program (Commercial)	$ 567	$ 314	1.8	7.60%	1.076	1.1916

Source: Navigant analysis

1.8 Comparison of Program Year 5 Performance to Approved EE&C Plan

Table 1-13 below shows Program Year 5 expenditures compared to the budget estimates set forth in the EE&C plan.

Table 1-13: Comparison of Program Expenditures to EE&C Plan

Program	Budget from EE&C Plan (million $)	Actual Expenditures (million $)	% Difference from EE&C Plan [(Planned - Actual)/Planned]
Residential			
Smart Appliance Recycling Program	$ 1.5	$ 0.9	37%
Smart Home Rebates Program	$ 13.9	$ 10.4	25%
Smart House Call Program	$ 4.4	$ 2.0	56%
Smart Builder Rebates Program	$ 0.5	$ 0.2	54%
Smart Energy Saver Program	$ 0.5	$ 0.4	23%
Smart Usage Profile Program	$ 0.6	$ 0.6	3%
Smart Multi-Family Solutions Program (Residential)	$ 1.1	$ 1.0	11%
Low-Income Energy Efficiency (LEEP) Program	$ 6.7	$ 6.0	11%
Non-Residential			
Smart Equipment Incentives Program (C&I)	$ 10.2	$ 6.4	37%
Smart Construction Incentives Program	$ 3.2	$ 1.6	49%
Smart Business Solutions Program	$ 1.3	$ 1.9	-47%
Smart On-Site Program	$ 5.7	$ 5.3	6%
Smart Multi-Family Solutions Program [1]	$ 0.9	$ 0.9	-4%
Non-Residential (Government, Nonprofit, Institutional)			
Smart Equipment Incentives Program (GNI)	$ 6.3	$ 3.6	43%
Demand Reduction			
Smart AC Saver Program (Residential)	$ 9.4	$ 6.9	26%
Smart AC Saver Program (Commercial)	$ 0.5	$ 0.3	41%

[1] The Smart Multi-Family Solutions program nonresidential sector budget and expenditure estimates also include segment-level budget and spending for the Smart Multi-Family Solutions GNI component.

Source: Navigant analysis

Table 1-14 shows Program Year 5 program savings compared to the energy and demand savings estimates filed in the EE&C plan.

Table 1-14: Comparison of Actual Program Savings to EE&C Plan

Program	MWh Savings Projected in EE&C Plan	*Actual* Reported MWh Savings	% Difference [(Planned-Actual) / Planned]	MW Savings Projected in EE&C Plan	*Actual* Reported MW Savings	% Difference [(Planned - Actual)/Planned]
Residential						
Smart Appliance Recycling Program	8,471	6,337	25%	1.0	0.9	15%
Smart Home Rebates Program	79,549	78,840	1%	18.1	7.0	61%
Smart House Call Program	1,793	954	47%	0.6	0.1	80%
Smart Builder Rebates Program	112	5	95%	0.0	0.0	95%
Smart Energy Saver Program	2,067	4,300	-108%	0.1	0.3	-218%
Smart Usage Profile Program [1]	0	2,247	N/A	0.0	0.0	N/A
Smart Multi-Family Solutions Program (Residential)	2,272	2,374	-4%	0.4	0.2	50%
Low-Income Energy Efficiency (LEEP) Program	13,732	14,127	-3%	1.8	1.1	38%
Non-Residential						
Smart Equipment Incentives Program (C&I)	55,941	28,267	49%	12.7	5.0	61%
Smart Construction Incentives Program	19,949	5,665	72%	4.8	0.9	82%
Smart Business Solutions Program	12,334	11,127	10%	2.5	2.2	10%
Smart On-Site Program	52,824	59,945	-13%	6.9	7.8	-12%
Smart Multi-Family Solutions Program [2]	1,647	2,961	-80%	0.3	0.3	24%
Nonresidential Participation in Smart Home Rebates	6,636	5,874	11%	1.5	0.3	77%
Non-Residential (Government, Nonprofit, Institutional)						
Smart Equipment Incentives Program (GNI)	24,158	10,173	58%	8.1	1.9	77%
Demand Reduction						
Smart AC Saver Program (Residential)	0	N/A	N/A	78.0	71.1	9%
Smart AC Saver Program (Commercial)	0	N/A	N/A	2.6	2.9	-11%

[1] SUP program projects all savings in the third year of Phase II (PY7), and thus there are no projected savings in PY5.

[2] The Smart Multi-Family Solutions program non-residential sector energy and demand savings include segment-level savings for both the SMFCI and SMFGNI components.

All demand values include a line loss factor.

Source: Navigant analysis

Across the entire portfolio of programs, PECO fell slightly short of the PY5 plan goal of 551,500 MWh of total energy savings, but did save 516,160 MWh or 94 percent of the portfolio's goal. The Smart Equipment Incentives (SEI) and Smart Construction Incentives (SCI) programs specifically fell short of their individual program goals, most likely from a slow start to the Phase II marketing and outreach efforts. Neither the SCI program nor the SEI program achieved its PY5 goals of 19,949 MWh and 80,099 MWh, respectively. The SEI program and the SCI program did not spend their full planned budget for this program year, 61 percent and 50 percent for the SEI program and the SCI program, respectively. The SEI program only spent $10 million of the $16.50 million budgeted, while the SCI program spent only $1.6 million of the $3.2 million budget for this program year. Both programs increased their marketing and outreach efforts throughout PY5 and into recent months, and program managers are confident that the programs will soon be on track to meet their overall Phase II plan goals, despite low participation in PY5.

Due to the nature of energy efficiency program implementation, program measures did not meet the exact number as projected. The team discusses a few, but not all, of them here. The portfolio incented approximately 90 percent of the planned level of CFLs, but 193 percent of planned LEDs. Linear fluorescents also came in below planned levels; PECO incented 70 percent of the planned PY5 units. Across all measure end use subcategories, the portfolio also saw a lower number of custom measures installed relative to planned levels, though specifically custom lighting was installed at 99 percent of planned levels.

PECO's portfolio had a TRC ratio of 1.47, and thus the portfolio was cost effective. Table 1-15 shows the actual program level TRC ratios compare to the projected values in the EE&C plan. Compared to the planned TRC benefit-cost ratio, the SHR, Smart Energy Saver (SES), and Smart Multi-Family Solutions (SMFS) Residential programs saw the greatest increase in the TRC ratio over the planned ratio.

Table 1-15: Comparison of Actual TRC Benefit-Cost Ratio to EE&C Plan

Program	Actual TRC Benefit-Cost Ratio	Planned TRC Benefit-Cost Ratio	% Difference [(Actual - Planned)/Planned]
Smart Appliance Recycling Program	4.8	4.6	3%
Smart Home Rebates Program	2.3	1.2	92%
Smart House Call Program	0.4	0.6	-34%
Smart Builder Rebates Program	0.0	0.2	-100%
Smart Energy Saver Program	3.6	1.5	143%
Smart Usage Profile Program	0.6	2.9	-79%
Smart Multi-Family Solutions Program (Residential)	1.8	0.7	150%
Low-Income Energy Efficiency (LEEP) Program	2.0	1.7	18%
Smart Equipment Incentives Program (C&I)	2.1	2.5	-15%
Smart Construction Incentives Program	1.5	2.1	-27%
Smart Business Solutions Program	3.1	2.0	57%

Program	Actual TRC Benefit-Cost Ratio	*Planned TRC* Benefit-Cost Ratio	*% Difference* [(Actual - Planned)/Planned]
Smart On-Site Program	0.7	1.6	-57%
Smart Multi-Family Solutions Program	1.1	1.6	-30%
Smart Equipment Incentives Program (GNI)	1.3	1.7	-24%
Smart AC Saver Program (Residential)	3.5	3.9	-10%
Smart AC Saver Program (Commercial)	1.8	2.5	-27%

Source: Navigant Analysis

PECO may consider changes to the EE&C Plan, but has no definite plans at this time.

1.9 Portfolio Level/Cross-Cutting Process Evaluation Summary for Program Year 5

The evaluation team completed the program-level process evaluations by using multiple evaluation techniques. The team reviewed over 140,000 records, surveyed nearly 1,000 participants, surveyed 500 non-participants, and held four focus groups with 15 participating and non-participating contractors. These various approaches help ensure both a thorough review of the Smart Ideas portfolio as well as a cost-effective means of evaluation.

Across PECO's entire portfolio, the evaluation team has provided various process recommendations that PECO will evaluate moving forward. The evaluation team's first recommendation is that PECO and its implementers provide more thorough quality control of input data. Evaluation program leads recommended that the tracking system could be improved for half of the 16 individual programs. These improvements include a more thorough review of the tracking data as well as including more data in the tracking system. These steps should improve evaluation efficiency and reduce evaluation spending.

The other portfolio level recommendation is that programs should provide more marketing and outreach and better link cross-program sales efforts. The evaluation team determined that customers might benefit from more information about the programs and more specific information about technologies offered in the programs. This additional marketing could help customers make more informed energy savings decisions.

2 Smart Appliance Recycling

The Smart Appliance Recycling (SAR) program provides PECO's residential customers with the opportunity to remove and replace old, inefficient refrigerators and freezers that are operating and in use at no cost to participants and to provide a small incentive for up to two units per participant. An independent implementation contractor, JACO, operates the program and handles all the application and pickup processes, collects data about each participant and their appliances, and recycles the collected units in their regional facility, which serves PECO and other area utilities.

2.1 Program Updates

The SAR program operated in PY5 much as it had in prior program years, continuing with the same implementation contractor, the same program marketing techniques, and the same participant enrollment and implementation processes.

The PY5 SAR participation (7,484) was approximately 2.5 times the total number of units recycled in PY4 (2,972), after restoring the participant incentive to $35. PECO reduced the incentive to $15 in PY4 as a means to manage participation. Despite the dramatic increase in the participation, the program only met 74 percent of its planned participation and 75 percent of the overall energy savings goals. Participation achievements were lowest for refrigerator and freezer replacements with Energy Star units, suggesting increased coordination with PECO's SHR program.

2.1.1 Definition of Participant

The target market for SAR is residential customers that own older but functional, in-use refrigerators and freezers. Some of these units are secondary appliances that will be removed and not replaced. Some units are primary units that are replaced by new, more efficient appliances. The program emphasizes replacement with Energy Star appliances but does not offer an additional incentive for those replacements.

2.2 Impact Evaluation Gross Savings

Navigant reviewed PECO's tracking database (SIDS) to verify savings and develop an estimate of PY5 gross impact analysis per rebated measure. Table 2-1 below summarizes the savings reported in the tracking data. While the population size is based on the total number of units recycled, the participant count from the tracking data is based on the number of pick-ups by JACO. The number of participants is smaller than the population size because customers are allowed to recycle up to 2 units.

Table 2-1: Phase II SAR Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	7,109	6,337	0.9	$262
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	7,109*	6,337	0.9	$262

Note: Participants for this table are the number of Orders/pickups made by JACO, not the total number of units.

Source: JACO tracking data.

Navigant verified ex ante savings to develop gross impact estimates for demand and energy. Both refrigerators and freezers have deemed savings in the 2013 Pennsylvania TRM depending on whether the unit was retired, replaced with an Energy Star unit, or replaced with a non-Energy Star unit. To estimate gross energy savings for PY5, the evaluation team made adjustments using the replacement type data from JACO's tracking data. In cases where the JACO data for replacement type was incomplete, Navigant used the conservative estimate for savings that the unit was replaced with a non-Energy Star appliance.

For the evaluation of impacts for the SAR program, Navigant stratified by measure type as described in Table 2-2. Navigant reviewed the tracking data for each measure in the database and recalculated the savings based on the 2013 Pennsylvania TRM. Additionally, Navigant randomly selected 35 refrigerator and 30 freezer records for a participant phone survey.

Table 2-2: SAR Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Refrigerators	6,163	N/A	Census	Census	Tracking Data Review
Freezers	1,321	N/A	Census	Census	Tracking Data Review
Refrigerators	6,163	85/15	35	35	Participant Phone Survey
Freezers	1,321	85/15	30	30	Participant Phone Survey
Program Total	7,484		Census/65	Census/65	

Source: Navigant analysis

The PY5 SAR program participant survey was oriented primarily to program impacts, although some process questions were asked as well. The single sample of SAR program participants was randomly

selected from the program-tracking database that PECO provided. The sample was developed primarily based upon the savings contributed by each measure and aligned as much as possible with the priorities of the Common Approach for determining net savings. Thus, quotas were developed for refrigerators and freezers that were removed and not replaced, as well as those replaced with Energy Star and those replaced with non-Energy Star units.

While the population size is based on the total number of units recycled, the participant count from the tracking data is based on the number of pick-ups by JACO. The number of participants is smaller than the population size because customers are allowed to recycle up to 2 units. Next, Navigant recalculated the reported savings using the 2013 Pennsylvania TRM deemed savings for refrigerators and freezers after making adjustments to the replacement type based data that JACO provided in the tracking data.

Table 2-3 and Table 2-4 show the energy and demand realization rates estimated from the program evaluation.

Table 2-3: Program Year 5 SAR Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Refrigerators	4,932	0.99	4,869	0	0%
Freezers	1,405	1.00	1,399	0	0%
Program Total	6,337	0.99	6,268	0	0%

Source: PECO reporting and Navigant analysis

Table 2-4: Program Year 5 SAR Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Refrigerators	0.65	0.99	0.6	0	0%
Freezers	0.21	1.00	0.2	0	0%
Program Total	0.85	0.99	0.8	0	0%

Source: PECO reporting and Navigant analysis

2.3 Impact Evaluation Net Savings

Once gross program impacts have been estimated, net program impacts are calculated by multiplying the gross impact estimate by the NTG ratio. The NTG ratio is equal to 1 minus the percentage of free riders

plus spillover. For this program, because the program theory does not espouse a logical linkage as to how spillover might occur. Further, the consensus of PECO, JACO and the SWE spillover seems unlikely to be significant. For these reasons, this evaluation does not attempt to quantify spillover. Should contrary evidence arise in the future, Navigant will revise its evaluation plans to assess this aspect of NTG.

Adoption of the Common Approach to Measure Free Ridership

In late 2013, the SWE initiated a Common Approach to estimating free ridership for all EDCs operating appliance recycling programs[5]. This approach differs from the methodology previously employed in PECO's research. The Common Approach divides participants into "Keepers" and "Removers" and then assigns percentages of claimed savings through four scenarios, dubbed "A, B, C and D", depending upon participant actions and intentions in the absence of the program. Navigant followed this method in the composition of its participant survey.

In implementing the free ridership determination in the Common Approach, Navigant closely followed the conceptual framework of Keepers and Removers and also attempted to closely follow Table 1 in the cited memo. Because the Common Approach was only an example of the possible "Keeper"/"Remover" scenarios and not a complete set of likely circumstances, three additional classifications were added to the Common Approach. Navigant assumed that the net savings for the additional classifications were in keeping with Common Approach scenarios.

In performing the Common Approach, Navigant noted some differences from the prior NTG method, noted below:

- The Common Approach sets a maximum age standard of 10 years for any appliance taken by a "dealer" for a participant classified as a remover. Actual practice in a given territory may vary, particularly if there is an active secondary appliance market, as some urban areas feature a lot of multifamily housing. The extent of such a market in PECO territory is not clearly established at this point but is an area for investigation.
- The Common Approach cites the Uniform Methods Project (UMP) for "Scenario C" participants who, in the absence of the program, would have given away or sold the unit or provided a unit of less than years to the retailer. The UMP assumes that "half of the respondents would receive full savings (assuming unit would have served as secondary unit for a different household), and the other half as the delta between a new and old unit (and assuming half of replaced units would be Energy Star vs. non-Energy Star). Common Approach goes further, and assumes that half would receive full savings as in the UMP but that 25 percent would receive one-quarter savings of the delta from the old to the new and one quarter would receive no savings. The basis for this assumption is not clear.

[5] *Common Approach for Measuring Net Savings for Appliance Retirement Programs*, February 9, 2014.

- The Common Approach counterfactuals are posed differently from the method used for PECO's programs, which might result in different responses by participants. In the prior method, respondents were asked if they would consider disposal by the various channels, while the Common Approach focuses on what the participants would have done in the absence of the program, a considerable difference in emphasis.

The PY5 SAR program participant survey was oriented primarily to program impacts, although some process questions were asked as well. The single sample of SAR program participants was randomly selected from the program-tracking database that PECO provided. The sample was developed primarily based upon the savings contributed by each measure and aligned as much as possible with the priorities of the Common Approach for determining net savings. Thus, quotas were developed for refrigerators and freezers that were removed and not replaced, as well as those replaced with Energy Star and those replaced with non-Energy Star units.

Navigant undertook basic data cleaning steps before the evaluation team derived the sample from the database so that, for example, records with missing or invalid phone numbers were removed. A total of 65 interviews were completed to meet these quotas. The sample size and sampling are shown in Table 2-5. A single sample was developed for both process and impact purposes for this evaluation. A more detailed sampling memo was submitted to the SWE for its review and comment.

Table 2-5: SAR Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[6] to Achieve Sample
Refrigerators	N/A	6,163	0.5	85/15	35	35	100%
Freezers	N/A	1,321	0.5	85/15	30	30	100%
Total	N/A	7,484	N/A	N/A	65	65	100%

Source: Navigant analysis

In total, 18 out of 30 refrigerator respondents (60 percent) and 12 of 24 freezer respondents (50 percent) revealed they would have used a method to dispose of their unit that would have permanently destroyed it, indicating they are free riders.

Net savings were calculated using the results of the surveys and Common Approach calculation methods. NTG ratios were estimated by dividing the total net energy savings of the sample by the total verified gross saving numbers for the sample. The NTG ratios calculated are 0.2 for refrigerators and 0.3 for

[6] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

freezers. Table 2-6 indicates the estimated free ridership and NTG ratios for each program appliance type. The net savings are weighted proportionally by the gross savings for each appliance type as well.

Table 2-6: Program Year 5 SAR Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	*Observed* Coefficient of Variation or *Proportion*	Relative Precision
Refrigerators	0.8	N/A	0.2	0.5	52%
Freezers	0.7	N/A	0.3	0.5	43%
Program Total	0.7	N/A	0.3	N/A	38%

Source: Navigant analysis

2.4 Process Evaluation

The process evaluation component of the SAR program evaluation focused on appliance usage data and satisfaction with program processes, including program sign-up, appliance pickup, and receipt of the refund check. Data sources for the process evaluation include the telephone survey of program participants and interviews communications with program staff and the implementation contractor. Overall, the program processes and issues have not changed greatly from Phase I. Program marketing continues as previously, though more work could be done with retailers. Program satisfaction remains high for all aspects of the program delivery to participants. The availability of eligible refrigerators and freezers continues to be high, though the program manager and implementation contractors expect that savings may decline as the stock of older more inefficient refrigerators continues to decline.

The PY5 SAR program participant survey was oriented primarily to program impacts, although some process questions were asked as well. The single sample of SAR program participants was randomly selected from the program-tracking database that PECO provided. The sample was developed primarily based upon the savings contributed by each measure and aligned as much as possible with the priorities of the Common Approach for determining net savings. Thus, quotas were developed for refrigerators and freezers that were removed and not replaced, as well as those replaced with Energy Star and those replaced with non-Energy Star units.

Navigant undertook basic data cleaning steps before the evaluation team derived the sample from the database so that, for example, records with missing or invalid phone numbers were removed. A total of

65 interviews were completed to meet these quotas. The sample size and sampling are shown in Table 2-7. A single sample was developed for both process and impact purposes for this evaluation.

Table 2-7: SAR Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
Refrigerators	N/A	6,163	0.5	85/15	35	35	100%	Participant Surveys
Freezers	N/A	1,321	0.5	85/15	30	30	100%	Participant Surveys
Total	N/A	7,484	N/A	N/A	65	65	100%	N/A

Source: Navigant analysis

The SAR program is a mature program, which has operated since 2010 and is using the same implementation contractor; thus, PY5 program changes have been incremental. The PY5 program had one significant change from PY4, increasing the participation incentive from $15 to $35 per unit recycled. The incentive increase was intended to stimulate participation, which fell off in PY4, compared to prior program years. The participation increase of approximately 250 percent in PY5 over PY4 strongly suggests that reinstating the $35 incentive was the primary factor in the increased participation, especially since there were no other significant program changes. It is not clear whether the incentive increase was a factor in the increased PY free ridership, since the methods used to assess free ridership did not directly address the role of the incentive in participant decision making.

Participation did increase significantly in Q1 and Q2. There was some fall-off in Q3, which appeared to result from a very harsh winter, which included much greater than typical snowfall, complicating scheduling with participants and actual pickups in some less accessible areas. Overall, however, the program achieved approximately two and a half times the PY4 participation level, when the incentive was reduced from $35 to $15. That reduction was made to slow the rate of program expenditure for PY4. Neither the PECO program manager nor the JACO managers believed the one-year incentive reduction had any lasting impact on participation. Since the program is well known in much of PECO's territory, PECO and JACO expect participation to continue at similar rates for PY6, although they expect the percentage of much older units to continue to decline.

The only noteworthy change in program processes in PY5 was the point at which JACO asked participants who intended to replace their appliances whether they intended to purchase Energy Star replacement units. Previously, this question was asked at the point of pickup, but some discrepancies were found with database entries and the participant survey. This question was transferred to the application process in

PY5, but we see some indication that it may not have improved the accuracy of customer intentions, possibly because customers were not certain what they would do.

In November 2011, PECO made a strategic decision to scale back this program, along with several others, based on its conclusion that the program portfolio had already met its energy savings goals for the entire program year. This continued throughout PY4 and resulted in a sharp reduction in the incentive level, elimination of the room AC measure, and also led to significant drops in participation levels.

In 2013, for PY5, PECO restored its incentive level to $35, the previous level, although room air conditioners were not reinstated as an eligible appliance for the program. Marketing in PY5, continued to rely on bill inserts and word of mouth, which survey results continue to show as the most common sources of information about the program. This marketing strategy appears to have been overall effective, since program participation increased by approximately 150 percent in PY5 compared to PY4. However, PY5 participation was still below the filed plan levels.

Program promotion seems less effective through recruiting retailers to work with the program. This stems partly from the nature of the on-the-sales-floor staff in the big box stores that are responsible for most of the new appliance sales. However, in order for PECO to reach its program goals, a more expanded and extensive marketing strategy seems to be called for. In this case, PECO may be missing an opportunity to coordinate closely with the Smart Home appliance rebates and increase Energy Star participation. If the understanding about the sales staff is correct, a program of education (and perhaps a small financial reward for successful referrals may be effective. The implementation contractor maybe a good source for looking at what works in increasing retailer participation.

Few renters participate in the SAR program. The most likely reason for rates of renter participation is lack of space for additional appliances. Furthermore, anecdotal information suggests refrigerators are supplied with most rental units in PECO's territory. Additionally, there appears to be an active market in used appliances. Therefore, another possible avenue of program marketing that could bring impacts on a more than one-at-a-time level of participation is working with residential property owners, particularly in multifamily buildings. As property owners turn over appliances, there is an opportunity to keep refrigerators off the used appliance market. Navigant recommends exploring connections with property owners as potentially a highly cost effective method for recycling these units.

2.5 Recommendations for Program

The evaluation staff noted that while the SAR tracking system has improved compared with prior years, several data fields continued to be incomplete. The tracking system includes the prior location of the unit but not if the space was conditioned or not. Additionally, there is a disconnect between participation numbers reported by number of orders and the actual units recycled by the program.

Although data problems are not widespread, PECO should consider conducting periodic data quality reviews of the program tracking data for data quality and completeness. Data exported for the evaluation team should also be checked for anomalies. Also, the program implementation contractor should start capturing if the recycled unit was located in a conditioned or unconditioned space and include that in the data sent to PECO, since this is an input into the unit energy consumption (UEC) regression model. Additionally, Navigant recommends that PECO rationalize its participation reporting settling on a single metric that is consonant with its Energy Efficiency Phase II plan.

JACO has improved the accuracy of reported replacement rates by asking participants about their replacement intentions at the point of application, rather than at the point of pickup, but there continue to be discrepancies between reported replacement and survey results. Though we did not find widespread problems in our database review, this particular issue does affect how gross program savings are determined and needs further attention.

The evaluation team recommends that at the point of pickup JACO attempts to confirm the participant's replacement intentions indicated at the point of application. Alternatively, we recommend that the PUC adopt a utility-specific deemed replacement rate in the TRM that is based on phone survey results from the most recently completed evaluation.

The evaluation team expects that the expected downward trend in program savings per unit will continue into PY6 and beyond. Therefore, the evaluation team recommends that PECO and JACO should continue the removal of old secondary appliances and replacements of primary units with Energy Star-qualified units, cross-promoting incentives for Energy Star appliances.

Table 2-8 lists each recommendation along with the PECO status.

Table 2-8: SAR Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Review tracking data periodically for completeness and have JACO record if unit is located in un/conditioned space	Being considered. JACO currently records unit location at the time of collection. PECO will work with JACO to address un/conditioned space questions as part of the program processes.
Recommendation 2: Have JACO confirm at pick-up the participant's replacement intentions as stated on the application	Being considered. PECO will work with JACO to confirm the participant's replacement intentions at the time unit is collected.
Recommendation 3: Further work with retailers to promote the program	Being considered. PECO will work with directly with retailers through Program Managers and CSPs to ensure proper education and awareness is instilled into retailer sales staff to promote the program.
Recommendation 4: Increase cross-promotion with the Smart Home Rebates Program	Implemented. PECO is actively cross promoting all residential programs (direct mail, bill inserts, etc.).
Recommendation 5: Provide customers with information on cost/energy savings from SAR and other PECO programs	Implemented. PECO provides customers information on cost/energy savings as part of all program promotions (bill inserts, radio, TV, customer newsletter, direct mail, etc.).

Source: Navigant analysis and PECO input

2.6 Financial Reporting

The SAR program remains highly cost-effective, with a B/C ratio of 2.91. The high TRC suggests that the program has the ability to absorb additional increases in the rebate offered, while still remaining cost-effective. Program costs totaled $1,550,000, while lifetime program benefits are $4,503,000. A breakdown of the program finances is presented in Table 2-9.

Table 2-9: Summary of SAR Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	662	662
Marketing[2]	285	285
Subtotal EDC Implementation Costs	947	947
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	947	947
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	947	947
Total NPV Lifetime Energy Benefits	4,188	4,188
Total NPV Lifetime Capacity Benefits	315	315
Total NPV TRC Benefits[6]	4,503	4,503
TRC Benefit-Cost Ratio[7]	4.75	4.75

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

3 Smart Home Rebates

In PY5, the SHR program offered PECO residential customers rebates for the purchase of qualifying high-efficiency appliances, heating, and cooling equipment; consumer electronics; and fuel-switching measures. In addition, the program provided "up-stream" buy-down incentives to manufacturers for CFL and LED measures. As such, the SHR program merged the Phase I CFL-measure offerings of Smart Lighting Discounts with the Phase I, appliance and LED measures of the SHR program.

3.1 Program Updates

In Phase II, the SHR program is combination of its LED non-lighting measures from Phase II and the CFL measures from the Smart Lighting Discounts program. The latter program did not continue in Phase II as a distinct program entity.

3.1.1 Definition of Participant

Participation in the SHR program is defined by the purchase of an incented non-lighting measure. The PY5 participation for this program totaled 12,109 participants. This participation does not include the 2,000,361 units sold via upstream incentives of the ENERGY STAR lighting sales.

3.2 Impact Evaluation Gross Savings

Navigant reviewed PECO's SIDS to verify savings and develop an estimate of PY5 gross impact analysis per rebated measure. Table 3-1 below summarizes the savings reported in the tracking data.

Table 3-1: Phase II SHR Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	12,109	78,840	7.0	$6,568
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	5,874	0.3	$325
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	**12,109**	**84,713**	**7.3**	**$6,892**

Source: Navigant analysis

To evaluate the gross energy and demand impacts, Navigant utilized the following sampling strategies.

Lighting

To calculate the number of intercept surveys required to meet regulatory compliance requirements of 85/15 confidence/precision for NTG ratio at the program level, the evaluation team used an expected NTG value of 0.40 from the PY2 program evaluation and an assumed CV of 0.5 and determined that intercept surveys with 76 program participants would be needed (see Table 3-2).

Table 3-2: Lighting NTG Sampling Strategy

Stratum	Stratum Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted to Achieve Sample
All lighting measures – Customer self-report	N/A	422,324	0.5	85/15	76	313	100%
All lighting measures – revealed preference demand model	N/A	422,324	0.5	85/15	76	313	100%
Supplier Self-Report NTG, LED Manufacturers	N/A	7	0.5	85/15	7	5	100%
Program Total	**N/A**	**422,331**	**0.5**	**85/15**	**76**	**318**	**100%**

Source: Navigant analysis

Non-Lighting

Table 3-3 details the sampling strategy for non-lighting measures. In PY4, Ground Source Heat Pumps constituted 17 percent of program non-lighting energy savings but 5 percent in PY5. Because of this decline in savings for this one individual measure, the non-lighting NTG sampling strategy focused on only two strata: HVAC and Appliances.

Table 3-3: Non-Lighting NTG Sampling Strategy

Stratum	Stratum Boundaries	Population Size	Assumed Coefficient of Variation (Cv) or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted to Achieve Sample[1]
Electric HVAC	N/A	9,239	0.50	85/15	100	100	13%
Fuel Switch HVAC	N/A	142	0.50	85/15	6	1	100%
Appliances	N/A	2,728	0.50	85/15	100	100	44%
Program Total	**N/A**	**12,109**	**0.50**	**85/15**	**206**	**201**	**18%**

Source: Navigant analysis

Table 3-4 provides the overall sampling strategy for both lighting and non-lighting measures.

Table 3-4: SHR Sampling Strategy for PY5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Electric HVAC	9,239	85/15	9,239	9,239 / 17 / 9	Tracking System Review, File Review, Follow-up Telephone Survey
HVAC Fuel Switching	142	85/15	142	142 / 11 / 6	
Appliances	2,728	85/15	2,728	2,728 / 7 / 0	
Lighting	422,324	85/15	76	313	In-Store Survey
Program Total	**N/A**	**85/15**	**12,185**	**85/15**	**12,109/35/17**

Source: Navigant analysis

Lighting Gross Impact Results

As noted in the methodology section, gross impacts for lighting measures are calculated according to the following algorithms from the PA TRM:

$$Total\ Savings = Number\ of\ Units\ X\ Savings\ per\ Unit$$

$$\Delta kWh = (Watts_{base} - Watts_{EE}) \times CF_{Hours} \times 365 / 1000 \times ISR_{EE}$$

$$\Delta kW_{peak} = (Watts_{base} - Watts_{EE}) / 1000 \times CF \times ISR_{EE}$$

In the case of TRM-Verified savings and Evaluation-Based savings, savings calculations include an estimate of the proportion of program bulbs going into nonresidential sockets, with nonresidential parameter values from the TRM applied to savings calculations for those bulbs. Evaluation-Based savings are the same as TRM-Verified savings except that for bulbs installed in residential sockets they also incorporate lighting-HVAC interactive effects and an updated peak load CF.

Results for each of the input parameters for the kWh and kW savings algorithms are presented below, followed by overall program savings calculations.

Program Bulbs

Overall program bulb sales in PY5 were 2,000,361. Table 3-5 shows the distribution of program bulbs by bulb specialty type.

Table 3-5: Distribution of SHR Program Sales by Bulb Type

Type	Sub-Type	Specialty Type	Bulbs Sold	Percentage of Bulbs Sold
CFL	Standard	Spiral	1,338,835	66.9%
	Specialty	3-Way	7,108	0.4%
		A-line	54,979	2.7%
		Candelabra	35,734	1.8%
		Dimmable Reflector	4,495	0.2%
		Dimmable Spiral	4,380	0.2%
		Globe	22,734	1.1%
		High Wattage	3,097	0.2%
		Reflector	130,785	6.5%
LED	Standard	Standard	23,520	1.2%
	Specialty	A-line	60,489	3.0%
		Dimmable Reflector	59,021	3.0%
		Dimmable Standard	141,641	7.1%
		Globe	93	0.0%
		Reflector	113,450	5.7%
All			**2,000,361**	**100%**

Source: Navigant analysis of program tracking data

Delta Watts

Based on the evaluation team's review of baseline wattage as a function of bulb type and lumens, we calculated overall weighted average delta watts as 44.1, compared with a weighted average of 43.3 from the unadjusted values in the program tracking data. This 2 percent increase in delta watts relative to reported values was driven primarily by identifying cases where a reflector bulb was mischaracterized in the tracking data as a non-reflector bulb. Weighted average delta watts by bulb subtype are shown in Table 3-6.

Table 3-6: Average Delta Watts by Bulb Specialty Type

Type	Subtype	Average Delta Watts, Evaluation Based
CFL	Standard	43.6
	A-Line	45.2
	Candelabra	39.1
	Globe	36.1
	Reflector	52.4
	Total CFLs:	44.2
LED	Standard	39.5
	A-Line	46.9
	Candelabra	--
	Globe	32.5
	Reflector	47.2
	Total LEDs:	43.8
All Program Bulbs:		**44.1**

Source: Navigant analysis

Table 3-7 shows average delta watts by baseline wattage equivalent. Consistent with expectations, delta watts generally increases with increasing baseline wattage within a given bulb type. Also, LEDs have slightly higher average delta watts than their CFL counterparts for a given bulb type.

Table 3-7: Average Delta Watts by Baseline Wattage Equivalent

	Standard CFLs	Specialty CFLs	All CFLs	Standard LEDs	Specialty LEDs	All LEDs	All Program Bulbs
40W	30.2	31.3	30.4	32.4	32.5	32.4	31.1
45W	--	31.0	31.0	--	37.0	37.0	36.1
53W	34.0	35.0	34.0	--	--	--	34.0
60W	46.4	45.6	46.2	49.9	47.1	48.0	46.6
72W	48.0	49.0	48.0	--	--	--	48.0
75W	--	53.3	53.3	--	56.7	56.7	55.5
100W	--	81.1	81.1	--	77.0	77.0	81.0
All:	43.6	47.4	44.2	39.5	47.1	43.8	44.1

Source: Navigant analysis

Hours of Use

The residential average daily hours of use (HOU) value in the 2013 PA TRM is 2.8 and is based on a review of secondary literature. At the direction of the Pennsylvania Public Utilities Commission, the SWE has undertaken a residential light metering study that is currently underway. Results from that study are expected to be used as the basis for residential HOU and Peak Load CF estimates in PY7 and beyond. In the PY5 evaluation, the evaluation team applies the 2.8 HOU from the 2013 PA TRM in the calculation of evaluation-based savings estimates for program bulbs installed in residential sockets and 10.7 for program bulbs installed in nonresidential sockets. As shown in Table 3-8 below, nonresidential hours of use are calculated as the weighted average annual HOU by building type from the 2013 TRM, based on the number of bulbs intercept respondents said they would be installing in each building type.

Table 3-8: Nonresidential HOU and Peak Load CF

	Cross Sector Bulbs	Annual HOU by Building Type	CF by Building Type
Restaurant	33%	3,613	0.65
Office	24%	2,567	0.61
Lodging common areas	12%	7,884	0.90
Grocery	10%	4,660	0.87
Auto Related	8%	4,056	0.62
Retail	7%	2,829	0.73
Daycare	4%	2,590	0.62
Religious Worship	2%	1,810	0.62
Industrial/Manufacturing	1%	4,739	0.57
Overall	**100%**	**3,915**	**0.69**

Source: Navigant analysis of in-store intercepts data and 2013 Pennsylvania TRM

Peak Load CF

The 2013 PA TRM value for Peak Load CF is 0.05, taken from a 2003 study conducted in New England. As mentioned above, the Pennsylvania statewide residential light metering study that the SWE is currently conducting will yield estimates of HOU and CF based on primary data collection specific to Pennsylvania. In PY4, the evaluation team re-evaluated CF from the most up-to-date and relevant secondary data available at that time, which yielded an updated CF of 0.117. This updated factor was not used by PECO in the calculation of reported peak demand savings for PY5, since it is not part of the deemed parameter values in the 2013 PA TRM. However, the evaluation-based savings peak demand savings estimate for bulbs installed in residential sockets incorporates this updated factor. For the portion of bulbs estimated to have been installed in nonresidential applications, both TRM-verified and evaluation-based savings utilize peak load coincidence factor based on applying CF by building type from the TRM to the distribution by building type from the in-store intercepts data.

In-Service Rate

The evaluation team took two specific steps regarding the calculation of in-service rates (ISR) for program CFLs and LEDs. The first of these was to estimate bulb-type specific first-year ISRs based on primary data collection from the in-store intercept surveys. The second was to make the decision to apply the lifetime ISR of 0.97 for CFLs and LEDs to the TRM-Verified and Evaluation-Based calculations for overall program energy and demand savings.

Table 3-9 shows results for ISR by program bulb type and for the PY5 program overall from the in-store intercepts data. LEDs have the highest ISR at approximately 94 percent. Standard CFLs have an ISR of 75 percent, while specialty CFLs are 76 percent.

Table 3-9: First Year In-Service Rate

	Installed Bulbs	Total Bulbs	N	ISR, First Year	ISR, TRM
Standard CFLs	634	841	155	0.75	0.97
Specialty CFLs	75	99	37	0.76	0.97
LEDs	192	204	75	0.94	0.97
Total	901	1,144	262	0.79	0.97

Note: The overall In-Service Rate across all bulb types is weighted by total verified program bulb sales by type in the tracking data, not by bulb type ratios in intercept shoppers' baskets.

Source: Navigant analysis of in-store intercepts data

Cross-Sector Installation Rate

In analyzing the collected data for cross sector installation rate, the evaluation team dropped a record in which the respondent indicated the location where they expected to install the bulbs (in this case a home location) was not in PECO service territory. Four records were dropped where baseline wattage had erroneously been entered in place of number of packs purchased, so no accurate determination could be made about bulb quantity. Respondents saying they didn't know where they would be installing the bulbs were also dropped from analysis for this factor.

Since respondents were asked separately regarding standard CFLs, specialty CFLs, and LEDs whether they planned to install the program bulbs they were purchasing in their home, in a business, or both, the evaluation team was able to calculate distinct cross sector installation rates for each program bulb type, as well as an average across all program bulbs, weighted by the total number of each type of bulb in the program tracking data.

Table 3-10 below shows the results for cross-sector installation rate for each bulb type. Standard CFLs have by far the highest cross-sector installation rate at 11.5 percent, while LEDs have a lower cross- sector installation rate at 3.3 percent and specialty CFLs the lowest at 2.3 percent. The weighted average across

all program bulb types based on total verified program bulb sales in the program tracking data is 8.5 percent.

Table 3-10: Cross-Sector Installation Rate

	Cross-Sector Bulbs	Total Bulbs	n	Cross-Sector Rate
Standard CFLs	111	966	176	0.12
Specialty CFLs	4	173	66	0.02
LEDs	7	209	76	0.03
Overall	122	1,348	313	0.09

Note: The overall Cross-Sector Installation Rate across all bulb types is weighted by total verified program bulb sales by type in the tracking data and not by bulb type ratios in intercept shoppers' baskets.

Source: Navigant analysis of in-store intercepts data

Note that the cross-sector installations rate of 8.5 percent comes from an approach that is slightly updated from the approach that was used in PY2, which yielded a cross-sector installation rate of 7.7 percent. Specifically, in the PY2 intercepts, respondents who indicated they would be installing program bulbs in both home and business locations were not asked a follow-up question about how many they expected to install in business sockets. To account for this, in PY2 the evaluation team assumed that half of program bulbs would be installed in home sockets and half in business sockets for those respondents who indicated both home and business and who purchased up to twice the average number of program bulbs per in-store intercept respondent. For those PY2 intercept interviewees who indicated both home and business and were purchasing more than twice the average number of program bulbs, the evaluation team assumed that the number going into home sockets was equal to the overall average number of program bulbs going into home sockets across all intercept respondents. The evaluation team further assumed that the remainder of the total would be installed in business sockets. This approach yielded a cross-sector installations estimate of 10 percent, and the evaluation team recommended that the lower bound on the 90/10 confidence interval for that estimate, 7.7 percent, be used as a conservative estimate of cross-sector installations rate.

By contrast, in PY5 respondents who indicated they would be installing program bulbs in both home and business were asked the follow-up question about specifically how many of these bulbs they expected to install in business sockets. As such, no estimation or extrapolation of this portion was required, and the cross-sector installation rates in Table 3-10 above by bulb type and for all program bulbs as a whole reflect that updated method.

Table 3-11 shows cross-sector installation rate broken out for standard CFLs by typical incandescent equivalent bulb wattage. Based on this breakout, the cross-sector installation rates for 40W, 60W, and 100W equivalent standard CFLs are comparatively high, ranging from 10 to 19 percent, while no instances of cross-sector installations were observed for particularly low- or high-wattage standard CFLs.

Table 3-11: Cross-Sector Installation Rate Detail

Bulb Type	Equivalent Wattage	Cross-Sector Bulbs	Total Bulbs	n	Cross-Sector Rate
Standard CFLs	25W	0	12	2	0.00
	40W	37	192	30	0.19
	60W	66	644	112	0.10
	75W	2	61	18	0.03
	100W	6	47	11	0.13
	125W	0	4	1	0.00
	150W	0	6	3	0.00
Standard CFLs		111	966	176	0.12
Specialty CFLs		4	173	66	0.02
LEDs		7	209	76	0.03
Overall:		233	1,348	313	0.09

Note: The overall cross-sector installations rate across all bulb types in this and other tables is weighted by total verified program bulb sales by type in the tracking data and not by bulb type ratios in intercept shoppers' baskets.

Source: Navigant analysis

Table 3-12 shows the distribution of nonresidential building types in which respondents said they would be installing SHR program bulbs. The most common nonresidential building types for cross-sector installation of bulbs are restaurants and offices, followed by common areas in lodging facilities and then grocery stores. These four business types represent approximately 80 percent of all cross-sector installations documents in the intercepts.

Table 3-12: Cross-Sector Bulb Installations by Business Type

	Standard CFLs	Specialty CFLs	LEDs
Restaurant	37	3	--
Office	24	--	5
Lodging common areas	15	--	--
Grocery	12	--	--
Auto Related	9	--	1
Retail	8	--	--
Daycare	4	1	--
Religious Worship	2	--	--
Industrial/Manufacturing	--	--	1
Total	**111**	**4**	**7**

Source: Navigant analysis of in-store intercepts data

Lighting-HVAC Interactive Effects

As noted above, the evaluation-based energy and demand savings calculations incorporate lighting-HVAC interactive effects factors. The evaluation team estimated lighting-HVAC interactive effects factors for energy and demand in Phase II using the BEopt building energy simulation model developed at the National Renewable Energy Laboratory (NREL), along with housing characteristics data and meteorological data from Pennsylvania, to estimate Interactive Effects Factors for energy (IEFe) and demand (IEFd). The IEFe and IEFd estimates for Phase II were developed using the 2012 typical meteorological year (TMY) weather data. The results are shown below:

$$IEF_{e\_Phase\ II} = 1.01$$
$$IEF_{d\_Phase\ II} = 1.228$$

Gross Parameter and Savings Estimates

Table 3-13 shows the final parameter estimates and resulting energy and demand savings estimates by each of the three savings calculation methodologies employed: Program-Reported, TRM-Verified, and Evaluation-Based.

Table 3-13: Gross Parameter and Savings Estimates

Gross Parameter and Savings Estimates	Program-Reported	TRM-Verified	Evaluation-Based
Program Bulb Sales	2,000,361	2,000,361	2,000,361
% Residential Installations	100%	91.5%	91.50%
% C&I Installations	0%	8.5%	8.5%
Average Displaced Watts	43.3	44.1	44.1
Res. Average Annual HOU	1022	1022	1022
Res. In-service Rate, CFLs	0.84	0.97	0.97
Res. In-service Rate, LEDs	0.95	0.97	0.97
Res. Energy Interactive Effects	1.00	1.00	1.01
Res. Demand Interactive Effects	1.00	1.00	1.228
Res. Peak Load Coincidence Factor	0.05	0.05	0.12
Res. Peak Line Loss Adjustment Factor	N/A	1.1916	1.1916
C&I Average Annual HOU	N/A	3,915	3915
C&I Realization Rate, energy	N/A	1.12	1.12
C&I Demand Interactive Effects	N/A	1.34	1.34
C&I Peak Load Coincidence Factor	N/A	0.69	0.69
C&I Peak Line Loss Adjustment Factor	--	1.111	1.111
Total Installed First-Year Gross MWh Savings	76,282	112,865	113,665
Total Installed First-Year Gross Peak MW Savings	3.7	12.4	21.0

Source: Navigant analysis

Non-Lighting Gross Impact Results

The impact evaluation included three phases. The first phase was a census comparing savings data in the tracking system to savings calculation algorithms in the TRM. This comparison provided an assurance that the ex ante savings were in compliance with accepted measurement and verification methods and is identical to the impact evaluation effort for PY2 and PY3. The comparison did not find significant errors in data or calculations for these strata.

For the second phase of the impact evaluation, Navigant conducted a review of project files for a random sample of projects from each of the HVAC, ENERGY STAR Appliances, and HVAC fuel switch strata. The sampling approach for SHR is shown in Table 3-4. Navigant found no significant difference between tracking system data and file data for any of the three strata.

The third phase was a phone verification survey for a subset of the files reviewed in the second phase for the HVAC and HVAC Fuel Switch strata only. Again, this third phase review found no significant difference between tracking system data and the participant responses for either of the two strata.

Navigant conducted 35 file reviews and nine telephone interviews to verify the tracking system findings. As in the evaluations of Phase I, all file review documentation and responses from participants matched the information in SIDS. The only adjustment to PECO's claimed savings came from the tracking system review and due diligence review. Even with these adjustments, the realization rates for HVAC (including fuel-switching) and appliances are both 1.0.

For the third year, Navigant found no discrepancy between file review data and SIDS data. For the second year in a row, Navigant found no discrepancy between the follow-up telephone interviews and SIDS.

Overall Gross Impacts

Table 3-14 and Table 3-15 show the energy and demand realization rates estimated from the program evaluation for both lighting and non-lighting measures. The high realization rate for energy (1.43) reflects the greater HOU for the program bulbs installed in the C&I sector. Similarly, greater CF from C&I bulbs drives the higher demand realization (2.09).

While cross-sector installation of SHR program bulbs accelerates energy and demand savings for the overall portfolio without increased cost, this outcome is external to SHR's program logic. As such, resources dedicated to the residential sector actually benefit commercial and industrial customers. While it is appropriate for PECO to report and for Navigant to verify these savings, future planning should the dual-sector effects of SHR savings.

Table 3-14: PY5 SHR Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Adjusted Ex-Ante Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
HVAC	7,822	7,822	1.00	7,822	0.0	0%
Energy Star Appliances	610	610	1.00	610	0.0	0%
Energy Star Lighting	76,282	77,670	1.48	112,865	0.8	8%
Program Total	**84,713**	**86,102**	**1.43**	**121,297**	**0.8**	**7%**

Source: Navigant analysis

Table 3-15: PY5 SHR Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Adjusted Ex-Ante Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
HVAC	2.7	2.7	1.00	2.7	0.0	0%
Energy Star Appliances	0.2	0.2	1.00	0.2	0.0	0%
Energy Star Lighting	4.4	4.5	2.79	12.4	1.8	15%
Program Total	**7.3**	**7.4**	**2.09**	**15.3**	**1.4**	**12%**

Source: Navigant analysis

3.3 Impact Evaluation Net Savings

Lighting NTG

As noted in the methodology section for lighting measures, the evaluation team investigated program NTG via three methods:

- Customer self-report NTG from the in-store intercept surveys
- Revealed preference demand modeling NTG from the intercept and shelf survey data
- Supplier self-report NTG from the market actor interviews (LED only)

Our recommended values for lighting NTG by bulb type come from the in-store intercepts customer self-report method, with additional context provided by the other two methods. Results from these methods

are shown and compared below, and the PY5 recommended values are compared to those of prior evaluation years.

When analyzing the intercepts data, the evaluation team noted some incorrect or unclear characterization of program bulbs on the part of some field surveyors who conducted the intercepts. Unfortunately, for a number of these bulbs only partial bulb identification information was collected, such as a partial universal product code in place of the proper bulb model number or stock-keeping unit (SKU) number. The evaluation team used online searches, checks against the shelf survey data, and checks against the program tracking data to make a positive identification of bulb identity, but was not able to make this positive identification in all cases. For NTG analysis from the intercepts data, the evaluation team conducted parallel analysis using both program bulb status as designated by the surveyor, as well as using the narrower sets of intercepts for which the evaluation team could independently verify program bulb status. These parallel analyses yielded similar values to each other, both by bulb type and for the program overall, and the final values recommended by the evaluation team are based on the narrower set of intercepts for which the evaluation team was able to specifically verify program bulb status.

Free-ridership, spillover, and NTG values for lighting measures from the in-store intercepts are shown by program bulb type in Table 3-16. Free ridership was lowest for program LEDs, at 0.5, and modestly higher for both standard CFLs and specialty CFLs at 0.6. For standard CFLs, 64 percent of respondents said that in the absence of the program and its discounts they would still have purchased the same number of energy-efficient bulbs. Approximately 20 percent said they would have purchased some of the bulbs and 16 percent said they would have purchased none of the bulbs in the absence of the program. These answers, combined with each respondent's rating of the program's influence on their purchases, yields the weighted average score for standard CFLs below. For specialty CFLs, 52 percent of respondents said they still would have purchased the same number of efficient bulbs in the absence of the program, 40 percent said they would have purchased some of the bulbs, and 8 percent said they would have purchased none of the bulbs. For program LEDs, 65 percent said they would have purchased all of the bulbs, 5 percent said they would have purchased some of the bulbs, and 30 percent said they would have purchased none of the bulbs.

Spillover, standard, and specialty CFLs yielded a spillover rate of 0.04, and LEDs had twice the spillover rate of the other bulb types, at 0.09.

Lighting NTG is calculated according to the following algorithm:

NTG = 1 – Free Ridership Rate + Spillover Rate

Table 3-16 shows NTG from the in-store intercepts by bulb type and as a weighted average for all program bulbs.

Table 3-16: Lighting NTG

	n	Free Ridership	Spillover	Net to Gross
Standard CFLs	104	0.6	0.04	0.5
Specialty CFLs	25	0.6	0.04	0.4
LEDs	37	0.5	0.09	0.6
Overall	166	0.6	0.05	0.5

Source: Navigant analysis

The customer self-report NTG results above stand as the recommended values in the PY5 evaluation. The two additional NTG methods that were conducted in PY5, revealed preference demand modeling and supplier self-report NTG, serve to support and add perspective to the primary NTG result. All results across methods are shown in Table 3-17. The revealed preference demand modeling approach yielded an NTG estimate for standard and specialty CFLs. The supplier self-report NTG interviews yielded an NTG estimate specifically for program LEDs. As can be seen in the table, results were remarkably consistent across methods. For standard CFLs and LEDs, the two NTG approaches yielded the same result. For specialty CFLs, customer self-report was slightly lower than demand modeling.

Table 3-17: Comparison of PY5 SHR Lighting NTG Across Methods

Label	NTG Method		
	Demand Modeling	Supplier Self-Report	Customer Self-Report
Standard CFLs	0.5	--	0.5
Specialty CFLs	0.5	--	0.4
LEDs	--	0.6	0.6
Overall	--	--	0.5

Source: Navigant analysis

Table 3-18 shows a comparison of results across program years for program-level free ridership, spillover, and NTG. Results are not broken out by bulb type in this table, as the PY1 and PY2 NTG estimation approaches were not broken out by bulb type. Because no primary research was done that yielded NTG estimates in PY3 and PY4 (PY2 values were carried over in the net savings analysis for those years), these values are left blank. For free ridership and NTG, the PY5 values are intermediate between those found in PY1 and PY2, and spillover has remained at the same level across program years.

Table 3-18: Comparison of Lighting NTG Across Program Years

	Program Year				
	PY1	PY2	PY3	PY4	PY5
Free Ridership	0.5	0.7	--	--	0.6
Spillover	0.1	0.1	--	--	0.1
NTG	0.6	0.4	--	--	0.5

Source: Navigant analysis

Non-Lighting Free Ridership

In PY2 and PY3, Navigant defined free riders as those customers who self-identified themselves, in response to the participant telephone survey, as having purchased or ordered rebated appliances or HVAC equipment before learning about the rebate. In PY4, Navigant explored three other methods of estimating free ridership: a multiple response model; the algorithm for Duquesne Power and Light's Residential Energy Efficiency Program; and a method developed by the Energy Trust of Oregon (ETO) [7]. The latter equally weights participant intention and program influence (see Table 3-19 and Table 3-20, respectively). At the direction of Pennsylvania's SWE, Navigant employed the latter for the PY5 evaluation.

Table 3-19: Free-Ridership Counterfactual Responses and Intention Scoring for SHR

Counterfactual Responses	Intention Score
Cancel/postpone purchase	0.00
Purchase less expensive appliance	0.25
Purchase less energy-efficient appliance	0.25
Purchase same appliance without the rebate	0.50
Don't know	0.25

Source: Memo from Research into Action to EDCs, TUS and SWE team re: Common Approach for Measuring Free-riders for Downstream Programs, December 23, 2013

[7] Jane Peters and Ryan Bliss, Research Into Action Team, *Common Approach for Measuring Free Riders for Downstream Programs*, October 4, 2013.

Table 3-20: Free Ridership Influence Scoring for SHR

Program Influence Rating	Influence Score
1 – not at all influential	0.500
2	0.375
3	0.250
4	0.125
5 – extremely influential	0.000
DK	0.250

Source: Memo from Research into Action to EDCs, TUS and SWE team, Re: Common Approach for Measuring Free-riders for Downstream Programs, December 23, 2013

For spillover, Navigant employed a standard methodology provided by the SWE[8] in which respondents to a telephone survey would identify non-rebated measures and score the program's influence as follows:

- A rating of 4 or 5 = 1.0 (full savings attributed to the program)
- A rating of 2 or 3 = 0.5 (half of the savings attributed to the program)
- A rating of 0 or 1 = 0 (no savings attributed to the program)

Free ridership for non-lighting measures increased compared to findings from the PY2 and PY3 evaluations of this program. However, this increase is due – at least in part – to a change in the methodology[9] to collect participant responses and compute free ridership. In PY4, however, for which Navigant applied this methodology, the overall free ridership was 0.9. Table 3-21 shows the results for PY5.

Table 3-21: Non-Lighting Free Ridership

	Free Ridership
Electric HVAC	0.7
HVAC Fuel Switching	0.0
Appliances	0.6

Source: Navigant analysis

Unlike previous years, a single multifamily facility constituted the bulk of all fuel-switching savings for this category. When asked about the influence of the program, participant respondents to telephone interviews referred the evaluation team to the building owner. The building owner's response to free-ridership questions was that none of the fuel-switching projects would have taken place without SHR

[8] Memo from Research into Action to EDCs, TUS and SWE team, *Re: Common Approach for Measuring Spillover (SO) for Downstream Programs*, February 2014.

[9] Phil Degens and Sarah Castor, Energy Trust of Oregon, *Energy Trust Free Ridership Methodology*, August 2013.

engagement and that SHR was very influential in the owner's decision to support measure installation. A call to the SHR program manager confirmed these details. Based on this information, Navigant has separated its calculation of HVAC fuel-switching free ridership.

Non-Lighting Spillover

In PY3 and PY4, Navigant estimated a spillover rate of 0.1. As Table 3-22 shows, this rate is unchanged for PY5.

Table 3-22: Non-Lighting Spillover

	Free Ridership
Electric HVAC	0.1
HVAC Fuel Switching	0.0
Appliances	0.1

Source: Navigant analysis

Most quantifiable spillover took the form of lighting. Respondents to the participant telephone survey reported 21 instances of spillover associated with appliance purchases. Of these reports, Navigant was able to quantify savings from 13 reports. Of the latter 13 reports, 10 were CFLs and 3 were LEDs. These respondents also identified windows and insulation measures but Navigant did not have sufficient information to quantify these reports of spillover.

HVAC participants reported seven instances of quantifiable spillover. Three were CFLs, two were LEDs; one was an efficient gas water heater fuel-switch and the last was a heat pump water heater. These respondents also reported ceiling fans and insulation but, again, Navigant did not have sufficient information to quantify these reports.

Overall NTG

Table 3-23 shows the sampling strategy for the PY5 NTG research and Table 3-24 shows the overall NTG ratio of 0.5 for the program.

Table 3-23: SHR Sampling Strategy for PY5 NTG Research

Stratum	Stratum Boundaries	Population Size	*Assumed CV or* Proportion in Sample Design	Assumed Levels of Confidence & Precision	*Target* Sample Size	Achieved Sample Size	Percent of Sample *Frame* Contacted [10] to Achieve Sample
Electric HVAC	N/A	9239	0.5	85/15	100	100	13%
Fuel-Switch HVAC	N/A	142	0.5	85/15	6	1	100%
Energy Star Appliances	N/A	2728	0.5	85/15	100	98	44%
Energy Star Lighting	N/A	422324	0.5	85/15	313	313	100%
Program Total	**N/A**	**434,433**	**N/A**	**519**	**514**	**434,433**	**N/A**

Source: Navigant analysis

Table 3-24: PY5 SHR Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Standard CFLs	0.6	0.04	0.5	0.5	10%
Specialty CFLs	0.6	0.04	0.4	0.5	17%
LEDs	0.5	0.09	0.6	0.5	12%
Electric HVAC	0.7	0.06	0.4	0.5	8%
HVAC Fuel Switching	0.0	0.0	1.0	0.0	0%
Appliances	0.6	0.13	0.5	0.5	10%
Program Total[11]	**0.6**	**0.05**	**0.5**	**N/A**	**7%**

Source: Navigant analysis

[10] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

[11] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

3.4 *Process Evaluation*

There were no requirements from a compliance standpoint that informed the process evaluation sampling strategy. Rather, the evaluation team sought to obtain process evaluation information from a sufficient number of program and non-program bulb purchasers to enable analysis by bulb type for standard CFLs, specialty CFLs, and LEDs.

The evaluation team budgeted for completing 800 total intercepts to enable differentiated analysis at the bulb type level (Standard CFLs, Specialty CFLs, and LEDs). According to Phase II SHR program design, overall program bulb sales are comprised of approximately 70 percent Standard CFLs, 20 percent Specialty CFLs, and 10 percent LEDs. PECO program staff have indicated that the proportion of LEDs may rise above 10 percent over the course of Phase II. Based on a planning estimate that approximately 45 percent of the overall intercepts total would be completed with program bulb purchasers, this would yield intercept survey completes with 360 program bulb purchasers. Based on the percentage breakdown of program bulbs in the tracking data by type, this would be expected to yield 252 completes with program standard CFL purchasers, 72 completes with program specialty CFL purchasers, and 36 completes with program LED purchasers. Target sample sizes to reach 85/15 confidence/precision for standard and specialty CFLs and to reach 85/25 for LEDs are shown in Table 3-25, along with achieved sample sizes by bulb type.

Table 3-25: SHR Sampling Strategy for PY5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
HVAC	N/A	9,381	0.5	85/15	100	98	13%	Telephone Survey
Energy Star Appliances	N/A	2,728	0.5	85/15	100	100	44%	Telephone Survey
Standard CFLs	N/A	295,627	0.5	85/15	252	176	0.30%	In-Store Intercept Survey
Specialty CFLs	N/A	84,465	0.5	85/15	72	66	0.90%	In-Store Intercept Survey
LEDs	N/A	42,324	0.5	85/25	36	76	1.90%	In-Store Intercept Survey
Program Total	N/A	**434,525**	N/A	N/A	560	516	N/A	N/A

Source: Navigant analysis

Awareness of Lighting Measures

Awareness of LEDs as a lighting option is moderate, as shown in Table 3-26. While the majority of lighting purchasers said they are aware of LEDs, almost 40 percent of all shoppers surveyed said they are not familiar with the technology. This number is virtually unchanged from two years ago.

Table 3-26: Awareness of LEDs as a Lighting Option

Response	PY3 total (n = 601)	PY5 total (n = 802)	% change
Yes	58%	58%	0%
No	41%	38%	-3%
Don't Know	1%	4%	3%

Source: Navigant analysis

Customers who indicated they had the intention to buy some kind of light bulb when they entered the store (77 percent of the total) were asked what type or types of bulbs they were intending to buy. As shown in Table 3-27 below, CFLs were the most common answer at 40 percent, followed by incandescent bulbs at 33 percent.

Table 3-27: Bulb Purchase Intentions on Entering Store

Type	n	%
CFLs	252	40%
Incandescent	211	33%
LED	86	14%
Halogen	36	6%
Don't Know	45	7%
Other	4	1%

Source: Navigant analysis

As shown in Table 3-28 below, the large majority of respondents who were aware they were purchasing discounted bulbs knew the discount was coming from PECO. Of the 134 respondents purchasing program CFLs who indicated they knew they were purchasing discounted light bulbs, 88 percent said they were aware the discount was provided by PECO. The proportion was slightly lower among program LED purchasers, at 80 percent.

Table 3-28: Awareness of PECO as Source of Discounts

Response	CFL		LED	
	n	%	n	%
Yes	118	88%	33	80%
No	16	12%	8	20%
Total	**134**	**100%**	**41**	**100%**

Source: Navigant analysis

Those who were aware the discount was coming from PECO indicated that they had first learned of the PECO program from a variety of sources. By far the most commonly cited of these, as shown in Table 3-29, was seeing the PECO sticker on the lighting shelf alongside the discounted bulb price, which was noted by 74 percent of respondents. Respondents also mentioned other in-store sources of program awareness, such as additional marketing materials in the store, learning from a store employee, or having seen a retail lighting demonstration in the store. Notably few respondents (10 percent of the total) mentioned having first learned of the program in their PECO bill or from another source outside the store such as a friend or the Internet.

Table 3-29: Source of First Learning of PECO's Lighting Discounts

Response	n	%
PECO sticker on the shelf	111	74%
Saw marketing materials in the store	11	7%
Store employee made me aware of the discount	9	6%
Read about it in my bill from PECO	6	4%
Saw a retail lighting demonstration	5	3%
PECO Representative	3	2%
Friend	3	2%
Internet	3	2%

Source: Navigant analysis

Table 3-30 shows the awareness of the source of in-store information and displays. Approximately 40 percent of all survey respondents (303 interviewees) said they had seen information or displays about energy-efficient lighting in this store. Of those, approximately three quarters said that PECO had sponsored the information, and most of the remainder said the sponsor was either the retail store (17 percent) or they said they didn't know (9 percent).

Table 3-30: Awareness of the Source of In-Store Information and Displays

Sponsor	n	%
PECO	233	73%
The store	53	17%
Don't know	29	9%
Bulb manufacturer	4	1%
ENERGY STAR	1	0.3%

Source: Navigant analysis

Approximately 40 percent of customers interviewed did not purchase any CFLs or LEDs at all, irrespective of program bulb status. Surveyors asked these customers if they had considered purchasing CFLs or LEDs that day and, as shown in Table 3-31 below, the large majority said they had not for both bulb types.

Table 3-31: Proportion of Non-CFL or LED Purchasers Who Considered Purchasing Them

Response	CFL		LED	
	n	%	n	%
Yes	23	7%	47	14%
No	301	92%	279	85%
Don't know	4	1%	1	0%

Source: Navigant analysis of in-store intercepts data

Awareness of Non-Lighting Measures

Program participants learned about the SHR program in a variety of ways, most often from an installation contractor/remodeler (42 percent), PECO bill insert/newsletter (18 percent), and/or the PECO website (10 percent). Of note, the percentage mentioning store staff (21 percent) increased from PY4 (14 percent). This finding is consistent with the mystery shopping results (see Table 3-32), where only 11 percent of store staff mentioned the SHR rebate without prompting.

Consistent with the results from the PY4, PY3, and PY2, the majority of respondents (56 percent) were not aware of any other PECO programs.

Table 3-32: Participant-Identified Sources of Information for Non-Lighting Measures

Source	PY3		PY4		PY5	
	Total Responding	Percentage Responding	Total Responding	Percentage Responding	Total Responding	Percentage Responding
Contractor / Installer / Home Builder Remodeler	110	56%	75	38%	82	42%
PECO Bill Insert, Newsletter	37	19%	39	20%	35	18%
PECO Website	20	10%	35	18%	20	10%
PECO Employee, Account Representative, Customer	2	1%	3	2%	2	1%
PECO Outdoor Advertisements, On Truck, Billboard,	0	0%	1	1%	1	1%
PECO Newspaper / Radio / TV Advertisement	-	-	-	-	15	8%
[PECO] Letter to My Home	2	1%	5	3%	5	3%
Other PECO Program	-	-	-	-	3	3%
Store Staff	59	30%	27	14%	42	21%
In-Store Display / Advertisement	17	9%	16	8%	13	7%
Internet Search	9	5%	15	8%	11	6%
Dealer / Retailer Store	3	2%	11	6%	-	-

Source	PY3		PY4		PY5	
	Total Responding	Percentage Responding	Total Responding	Percentage Responding	Total Responding	Percentage Responding
Friend, Relative, Colleague	12	6%	10	5%	15	8%
Home Show	-	-	-	-	1	0%
Non-PECO Newspaper / Radio / TV Story	3	2%	2	1%	4	2%
Manufacturer	6	3%	2	1%	4	2%
Manufacturer / Retailer Website	-	-	2	1%	1	0%
Other	3	2%	5	3%	0	0%
Do Not Know	9	5%	5	3%	4	2%

Source: Navigant analysis

Overall Awareness

In general, awareness of both lighting and non-lighting measures has not reached full saturation. For all SHR measures, trade allies could play key roles in affecting higher levels of awareness; however, this would require greater levels of engagement by both PECO and Ecova.

Satisfaction with Lighting Measures

The questions in the in-store intercepts surveys that relate to what customers think of CFLs and LEDs were also designed to shed light on the applications in which they do and don't use these bulb types. Data collected from these questions simultaneously serve as indicators of satisfaction with program products as well as indicators of the future market potential for program bulb types. Results described in this section touch on the degree to which customers already have energy-efficient bulbs installed in their home and business sockets, the reasons why they chose or didn't choose to buy a given bulb type for their specific needs, customers' description of the bulb types they will be replacing with the program bulbs they purchased, the types of bulbs they would have purchased in the absence of the program, the degree of customers' basic interest in CFLs irrespective of their incremental cost, and their future bulb purchase intentions in response to Energy Independence and Security Act of 2007 (EISA) legislation.

The evaluation team conducted analysis on these questions both for program bulb purchasers as designated by the field surveyors and for the narrower set of program bulb purchasers as independently verified by the evaluation team based on program bulb model number. The distribution of responses was consistently very similar across these two groups. Because the question topics addressed in this section are particularly relevant to the larger lighting market, the results presented below are delineated based on program bulb purchase status as marked by the surveyors.

Respondents who indicated they would be installing program bulbs in their homes were asked if they already have energy-efficient bulbs installed in their homes. As shown in Table 3-33, the large majority of

program CFL purchasers (91 percent) said they already have at least one CFL installed in their home, and approximately half of program LED purchasers indicated they already have at least one LED installed.

Table 3-33: Efficient Bulbs Already Installed in Home

Response	CFL		LED	
	n	%	n	%
Yes	209	91%	18	46%
No	20	9%	21	54%

Source: Navigant analysis

Similarly, respondents who indicated they would be installing program bulbs in a nonresidential setting were asked if they already have energy-efficient bulbs installed in their business, and the large majority said yes, both for CFLs and for LEDs. As shown in Table 3-34, a slightly higher proportion already have CFLs installed in their business.

Table 3-34: Efficient Bulbs Already Installed in Business

Response	CFL		LED	
	n	%	n	%
Yes	19	83%	3	75%
No	4	17%	1	25%

Source: Navigant analysis

Surveyors asked customers who were purchasing LEDs to indicate why they were purchasing LEDs instead of some other kind of light bulb such as CFLs or incandescents. As shown in Table 3-35, respondents indicated a variety of reasons, the most common of which were to save money over the life of the bulb, to protect the environment, the low up-front cost for what you're getting, and recommendations from friends and family.

Table 3-35: Reasons LED Purchasers Chose LEDs over Other Bulb Types

Reason	First Mention		Other Mention		ALL	
	n	%	n	%	n	%
To save money	43	35%	6	17%	49	31%
To save energy for lower utility bills	24	19%	5	14%	29	18%
LEDs are good for the environment	12	10%	8	23%	20	13%
The price (LEDs are inexpensive/price is low)	12	10%	2	6%	14	9%
Recommended by friends/family	11	9%	1	3%	12	8%
Like the light quality of LEDs	9	7%	3	9%	12	8%
Prior good experience with LEDs	5	4%	2	6%	7	4%
Saw LEDs advertised in store/saw display in store	4	3%	2	6%	6	4%
Like the versatility of LEDs	2	2%	1	3%	3	2%

Reason	First Mention		Other Mention		ALL	
	n	%	n	%	n	%
Like the aesthetic/appearance of LEDs	1	1%	2	6%	3	2%
The long life	1	1%	1	3%	2	1%
To try/test it out	0	0%	2	6%	2	1%

Source: Navigant analysis

Respondents who indicated they were aware of energy-efficient bulb types but had not purchased them were asked why they chose not to purchase CFLs or LEDs. As shown in Table 3-36, the most common responses for CFLs were that people didn't like the light quality or light color, that they didn't like the way CFLs fit or look in fixtures, and that CFLs take too long to reach full brightness. In the case of LEDs, the most common reasons cited for not purchasing them were that they are too expensive, that the respondent indicated that they don't know enough about LEDs, or that they dislike the light quality or color.

Table 3-36: Reasons Cited for Not Purchasing Energy-Efficient Bulb Types

Reason	CFLs		LEDs	
	n	%	n	%
Dislike the light quality/color	10	17%	16	9%
Don't like the way they fit or look in fixtures	8	13%	11	6%
Take too long to reach full brightness	7	12%	0	0%
Need 3-way bulbs	5	8%	2	1%
Need other specialty bulb	5	8%	12	7%
Burn out too quickly	4	7%	0	0%
Mercury/Dangerous	4	7%	0	0%
Already have some/Don't need any	3	5%	4	2%
Too expensive	3	5%	74	41%
Need dimmable bulbs	3	5%	2	1%
Accustomed to incandescent bulbs	2	3%	11	6%
Don't know enough about them	2	3%	18	10%
I am shopping for someone else	2	3%	0	0%
They flicker	1	2%	0	0%
Seem too complicated	0	0%	3	2%
Not aware of them before today	0	0%	10	5%
Waiting for the technology to become more mainstream	0	0%	15	8%
Don't use them/ Don't want them	0	0%	3	2%
I purchased/have CFLs	0	0%	1	1%
Don't know	1	2%	0	0%

Source: Navigant analysis of in-store intercepts data

Several of the responses customers provided for why they were not purchasing CFLs or LEDs related to needing bulbs for a specific application, such as 3-way or dimmable bulbs. Surveyors asked these customers why they didn't choose CFLs or LEDs that have these special features. As shown in Table 3-37, reasons cited for not purchasing 3-way or dimmable CFLs or LEDs centered on either not liking them for the specific application or not being aware that they were available for that application.

Table 3-37: Reasons Cited for Not Purchasing 3-Way or Dimmable CFLs/LEDs

Label	CFLs		LEDs	
	3-Way	Dimmable	3-Way	Dimmable
Do not like CFLs/LEDs for this application	43%	33%	--	50%
Bulbs are too big for this application	29%	--	--	--
Bulbs are too expensive	14%	--	--	--
Did not know they made CFLs/LEDs for this	14%	67%	100%	50%

Source: Navigant analysis

To gauge the overall appeal of CFL and LED products without regard to price, intercept respondents who were not purchasing a given type of energy-efficient bulb, CFLs or LEDs, were asked on a scale of 0 to 10 (where 0 means not at all likely and 10 means extremely likely), if the price of the energy-efficient bulbs was the same as, or less than, the price of an incandescent or halogen bulb, how likely they would be to purchase a CFL or LED instead of the bulbs they were purchasing. As shown in Table 3-38, respondents showed a relatively broad range of responses across the full scale, both for CFLs and for LEDs, with the main exception being that approximately 40 percent of those asked said it was not at all likely they would purchase CFLs.

Table 3-38: Likelihood of Buying Efficient Bulbs if There Was No Price Premium

	CFL		LED	
	n	%	n	%
0 - Not at all likely	10	38%	18	12%
1	1	4%	1	1%
2	1	4%	4	3%
3	2	8%	10	7%
4	0	0%	6	4%
5	4	15%	26	17%
6	1	4%	17	11%
7	2	8%	14	9%
8	0	0%	15	10%
9	2	8%	7	5%
10 - Extremely likely	3	12%	26	17%
Don't know	0	0%	7	5%

Source: Navigant analysis

To get an indication of customer awareness of EISA implementation and how it will affect their bulb purchasing choices, surveyors asked customers about their familiarity with the law and their plans for bulb purchases as the law rolls into effect. As shown in Table 3-39, three quarters of respondents said they are familiar with the law. A relatively small proportion of respondents, only 16 percent, indicated they have or intend to stock up on traditional incandescent bulbs before they are no longer available. Also, just 27 percent of respondents said they are aware of the EISA-compliant halogen bulbs that are now available on the market.

Table 3-39: Familiarity with EISA Legislation

	Yes		No		Don't Know	
	n	%	n	%	n	%
Familiar with EISA	259	76%	81	24%	3	1%
Planning to stock up on extra traditional incandescent bulbs	41	16%	212	82%	6	2%
Familiar with EISA-compliant halogen bulbs	93	27%	237	69%	13	4%

Source: Navigant analysis

Finally, respondents were asked what they expect they will do the next time they need a 40W to 100W light bulb and there are no traditional incandescent lamps in these wattages on store shelves. The vast majority of respondents indicated they expect to buy an efficient light bulb of equal or higher light output than the bulb they are replacing (90 percent), as shown in Table 3-40.

Table 3-40: Purchase Intention in Absence of 40W-100W Traditional Incandescent Bulbs

	n	%
Equivalent light CFL, halogen or LED bulb	255	74%
Higher light output CFL, halogen or LED bulb	54	16%
Incandescent bulb above 100W and exempt from the new law	1	0%
There is no funding to enforce the law so I expect to keep buying traditional incandescent bulbs.	5	1%
Have already bought enough bulbs to last me	1	0%
Will buy whatever is cheapest	1	0%
Don't know	26	8%

Source: Navigant analysis

Satisfaction with Non-Lighting Measures

In Phase I, Survey respondents rated their satisfaction with various aspects of PECO's SHR program on an 11-point scale, where a "0" meant "Extremely Dissatisfied" and a "10" meant "Extremely Satisfied." To make the scale consistent with the SWE's common methods for calculating free ridership and spillover, Navigant revised the scale to six points where a "0" meant "Extremely Dissatisfied" and a "5" meant "Extremely Satisfied." For the purposes of comparison to previous years, Navigant has doubled the PY5 satisfaction values in the following text and tables.

Table 3-41 shows that, on average, program participants in PY5, PY4, and PY3 were very satisfied with the PECO SHR program overall, as well as with specific aspects of the program. The program participants gave the SHR program an average rating of 9.2, essentially the same as for the previous two years. The only notable differences from PY5 to the previous years were the rebate amount and variety of product eligible for rebates, where satisfaction ratings increased.

Table 3-41: Participating Customers' Satisfaction Ratings

Average Rating	PY3 (n = 200)	PY4 (n = 200)	PY5 (n = 200)
SHR Program Overall	9.1	9.1	9.2
Information Provided on PECO Website	N/A	9.0	8.7
Variety of Products Eligible for SHR Rebate	N/A	8.2	9.1
Contractor that Installed Measure	9.1	9.1	9.2
Measure Purchased	9.1	9.2	9.2
Rebate Amount Received	8.3	8.2	9.0
Speed of Rebate	8.8	8.9	8.6
Completing the Application Form	8.8	8.8	9.0

Source: Navigant analysis

Satisfaction with PECO

The survey respondents indicated their overall satisfaction with PECO. The average rating was 8.30, indicating a high level of satisfaction. These findings are consistent with the satisfaction ratings provided by the PY4 and PY3 respondents, as Table 3-42 shows.

Table 3-42: Overall Satisfaction with PECO

Satisfaction	PY3 (n = 200)	PY4 (n = 200)	PY5 (n = 200)
Overall Satisfaction with PECO	8.2	8.3	8.3

Source: Navigant analysis

Table 3-42 shows ratings for overall satisfaction with PECO among survey respondents after their participation in SHR. In both PY4 and PY3, program participation led about one-quarter of the respondents (23 percent) to express greater overall satisfaction with PECO, while three-quarters (75 percent in PY4 and 74 percent in PY3) reported no change in their satisfaction ratings for PECO based on program participation. In PY5, however, 40 percent of respondents stated that they had a higher level of satisfaction with PECO after their participation. This is a significant increase in this response category.

Table 3-43: Comparisons of Change in Satisfaction with PECO After Participation

Higher/Lower	PY3 (n = 200)		PY4 (n = 200)		PY5 (n = 200)	
	Total Respond	Total Respond	Total Respond	% Respond	Total Respond	% Respond
Higher	46	23%	46	23%	80	40%
About the Same	147	74%	149	75%	116	58%
Lower	5	3%	2	1%	3	2%
Too Early to Tell	1	1%	3	2%	0	0%
Don't Know	0	0%	0	0%	1	1%
Total	**200**	**200**	**200**	**100%***	**200**	**100%***

*Percentages add up to more than 100% due to rounding.

Source: Navigant analysis

Reasons for Program Dissatisfaction

Few respondents indicated any reasons for dissatisfaction with the SHR program. This small minority of respondents (3, compared to 27 in PY4) complained that they did not receive the rebate in a timely manner or had trouble with the application. These were the same issues reported in PY4 when the level of dissatisfaction was greater by a factor of 9. This change reflects earlier findings of overall increased satisfaction with the program on the part of participants who purchased non-lighting measures.

Areas for Program Improvement

Consistent with the high satisfaction ratings, as in PY4 and PY3, the majority of PY5 survey respondents did not have any recommendations for program improvement (51 percent – identical to PY4). Among those PY5 respondents that did have recommendations for improvement, the most frequently mentioned ideas were for higher rebates (9 percent) and faster application processing (6 percent).

Overall Participant Program Satisfaction

Overall, satisfaction with PECO and with the SHR program is high. Participants commented most favorably on the variety of products available through the program, the high quality of those products, and the professional assistance they have received from program contractors and other sources. Participants in non-lighting measures gave relatively high marks to all aspects of the program, including the size of the rebate received. Lighting purchasers note a variety of positive features of energy-efficient bulbs when citing why they purchased them. The large majority of lighting purchasers say they will buy high-efficiency bulbs as these take the place of traditional incandescent bulbs under EISA. At the same time, approximately 40 percent of respondents who were not purchasing CFLs note that even if there was no price premium for CFLs relative to the baseline technology, it is not at all likely that they would purchase them. Twelve percent of respondents gave this answer for LEDs.

Measure Installation Rate for Purchase of Non-Lighting Measures

The participant survey respondents installed a total of 205 measures. As in previous years, all 200 PY5 participants installed at least one qualifying measure, a 100 percent installation rate. Three (1.5 percent) of these respondents installed at least one additional qualifying measure. The percentage installing a second measure was lower than for PY4 (36 participants or 18 percent).

About half of PY5 respondents (54 percent) indicated that their reason for purchase was to replace old or outdated equipment, comparable to PY4 responses (52 percent) but less than in PY3 (67 percent). PY5 respondents' next most frequently cited reason was to be more energy efficient, with nearly one-quarter (24 percent) citing this reason. This is similar to the proportion that mentioned EE as the reason for their purchase in PY3 (8 percent) but less than half of those that mentioned this reason in PY4 (23 percent). The number of respondents citing a desire to reduce energy costs in PY5 (1 percent) declined significantly in previous years (15 percent in PY4 and 18 percent in PY3). This declining focus on energy as a rationale for purchases may indicate a reduced interest in EE overall.

Low-Income Participation

According to the 2008 – 2012 American Community Survey, 21 percent of families in Philadelphia County have income below the federal poverty level (FPL).[12] However, SHR lighting participants do not reflect this demographic.

All intercept survey respondents were asked if their household income, based on the number of people living in the home full-time, was above or below the program definition of low-income participation. Per Table 3-44, overall, approximately 11 percent of program participants indicated their households qualify as low income.

Table 3-44: Low-Income Participation Rate

Bulb Type	Low Income		All Program Participants		% Low Income
	Bulbs	n	Bulbs	n	
Standard CFLs	96	18	586	102	16%
Specialty CFLs	2	1	69	22	3%
LEDs	1	1	105	37	3%
Total	**99**	**19**	**760**	**160**	**11%**

Note: Overall low-income participation rate across bulb types is weighted by total verified program bulb sales by type from the program tracking data, not by the relative proportions in respondents' baskets.

Source: Navigant analysis of in-store intercepts data

[12] *U.S Census Bureau, 2008 – 2012 American Community Survey,* http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF, accessed September 25, 2014.

Looking across all intercept respondents, households qualifying as low income have anywhere from 1 to 8 people living in the home, with most low-income households having 2 to 5 occupants. Table 3-45 shows the distribution of number of people per household as well as self-identified income status for all intercept respondents.

Table 3-45: Household Income by Number of Occupants

Was your total 2013 household income before taxes below...			Below	Above	Prefer not to share	Don't know	Total
How many people, including yourself, live in your home full-time?	1	$17,235	17	33	19	1	70
	2	$23,265	22	136	39	1	198
	3	$29,295	11	88	14	3	116
	4	$35,325	23	156	29	3	211
	5	$41,355	28	79	25	0	132
	6	$47,385	19	23	7	3	52
	7	$53,415	7	3	2	0	12
	8	$59,445	2	1	0	0	3
	9	$65,475	0	0	2	0	2
	10	$71,505	0	1	4	0	5
	Refused	N/A	0	0	1	0	1
Total			**129**	**520**	**142**	**11**	**802**

Source: Navigant analysis

Eleven percent of non-lighting survey respondents self-reported as low-income customers (less than 150 percent of the FPL). The basis for this designation is a combination of annual income and household population. The level of low-income participation is unchanged since PY4, the first time this evaluation examined this topic. As with the lighting participants, HVAC and Appliance participants are not commensurate with the surrounding community.

Trade-Ally Perspectives - Retailers

The PY5 mystery shopping results demonstrate an overall positive view of the PECO SHRs program among sales personnel, with some room for improvement. Sales personnel were generally knowledgeable and enthusiastic about the rebated products and about EE, and mystery shoppers gave them above average ratings in terms of knowledge of the PECO SHR program. However, the program does not have a significant presence in stores, with the majority of retailers lacking promotional materials and a low percentage of sales personnel making unprompted mentions of the available rebates. This lack of program presence may, in turn, be leading to a lack of sales effort on the part of retail staff.

Trade Ally Perspectives - HVAC Installers

As in previous years, participating HVAC installers continue to have a high level of satisfaction with the program. These respondents indicated that outreach by PECO, rather than Ecova, was the source of their information about the program. Respondents also indicated that the program has influenced them, to some degree, to sell higher efficiency equipment.

Program Materials Review

PECO and Ecova provided the evaluation team with samples of customer-facing program marketing materials, as well as samples of internal reporting and program documentation materials that facilitate communication regarding program implementation. The evaluation reviewed all of these materials as well as the PECO Smart Ideas website for their information content, stylistic details, and consistency of presentation.

Market Actor Insights – LED Manufacturers

The evaluation team interviewed five lighting manufacturers and two retail buyers. The retail buyers represented the warehouse and big box retail sales channels, and the manufacturers represented bulb sales through warehouse, big box, DIY/home improvement, and discount/thrift retail channels, which collectively represent 95 percent of PY5 program bulb sales. Retail sales channels not represented in the interviews were small hardware and grocery/drug stores.

A number of themes emerged from the trade ally interviews, some of which were articulated by just one or two respondents while others were echoed with slight variations across all respondents on both the manufacturer and retailer side. Respondents varied significantly in terms of the degree to which they say they would have been selling the same selection of LEDs in the absence of the program. One respondent said they would not be selling LEDs at all in the absence of the program, and another said their range of offerings would be 80 percent fewer without the program, while two others said the program had no effect on their LED offerings at all.

Respondents, especially manufacturers, consistently remarked that their LED offerings have expanded since mid-spring 2014 as PY5 was drawing to a close. In some cases this expansion in program offerings is accompanied by a decrease in the incentive per package for a given product. One manufacturer noted that they have shifted from selling a mix of CFLs and LEDs through the program to focusing exclusively on LEDs as of the tail end of PY5.

Respondents noted that, by and large, incentive levels in SHR are on par with those of other programs across the U.S. If anything, SHR incentive amounts are somewhat higher than average, which respondents say is necessary given the program's focus on LEDs. With regard to changing incentive levels, respondents estimated on average that a 25 percent increase in incentive from current levels would likely yield a 10 percent increase in program LED sales. The percent increase in incentive levels might need to be a bit higher than that for reflector LEDs and lower for globes and other covered bulbs. At the same time,

interviewees responded positively to the fact that incentive levels and program offerings are generally quite stable in the SHR program, and they asked that this stability continue as a theme in the overall program design.

Most respondents noted that a 10 percent increase in program LED sales could also be achieved through increased program promotion if incentive levels stayed constant. Respondents emphasized that all the main promotional approaches are effective at driving sales, including active promotion at end caps, more in-store promotions, and anything done to increase customer education about the long-term cost savings *from investing in LEDs.*

Respondents estimated the lift they have seen in LED sales relative to the absence of an incentive program. Table 3-46 below shows estimated sales lift alongside program lamp sales and a resulting weighted average NTG estimate based on the completed interviews.

Table 3-46: NTG Based on Lighting Manufacturer Estimates

Retail Channel	Retail Channel LED Sales	NTG Estimate
Warehouse/Club	252,046	0.6
DIY/Home Improvement	136,621	0.6
Big Box	682	0.9
Thrift/Discount	8,388	1.0
Weighted Average:	--	**0.6**

Source: Lighting Manufacturer Interviews

3.5 Recommendations for Program

Table 3-47 lists Navigant's recommendations for SHR programming in the remainder of Phase II, and the status of action on the recommendations

Table 3-47: PY5 SHR Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should consider collecting unit model number and Energy Factor (EF) and including this information in the tracking database for all water heaters.	Implemented on 6/1/2014 as part of the 2014 TRM implementation work.
Recommendation 2: In Phase III, we recommend that these measures be included in the Smart Multifamily program since this program has *apartments and condominiums as their target market.*	Considering. Will take into account when we begin planning for Phase III.
Recommendation 3: Database should include data on whether a Room Air Conditioner is a window or wall unit. This will enable more accurate accounting of energy savings.	Completed on 6/1/2014 as part of the 2014 TRM implementation work.
Recommendation 4: TRM lumen bins should be used to derive baseline wattage for reflector lamps. Other EISA-exempt lamps should use the manufacturer's equivalent wattage.	Completed on 6/1/2014 as part of the 2014 TRM implementation work.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 5: Ecova should add a column to the program database with manufacturer's equivalent wattage. As the SWE guidance states, this manufacturer's equivalent wattage should be used as the baseline wattage for all EISA-exempt CFLs other than reflectors (i.e., specialty CFLs and CFLs >2,600 rated lumens output).	Implemented. Completed on 6/1/2014 as part of the 2014 TRM implementation work.
Recommendation 6: At PECO's direction, Ecova should increase outreach to retail and installation contractor trade allies that will enhance sales and technical staff knowledge of qualifying non-lighting measures and benefits to customers. This will raise awareness and assure that SHR will meet its participation and savings goals for the rest of Phase II.	Implemented/In Process. PECO has a field team that has built good relationships with retailers and contractors. We have already begun "lunch-and-learns" particularly in Home Depot stores regarding lighting education. We will step up these efforts and expand this initiative further.
Recommendation 7: At PECO's direction, Ecova should invest more time training and motivating retail staff to use rebates to sell qualifying lighting and appliances.	Implemented/In Process. We will be working with the retailers to ensure that the rebate and the purpose of energy efficiency rebates are part of the sales process. We have already identified opportunities in Sears locations and will be testing the approach.
Recommendation 8: As a program management technique to manage the program to meet the EE&C plan goals, PECO could adjust upstream incentives to influence specific retail price targets. As described by the market actors, once price points drop below certain levels.	Implemented. Completed. PECO adjusts the upstream incentives on a regular basis to account for market changes. Additionally we have been using special promotions by brand and store to identify how the rebate can effect sales and market penetration.
Recommendation 9: To shift the program participation to achieving deeper, longer term lighting savings using LEDs, PECO and Ecova should increase the marketing and education emphasis on LED models that exceed the capabilities of CFLs.	Implemented. Completed. PECO/Ecova launched an educational tool that is iPad based and used by our field team to educate customers and employees on the use of efficient lighting in the home – this education helps match uses in the home to specific lamp types.
Recommendation 10: PECO, Ecova and Navigant should collaborate with willing retailers and manufacturers to collect data in order to document the lift effect among participating and non-participating retail stores.	Being considered. This may be a heavy lift for Navigant and PECO as manufacturers consider this data to be proprietary and confidential. The potential of obtaining this data will need to be evaluated.
Recommendation 11: To have a greater impact on market transformation and savings that last longer, PECO, through Ecova, should focus rebate funding and promotion on measures with deeper, longer term savings.	Implemented. PECO has made a strong effort to increase deeper measures and are consistently targeting higher volumes of appliances and HVAC equipment through direct mail, bill inserts, and out of home media
Recommendation 12:PECO, with input from Navigant and Ecova, should identify geographies within its service territory that have had limited participation in the past five program years. Based on this identification effort, PECO and Ecova should retarget promotional efforts – both in terms of content and media.	Implemented/In process. PECO has completed focus groups in October 2014 with non-participating middle-lower income individuals in zip codes that are not heavily participating. From these findings we will be crafting strategies to reach this population and encourage participation.

Source: Navigant analysis

3.6 Financial Reporting

As shown in Table 3-48, the Total Resource Cost test for SHR yielded a result of 2.25. This is nearly twice the PY5 planned goal of 1.20. The achievement of this level of cost-effectiveness indicates consistent delivery of program measures throughout the program year. However, in the context of a 75 percent annual budget spend, participation skewed towards upper income demographics, and moderate to high free ridership, SHR may be seizing the proverbial "low hanging fruit" while missing the opportunity to serve a broader range of its ratepayers with measures that offer "deeper savings." To accomplish this latter end, Navigant made several recommendations to shift the program participation towards longer term savings measures.

Table 3-48: Summary of PY5 Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	6,892	6,892
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	6,892	6,892
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	3,486 29	3,486 29
Marketing[2]	**3,515**	**3,515**
Subtotal EDC Implementation Costs		
	0	0
EDC Evaluation Costs	0	0
SWE Audit Costs	10,407	10,407
Total EDC Costs[3]	29,434	29,434
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**32,949**	**32,949**
Total NPV Lifetime Energy Benefits	**60,266**	**60,266**
Total NPV Lifetime Capacity Benefits	**4,040**	**4,040**
Total NPV TRC Benefits[6]	**73,982**	**73,982**
TRC Benefit-Cost Ratio[7]	**2.25**	**2.25**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs. Navigant recommends allocating 8.5% of these costs to the Commercial and Industrial Sector due to cross-sector installations
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

4 Smart House Call

PECO's SHC program is a new program in Act 129 Phase II that focuses on direct installation of energy efficiency measures in participants' homes and incentivized opportunities for electric heat rate customers to pursue additional heating, ventilation, and air conditioning (HVAC) and building shell measures installed by program-approved contractors. The program targets all PECO residential electric customers with single-family detached, attached, and multi-family buildings with less than four residentially metered units. The education component of the program is targeted at improving customer understanding of how their homes use energy and how they can use it more efficiently, as well as at fostering a trained, building science-focused, professional retrofit workforce of contractors.

The program is built around the following energy efficiency measures:

- Air Source Heat Pump (Duct Sealing)
- Air Source Heat Pump (Maintenance)
- Ceiling/Attic and Wall Insulation
- Air Sealing
- Electric Water Heater Pipe Insulation
- ENERGY STAR Compact Fluorescent Lamp (CFL) Bulbs
- ENERGY STAR Light-Emitting Diodes (LEDs)
- *LED Nightlight*
- Low-Flow Faucet Aerators
- Low-Flow Showerheads
- Smart Strip Plug Outlets

4.1 *Program Updates*

As a new program in Phase II, there are no updates for SHC.

4.1.1 Definition of Participant

A participant is defined as a PECO customer who has received either an audit or an assessment. In most cases, this means one or more direct install measures have been installed in their home, and the customer may have proceeded to one or more of the building shell measures in the case of audit participants. *However, note that there are some cases where a participant receives an audit or assessment, but chooses* to decline the direct install and building shell measures. These customers are still considered program participants since they received the audit or assessment and the associated report detailing energy efficiency opportunities for their home.

4.2 Impact Evaluation Gross Savings

Energy Efficiency measures in the SHC program consist of deemed measures in the Pennsylvania TRM, as well as one measure, air sealing, for which there is no TRM guideline, but for which Navigant developed an Interim Measure Protocol (IMP) that was approved by the SWE. This section presents overall gross impact results, exhibited by program measure and by sector, including realization rates.

4.2.1 Gross Savings Evaluation Methods

To generate program-reported savings by measure, PECO uses algorithms from the 2013 Pennsylvania TRM. Energy Advisors and home retrofit installation contractors collect data during home visits to inform the parameter inputs for savings algorithms.

The evaluation team reconstructed the energy and demand savings calculations based on the collected site-level data and the TRM algorithms, and compared these calculations against energy and demand savings that PECO reported. The evaluation team performed the analysis on a record-by-record basis, recreating savings calculations based on the TRM algorithms and the relevant parameter values in the tracking data. Any observed discrepancies between the savings goals, reported values, and evaluated values are framed in terms of how the discrepancies can best be mitigated. Total reported participation, energy savings, demand savings, and total incentive amounts are shown in Table 4-1.

Table 4-1: Phase II SHC Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	1,182	954	0.1	$72.5
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	1,182	954	0.1	72.5

Source: Program tracking data

The evaluation team calculated gross energy and demand savings for this program directly as a function of the verified program tracking data, with per-unit savings calculated from algorithms in the Pennsylvania TRM. As such, the verification of gross program savings is based on a census. As part of the verification and due diligence process, the evaluation team performed file review on a sample of 40 randomly selected participants to compare program tracking data against all data collected for a given participant by the CSP.

Table 4-2 below shows the number of sample points by data source for each program measure. These are listed in order for the tracking data review, the participant telephone survey, and the participant file review (tracking data review/participant telephone survey/file review). Sampling approaches by data source are described below the table.

Table 4-2: SHC Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Smart Strip Plug Outlets	645	85/15	645/42/23	645/42/23	File review, bottom-up calcs
ENERGY STAR CFL Bulbs	935	85/15	935/53/85	935/53/85	File review, bottom-up calcs
Ceiling / Attic and Wall Insulation	72	85/15	72/0/5	72/0/5	File review, bottom-up calcs
Insulation-Air Sealing	85	85/15	85/0/5	85/0/5	File review, bottom-up calcs
ENERGY STAR LEDs	366	85/15	366/25/10	366/25/10	File review, bottom-up calcs
LED Nightlight	55	85/15	55/5/6	55/5/6	File review, bottom-up calcs
Low flow Faucet Aerators	439	85/15	439/36/17	439/36/17	File review, bottom-up calcs
Low Flow Showerheads	504	85/15	504/39/23	504/39/23	File review, bottom-up calcs
Electric Water Heater Pipe Insulation	37	85/15	37/1/0	37/1/0	File review, bottom-up calcs
Program Total	1180	85/15	N/A	N/A	N/A

Source: Program tracking data, Phase II evaluation plan

Verification of program measure installation took the form of asking participant telephone survey respondents to confirm which program measures had been installed in their homes as compared with the program tracking data, as well as performing file review of 40 randomly selected participants from the tracking data. In the participant telephone survey, all respondents confirmed that all measures as recorded in the program tracking data were, in fact, installed in their homes, with one exception. One respondent, when asked about a low-flow faucet aerator that had been noted in the tracking data as being installed, said that it was offered, but that they declined it. The evaluation team did not use this one exception to adjust the overall program realization rate; rather, the evaluation team regarded the virtually comprehensive affirmation of program measure installation as verification of the tracking data's accuracy.

4.2.2 Gross Savings Evaluation Findings

In the file review, all measures shown in the tracking data were confirmed against the audit reports, assessment receipts, and assessment data collection forms as being consistent across the data sources. The match was confirmed for customer identifying information, housing characteristics information, and types and quantities of program measures installed. Table 4-3 below shows the number of each measure type represented in the file review sample and shows the one-to-one correspondence between the tracking data and participant files.

Table 4-3: Measure Confirmation in File Review

Measure Name	Measures in Sample from Program Tracking Data	Measures Confirmed Against Participant Files	% Match Between Sources
Air Source Heat Pump(Duct)	1	1	100%
Air Source Heat Pump(Maintenance)	1	1	100%
Ceiling / Attic and Wall Insulation	5	5	100%
ENERGY STAR CFL Bulbs	85	85	100%
ENERGY STAR LEDs	10	10	100%
Insulation-Air Sealing	5	5	100%
LED Nightlight	6	6	100%
Low flow Faucet Aerators	17	17	100%
Low Flow Showerheads	23	23	100%
Smart Strip Plug Outlets	23	23	100%
Grand Total	176	176	100%

Source: Program tracking data and participant audit reports, assessment receipts, and assessment data collection forms provided to Itron by CSP

The evaluation team also notes that there are 1,180 unique customer numbers in the program tracking data across PY5, whereas there are 1,182 participants reported. The PY5 Q4 savings report quarterly data noted a retroactive adjustment to the number of participants in PY5 Q2, moving it upward from 170 to 173 and noting, "Q2 participants adjusted by 3 to match SIDS". There were no accompanying kWh or kW adjustments. Also, in PY5 Q4, 738 participants were reported, but 739 unique customer numbers are found in the program tracking data. Based on observing 1,180 unique customers in the PY5 tracking data, the evaluation team reports all results as stemming from these 1,180 verified program participants.

Reported and verified energy and demand savings by measure for the whole program are shown in Table 4-4 below. CFLs, low-flow showerheads, and smart strip plug outlets were responsible for the largest proportion of program savings, collectively comprising approximately 71 percent of total program energy savings and 45 percent of program demand savings. Eight out of 11 measures in the program showed an energy savings realization rate of 1.00. The energy savings realization rate for the program overall was

1.03, driven upward by the ceiling/wall insulation, air source heat pump (ASHP) maintenance, and air sealing measures.

Table 4-4: Program Year 5 SHC Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
ASHP (Duct)	47.627	1.00	47.625	0.0	0%
ASHP (Maintenance)	9.637	3.33	32.118	0.0	0%
Smart Strip Plug Outlets	*135.056*	*1.00*	*135.056*	*0.0*	*0%*
ENERGY STAR CFL Bulbs	287.515	1.00	287.564	0.0	0%
Ceiling / Attic and Wall Insulation	65.769	1.05	68.934	0.0	0%
Insulation-Air Sealing	41.456	1.17	48.410	0.0	0%
ENERGY STAR LEDs	30.865	1.00	30.847	0.0	0%
LED Nightlight	*2.928*	*1.00*	*2.935*	*0.0*	*0%*
Low flow Faucet Aerators	48.24	1.00	48.361	0.0	0%
Low Flow Showerheads	281.348	1.00	281.305	0.0	0%
Electric Water Heater Pipe Insulation	4.032	1.00	4.032	0.0	0%
Program Total	954.473	1.03	987.188	0	0%

Source: Navigant analysis, program tracking data

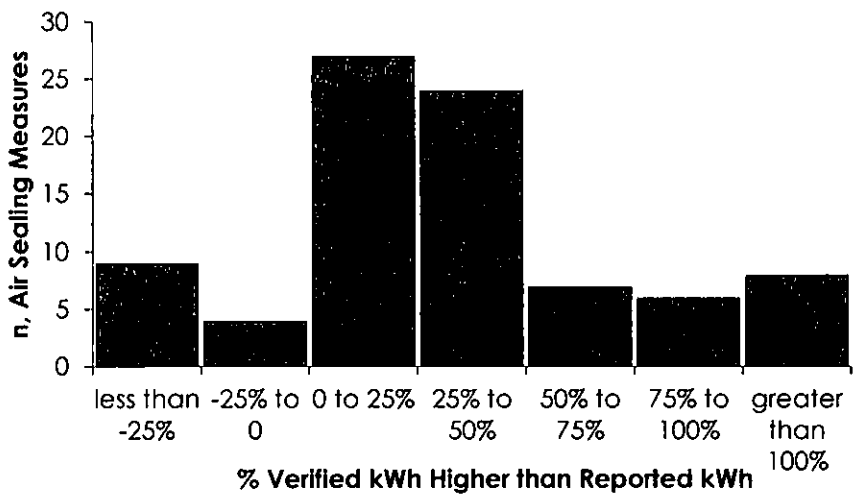
For the ASHP maintenance measure, the realization rate was 3.33. The difference between reported and verified savings for both energy and demand stems from a pair of values in the savings calculation algorithm. Specifically, the Maintenance Factors for heating and cooling (MFcool and MFheat) both have a default value of 10 percent in the TRM. A value of 3 percent for MFcool and MFheat was put forward in a draft IMP for ASHP maintenance and appears to have been used in the derivation of program reported savings, but this draft IMP was never submitted by the implementation CSP to PECO or the SWE and was, therefore, not adopted in PY5. As such, the algorithm and default input values in the TRM continue to form the correct basis for this calculation.

For attic and wall insulation, the realization rate based on energy savings was 1.05. The difference between reported and verified savings appears to be again due to a difference between default values in the TRM and those used in the reported savings algorithms. Specifically, for cases where R-value for the efficient case (Rwall,ee) is unknown, the default value in the TRM is 9.0. Similarly, where there was no insulation before the retrofit, the default value in the TRM for R-value of the wall (Rwall,bl) is 3.0 (assumes existing, un-insulated wall with 2-by-4 studs at 16 inches on center with wood or vinyl siding). The evaluation team applied these default TRM values in cases where Rwall,ee or Rwall,bl was zero or missing in the tracking data, and this drove the energy savings higher.

For the air sealing measure, there is no section in the TRM. Navigant put forward an IMP for this measure early in PY5, and the algorithms and default input values in that IMP formed the basis for the verified savings calculations. However, it is important to note that there appears to be an error in the algorithm for demand savings in that IMP. Because the algorithm is structured to yield savings per change of 50 cubic feet per minute (CFM50) in a home's air leakage rate, it appears that the algorithm should include a "/50" term (i.e., should express the savings calculation per change of 50 units), as these are the units in which the input values to the algorithm are expressed. The evaluation team applied this edit to the kW algorithm in the verified savings calculations, and the resulting kW savings values are consistent with expectations.

Another important observation is that, while the overall realization rate for the air sealing measure was 1.17, the evaluation team observed widely varying differences between reported and verified savings calculations on a record-by-record basis. The distribution of the observed differences in energy savings between reported and verified calculations can be seen in Figure 4-1 below, displayed as verified kWh relative to reported kWh for a given participant. The evaluation team infers that the savings algorithm is not being consistently applied in SIDS and recommends that the SIDS algorithms informing this measure be revisited and re-evaluated for both energy and demand.

Figure 4-1: Participant-Level Air Sealing kWh Savings, Verified Relative to Reported



Source: Navigant analysis

Whereas gross impact results for energy savings were driven especially by CFLs, low-flow showerheads, and smart strip plug outlets, gross impact results for peak demand savings were driven predominantly by low-flow showerheads, air sealing, ASHP duct cleaning, and CFLs. These four measures were collectively responsible for 68 percent of peak demand savings. Realization rates for demand showed the same pattern as for energy savings and for the same reasons. As shown in Table 4-5, ASHP maintenance and insulation had demand realization rates of 3.33 and 1.06 respectively, driven by the differences in default

algorithm input values cited above. Air sealing exhibited a demand realization rate of 1.09, and reported values showed a wide dispersion across respondents relative to the bottom-up calculations by the evaluation team based on the IMP. All other measures exhibited demand realization rates of 1.00.

Table 4-5: Program Year 5 SHC Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
ASHP (Duct)	0.017	1.00	0.017	0.0	0%
ASHP (Maintenance)	0.004	3.33	0.014	0.0	0%
Smart Strip Plug Outlets	0.011	1.00	0.011	0.0	0%
ENERGY STAR CFL Bulbs	0.017	1.00	0.017	0.0	0%
Ceiling / Attic and Wall Insulation	0.008	1.06	0.009	0.0	0%
Insulation-Air Sealing	0.023	1.09	0.025	0.0	0%
ENERGY STAR LEDs	0.002	1.00	0.002	0.0	0%
LED Nightlight	0	0.00	0.000	0.0	0%
Low flow Faucet Aerators	0.005	1000	0.005	0.0	0%
Low Flow Showerheads	0.031	1000	0.031	0.0	0%
Electric Water Heater Pipe Insulation	*0.000*	*1.00*	*0.000*	*0.0*	*0%*
Program Total	0.119	1.11	0.131	0	0%

Source: Navigant analysis

4.3 Impact Evaluation Net Savings

The evaluation team used a customer self-report approach from the participant telephone surveys to develop estimates of participant-level and program-level free ridership, spillover, and resulting NTG ratio. Specific methods and findings are presented in this section.

4.3.1 Net Savings Evaluation Methods

Using guidelines in NTG approach from the ETO NTG methodology, the evaluation team developed a series of questions in the participant telephone survey that target what survey respondents would have done in the program's absence and that ask respondents to rate the influence of a series of program factors on their decision to install the energy efficient measures. Using this approach, free ridership can take on values ranging from 0 to 1.0 for each respondent and for the program overall. High free rider scores are associated with survey respondents who reported they would have pursued all of the program measures in the absence of the program and who rated the influence of the program on their decision making as very low or zero.

While the evaluation team structured the survey to ask respondents about the program's influence on their overall installation decisions, the survey also asked respondents to rate the program's influence on their decisions at a measure-by-measure level. This measure-level inquiry is separate from the ETO method and provides information for free ridership and NTG calculation in parallel with the ETO method. By design, the ETO method yields the formal recommended values for free ridership by participant type and overall. The parallel method is used to add qualitative insight on program impacts by measure type.

To gauge program spillover, participant telephone survey respondents were asked to identify any non-rebated energy efficiency measures they installed directly due to program participation and for which they received no rebate or other incentive. Individuals first identified through the computer-assisted telephone interviewing-based (CATI-based) survey as potential spillover participants were then contacted by professional interviewers to reconfirm the nature of the measures, the role of the program in their installation, the absence of a rebate or other incentive for the measures, and specific information to inform the calculation of savings from the spillover measures. As a qualitative check, the professional interviewer asked respondents, where possible, to rate the energy savings they observed from these spillover measures relative to savings observed from the SHC program measures. In cases where a respondent could confirm the measure was installed but could not provide reliable information necessary for the spillover savings calculations, the evaluation team used default input parameter values from the TRM or used the weighted average value for that parameter in the tracking data from the SHC program population.

The evaluation team estimated program NTG ratio based on responses to the participant telephone survey. The sample for the participant telephone surveys was selected at random from the complete program tracking data to date (644 participants as of April 2014, when calling for the survey began). The Itron CATI Center pulled a sample of 619 customers at random from the PECO Smart Ideas Data System database with an anticipated completion rate of 12 percent based on the Itron CATI center's past experience of survey response rates. The number of completed surveys was designed to provide free ridership estimates consistent with gross savings estimate requirements for 90 percent confidence with ±10 percent precision at the program level, as shown in Table 4-6.

Table 4-6: SHC Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[13] to Achieve Sample
All SHC Participants	N/A	1,180	0.5	90/10	68	70	0.114
Program Total	N/A	1,180	0.5	90/10	68	70	0.114

Source: Phase II evaluation plan

4.3.2 Net Savings Evaluation Findings

Based on the participant telephone survey results, program free ridership is low, at 0.2, both for audit- and assessment-level participants. In addition, both audit and assessment participants report program spillover, and spillover is especially high for assessment participants, at 0.2. The resulting weighted average NTG for the whole program, weighted by kWh savings across all respondents, is 0.9, as shown in Table 4-7.

Table 4-7: Program Year 5 SHC Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Audit Participants	0.2	0.0	0.8	0.5	7.7%
Assessment Participants	0.2	0.2	1.0	0.5	8.4%
Program Total[14]	0.2	0.1	0.9	0.5	5.6%

Source: Participant telephone survey

Looking in more detail at the individual free ridership scores comprising the overall total, two scores were by far the most common. Twenty-four respondents received a free ridership score of zero, meaning they said they would have installed none of the program measures in the absence of the program and rated at least one of the program elements with the highest score for having impacted their decision to install the program measures. These program elements included:

[13] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

[14] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

- The program incentives
- The change in energy bills associated with having the efficient equipment installed
- The price of the assessment or audit
- The level of service provided by the contractor
- The information provided in the assessment or audit report

Also, 26 respondents received a free ridership score of 0.25 from having said they would have installed some of the measures in the absence of the program, but also having given the highest influence score to at least one of the program elements in their decision to install the measures. These two specific scoring outcomes scores collectively represented over 70 percent of respondents and energy savings in the survey sample. No participants were scored as full free riders, and the highest free ridership score in the sample was 0.75, as shown in Table 4-8.

Table 4-8: Free Ridership Distribution, ETO Methodology

Program Influence Score	Free Rider Rate for Program Influence	Stated Intent: Would have installed... in absence of program	Free Rider Rate for Stated Intent	Overall Free Rider Rate	Number of Survey Respondents with This Score, n	% of kWh Represented	% of kW Represented
5	0	None	0	0	24	36%	36%
4	0.125	None	0	0.125	4	3%	4%
3	0.25	None	0	0.25	5	4%	5%
2	0.375	None	0	0.375	--	--	--
1	0.5	None	0	0.5	--	--	--
5	0	Some	0.25	0.25	26	42%	40%
4	0.125	Some	0.25	0.375	3	3%	4%
3	0.25	Some	0.25	0.5	2	3%	3%
2	0.375	Some	0.25	0.625	--		
1	0.5	Some	0.25	0.75	2	1%	1%
5	0	All	0.5	0.5	3	6%	6%
4	0.125	All	0.5	0.625	1	1%	1%
3	0.25	All	0.5	0.75	--	--	--
2	0.375	All	0.5	0.875	--	--	--
1	0.5	All	0.5	1	--	--	--
DK	NA	DK	NA	NA	--	--	--
Free Ridership, Weighted Avg.:				0.2	70	100%	100%

Source: Participant telephone survey

Table 4-9 shows free ridership rates broken out separately for assessment and audit participants. Free ridership scores of zero and 0.25 were most common both for assessment and for audit participants.

Table 4-9: Free Ridership by Participant Type, ETO Methodology

Overall Free Rider Rate	Assessment			Audit			All		
	n	kWh	kW	n	kWh	kW	n	kWh	kW
0	10	36%	34%	14	36%	37%	24	36%	36%
0.125	4	10%	12%	--	--	--	4	3%	4%
0.25	10	44%	44%	21	47%	46%	31	46%	45%
0.375	2	5%	6%	1	2%	3%	3	3%	4%
0.5	1	4%	3%	4	12%	11%	5	9%	9%
0.625	--	--	--	1	1%	2%	1	1%	1%
0.75	1	1%	1%	1	1%	1%	2	1%	1%
0.875	--	--	--	--	--	--	--	--	--
1	--	--	--	--	--	--	--	--	--
TOTAL	28	100%	100%	42	100%	100%	70	100%	100%
Weighted Avg:	**0.2**			**0.2**			**0.2**		

Source: Navigant analysis

As noted in the methods section of this report, the evaluation team also undertook a second, parallel approach to estimating free ridership via questions in the participant telephone survey that asked respondents to rate the program's influence on their decisions on a measure by measure basis.

Table 4-10 below shows the results of the parallel, informal free ridership approach, which yields an overall weighted average free ridership score of 0.3. Weighted average free ridership scores vary significantly across program measures, from a low of zero for pipe insulation to a high of 0.6 for LED nightlights. By this method, free ridership scores are comparatively high, around 0.5, for CFLs and LEDs, and comparatively low, around 0.2, for shower aerators, faucet aerators, and smart strip plugs. Also, CFLs

and shower aerators are responsible for over 70 percent of total kWh savings among survey respondents, so these play a large role in driving the overall weighted average score.

Table 4-10: Free Ridership from Parallel, Non-ETO Methodology

Measure	Assessment			Audit			Total		
	Free Ridership	% kWh	% kW	Free Ridership	% kWh	% kW	Free Ridership	% kWh	% kW
CFL	0.58	44%	33%	0.52	27%	17%	0.55	33%	22%
LED	0.49	5%	4%	0.50	3%	2%	0.49	4%	3%
Pipe Insulation	0.00	0%	0%	0.00	0%	0%	0.00	0%	0%
LED Nightlight	0.57	2%	0%	0.75	0%	0%	0.61	1%	0%
Low Flow Shower Aerator	0.38	26%	36%	0.19	46%	56%	0.23	39%	50%
Smart Strip Plug	0.23	21%	22%	0.22	14%	14%	0.23	17%	16%
Bathroom Faucet Aerator	0.35	4%	5%	0.10	9%	11%	0.15	7%	9%
Total	0.44	100%	100%	0.29	100%	100%	0.34	100%	100%

Source: Participant telephone survey

Table 4-11 below also shows free ridership by measure from the parallel, non-ETO methodology, broken out by the proportion of respondents receiving each possible free ridership score. It is worth noting that by this method approximately 14 percent of respondents were marked as full free riders, in contrast to the ETO method where zero respondents were scored as full free riders. The table below is split into two sections by measure for easier viewing.

Table 4-11: Free Ridership Scores Distribution from Non-ETO Methodology

Free Ridership	CFL		LED		Pipe Insulation		LED Nightlight	
	n	% kWh	n	% kWh	n	% kWh	n	% kWh
0	11	5%	6	1%	1	0%	1	0%
0.25	4	4%	3	0%	--	--	--	--
0.5	13	9%	8	1%	--	--	2	0%
0.75	14	6%	3	0%	--	--	--	--
1	11	8%	5	1%	--	--	2	0%
Total:	53	33%	25	4%	1	0%	5	1%
Free Ridership:	0.6		0.5		0.0		0.6	
Free Ridership	**Low-Flow Shower Aerator**		**Smart Strip Plug**		**Bathroom Faucet Aerator**		**Total**	
	n	% kWh	n	% kWh	n	% kWh	n	% kWh
0	24	24%	25	10%	24	5%	--	46%
0.25	3	3%	5	2%	4	1%	--	11%
0.5	5	5%	7	3%	4	1%	--	20%
0.75	3	3%	2	1%	1	0%	--	10%
1	4	4%	3	1%	3	0%	--	14%
Total:	39	39%	42	17%	36	7%	70	100%
Free Ridership:	0.2		0.2		0.2		0.3	

Source: Participant telephone survey

4.4 Process Evaluation

The evaluation team based the process evaluation for PY5 on data from several sources. The only process evaluation data source that involved sampling was the participant telephone survey, and the sampling methodology for that survey is presented in its respective section below. Data sources that informed the process evaluation include the following:

- Participant Telephone Surveys
- Program Material Review
- Program Manager and Implementer Interviews
- Energy Advisor and Contractor Interviews
- Tracking System Assessment
- Program Theory Review

4.4.1 Process Evaluation Methods

The process evaluation drew upon diverse data sources as noted above. The following sections describe specific methods associated with each data source.

Participant Telephone Surveys

The telephone survey was conducted with 70 program participants drawn at random from the population of 644 participating PECO customers who were in the program implementer's database as of the sampling date. The survey was conducted with 42 audit-level participants and 28 assessment-level participants, which reflects the overall proportion of program participants at these two levels. Questions in the survey focused on the influence of the program on respondents' decision to implement the program measures, their experience of and satisfaction with various elements of the program, and ways in which the SHC program may serve as a lever to promote energy efficient actions that go beyond the specific measures of the program.

The evaluation team drew a sample of 619 program participants from the overall program population at the time of interviewing in order to achieve 70 completed interviews. This represents 11 percent of the population frame, as shown in Table 4-12.

Table 4-12: SHC Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
All SHC Participants	N/A	1,180	0.5	85/15	68	70	11%	Participant Telephone Survey
Program Total	N/A	1,180	0.5	85/15	68	70	11%	Participant Telephone Survey

Source: Phase II evaluation plan

Program Materials Review

To perform the program materials review, the evaluation team requested program materials covering an array of program functions. These include program marketing materials, Energy Advisor and contractor training materials, and sample audit and assessment reports. The program implementer sent these materials, and the evaluation team reviewed them with an eye toward their completeness, their effectiveness from an education standpoint, and possible areas for improvement. The evaluation team also reviewed the layout of the PECO webpage for SHC program in the context of the overall Smart Ideas website.

Program Manager and Program Implementer Interviews

The evaluation team interviewed the PECO program manager and the Ecova program implementer project lead in January 2014. Topics covered in the program manager and implementer interviews included program design, program implementation details, feedback on early customer and staff experiences, and progress toward program goals.

Energy Advisor and Contractor Interviews

The evaluation team interviewed six energy advisors and seven program-approved residential retrofit contractors. The evaluation team contacted all Energy Advisors and program-approved contractors at the time of the interviews. Because the evaluation team reached out to all Energy Advisors and contractors at the time of the interviews, no formal, randomized sampling method was employed. Topics featured in the interviews included the quality and effectiveness of training materials, the preparedness and effectiveness of instructors, satisfaction with various program elements, details on program logistics, and specific areas for program improvement.

Participant File Review

The participant file review was part of program measure installation verification and due diligence. This data source consisted of project files on 40 program participants drawn at random from the program tracking data. Files represented both audit- and assessment-level participants and included data that could be used to verify measure identities and quantities against the program tracking data.

Tracking System Assessment

As a new program in Phase II, the tracking system specific to the SHC program is also new. The evaluation team reviewed the content and overall layout of the tracking system. We also analyzed the program tracking data to check for possible errors by verifying that the values for each variable in the tracking data fall within reasonable bounds and are consistent with what is expected based on the program measure definitions.

PECO provided the updated tracking data set to the evaluation team on a quarterly basis. The evaluation team imported these accumulating quarterly tracking data files into Smart A/C Saver (SAS) for analysis, and these formed the basis for the compliance reporting process.

Program Theory Review

The evaluation team performed a high-level program theory review through which to interpret the program's design, success, and areas for improvement. A central theme for the logic model is identifying and understanding barriers to expanding the program's success. This assists Navigant in identifying specific recommendations for how to lower those barriers. The evaluation team used results from the process evaluation-related activities to inform the program theory review.

4.4.2 Process Evaluation Findings

The process evaluation for the SHC program is focused on providing feedback regarding customer awareness and education around EE, assessing levels of participant and trade ally satisfaction, and making recommendations for program modification and improvement.

Participant Telephone Surveys

This section presents results from the participant telephone survey conducted with 70 SHC program participants in April and May 2014. The survey was conducted with 42 audit-level participants and 28 assessment-level participants.

The distribution of measures in the survey sample is shown in Table 4-13 below. The average number of program measures installed per home is 2.9. At the time the survey sample was pulled, only five out of 644 total program participants had installed one or more of the major program measures that typically involve a contractor, such as the insulation, air sealing, or ASHP measures. None of these five participants was in the final survey sample of 70 respondents. A number of respondents in the survey sample described having reached out to contractors and having had major measure work done on their homes that was not yet reflected in the program tracking data at the time of sampling. Table 4-13below shows the number of respondents in the survey sample with each measure type installed.

Table 4-13: Distribution of Measures among Telephone Survey Respondents

Type	Measure	n, respondents	n, measures	% kWh savings
Audit	ENERGY STAR CFL Bulbs	30	300	$0.52
	ENERGY STAR LEDs	13	25	0.01
	LED Nightlight	2	4	0.02
	Low-Flow Showerheads	30	49	0.08
	Low-Flow Faucet Aerators	29	67	0
	Smart Strip Plug Outlets	24	28	0
	Electric Water Heater Pipe Insulation	1	1	0.02
Assessment	ENERGY STAR CFL Bulbs	23	262	0.32
	ENERGY STAR LEDs	12	20	0
	LED Nightlight	3	14	0.01
	Low-Flow Showerheads	9	15	0.02
	Low-Flow Faucet Aerators	7	15	0
	Smart Strip Plug Outlets	18	22	0
	Electric Water Heater Pipe Insulation	0	0	0

Source: Participant telephone survey

Respondents described having heard of the SHC program via a number of channels. As shown in Table 4-14 below, the most common channel was bill inserts, cited by 34 percent of overall respondents, followed by mailers and the PECO website, each cited by 19 percent of overall respondents.

Table 4-14: How Respondents First Learned of SHC Program

Source	Assessment		Audit		All	
	n	%	n	%	n	%
Bill insert	10	36%	14	33%	24	34%
Mailer	5	18%	8	19%	13	19%
PECO website	6	21%	7	17%	13	19%
Word of mouth	3	11%	3	7%	6	9%
Newspaper	--	0%	2	5%	2	3%
Community event	--	0%	1	2%	1	1%
Home/remodeling show	1	4%	--	0%	1	1%
TV commercial	--	0%	1	2%	1	1%
PECO representative came to my door	--	0%	1	2%	1	1%
Don't know	2	7%	3	7%	5	7%
Other – describe source	1	4%	2	5%	3	4%
All	28	100%	42	100%	70	100%

Source: Participant telephone survey

When asked about program costs and savings relative to their expectations, program participants generally feel that program costs and savings are in line with what they anticipated when deciding to participate in the program. As shown in Table 4-15 below, over half of overall respondents said that program costs and savings were in line with their expectations. Another third said they were not sure or that they did not have particular expectations at the outset.

Table 4-15: Alignment of Program Costs and Savings with Expectations

Response	Assessment	Audit	All
Yes	45%	56%	52%
No	9%	5%	7%
Too Soon To Tell	9%	8%	8%
Don't Know	36%	31%	33%

Source: Participant telephone survey

A number of respondents reported having been given recommendations to pursue EE actions beyond the direct install measures. The details below are focused on those additional EE actions. As of the date when the participant telephone survey sample was pulled from the program tracking data, none of these measures were reflected the program tracking system, presumably due to the time delay between hiring

a contractor and having program-reported measure savings appear in the tracking data. Hence, information in this section that relates to installed building shell is based on respondents' self-reports regarding major measures installed.

Virtually all respondents across both audits and assessments said that their audit report or assessment report included additional recommendations for ways to save energy beyond the items that were directly installed during the Energy Advisor's visit, as shown in Table 4-16.

Table 4-16: Presence of Additional Energy Savings Recommendations in the Report

Response	Audit	Assessment	Total
Yes	97%	91%	95%
No	--	--	--
Don't know	3%	9%	5%

Source: Participant telephone survey

Specific recommendations that respondents recalled cover an array of end uses and focused most frequently on insulation and air sealing, as shown in Table 4-17.

Table 4-17: Recommended Measures as Recalled By Participants

Measure	Assessment		Audit		All	
	n	%	n	%	n	%
Install insulation	13	41%	23	43%	36	42%
Perform air sealing	7	22%	13	25%	20	24%
Lighting upgrade	2	6%	3	6%	5	6%
Perform duct sealing	3	9%	2	4%	5	6%
Replace windows	1	3%	3	6%	4	5%
Upgrade appliances	2	6%	0	0%	2	2%
Install CFLs	1	3%	0	0%	1	1%
Install boxes in back of the lights in the ceiling	0	0%	1	2%	1	1%
Remove appliance(s)	1	3%	0	0%	1	1%
Replace ASHP	0	0%	1	2%	1	1%
Replace central air conditioner	1	3%	0	0%	1	1%
Replace fan	0	0%	1	2%	1	1%
Replace furnace	0	0%	1	2%	1	1%
Replace ground source heat pump	0	0%	1	2%	1	1%
Don't know	1	3%	4	8%	5	6%
All	32	100%	53	100%	85	100%

Source: Participant telephone survey

Participants generally indicate that the different components that comprise the program design are proceeding as planned. Table 4-18 below shows results specifically for audit-level participants regarding logistics associated with their audit report. The majority note that they received an audit report and that they found it to be useful. A somewhat smaller proportion of respondents said that their Energy Advisor had gone over the report with them and that they had received a copy of the report within 24 hours. Also, under half of audit participants said they had seen their audit report on their Energy Advisor's computer or tablet screen the day of the audit.

Table 4-18: Audit Report Logistics

Audit	Yes	No	Don't know
Did you receive an audit report that described what was installed in your home during the Energy Advisor's visit and provided recommendations for additional ways you could take to save more energy?	93%	5%	2%
Did the Energy Advisor go over the report with you and explain the results of the audit?	79%	13%	8%
Did you find the report to be useful?	90%	8%	3%
Did you view your audit report on your Energy Advisor's computer (or tablet) screen on the same day the audit was conducted?	44%	28%	28%
Did you receive a copy of your audit report by email within 24 hours of when it was conducted?	79%	13%	8%

Source: Participant telephone survey

A somewhat smaller proportion of assessment participants noted having received an assessment report. Similar to audit-level participants, assessment-level participants in large measure found the report to be useful. Approximately 73 percent of assessment participants said they received a copy of their assessment report within 24 hours, and just over 40 percent said they viewed their assessment report on their Energy Advisor's screen on the day of the visit, as shown in Table 4-19.

Table 4-19: Assessment Report Logistics

Assessment	Yes	No	Don't know
Did you receive an assessment report that described what was installed in your home during the Energy Advisor's visit and provided recommendations for additional ways you could take to save more energy?	79%	--	21%
Did the Energy Advisor go over the report with you and explain the results of the assessment?	95%	--	5%
Did you find the report to be useful?	91%	9%	--
Did you view your assessment report on your Energy Advisor's computer (or tablet) screen on the same day the assessment was conducted?	41%	14%	45%
Did you receive a copy of your assessment report by email within 24 hours of when it was conducted?	73%	9%	18%

Source: Participant telephone survey

Customers generally note a high degree of satisfaction with all major aspects of the program. Survey respondents were asked to rate several elements of the program on a scale of 1 to 5 where 1 is "not satisfied" and 5 is "extremely satisfied". As shown in Table 4-20 below, more than 80 percent of respondents rated their level of satisfaction for all key program elements at a 4 or 5 on a 5-point scale. Participants were most satisfied with their contractor and with the audit report and were least satisfied with the particular EE upgrades or equipment that were installed in their home during the audit. While approximately 83 percent of audit participants rated their overall satisfaction with the SHC program at a 4 or 5, 17 percent of respondents gave the program one of the bottom three scores.

Table 4-20: Audit Satisfaction Ratings

Audit	Extremely Satisfied				Not Satisfied
	5	4	3	2	1
How satisfied were you with the information provided by PECO when you first contacted PECO about receiving an audit?	57%	24%	12%	5%	2%
How satisfied were you with the process of scheduling your audit?	74%	21%	5%	0%	0%
How satisfied were you with the information that the PECO energy advisor provided to you?	62%	19%	14%	0%	5%
How satisfied were you with the energy efficiency upgrades or equipment that was installed in your home during the audit?	60%	10%	14%	10%	7%
How satisfied were you with the audit report?	74%	10%	10%	3%	3%
How satisfied were you with the contractor that installed the major energy efficiency upgrades or equipment?	85%	15%	0%	0%	0%
How satisfied were you with the rate the contractor charged to complete your project?	67%	25%	8%	0%	0%
How satisfied were you with the PECO Smart House Call program overall?	60%	24%	5%	5%	7%

Source: Participant telephone survey

Table 4-21 below shows similar results for assessment-level participants. Assessment-level participants were most satisfied with their contractor (i.e., any contractor they contacted from the PECO approved list for nonincentivized measures, as there was no program rebate for measures involving a contractor at the assessment level of program participation). They also gave high satisfaction ratings to the assessment report and to the process of scheduling the assessment. Approximately 15 percent of assessment-level participants gave their overall satisfaction with the program one of the bottom three scores.

Table 4-21: Assessment Satisfaction Ratings

Assessment	Extremely Satisfied				Not Satisfied
	5	4	3	2	1
How satisfied were you with the information provided by PECO when you first contacted PECO about receiving an assessment?	57%	21%	14%	4%	4%
How satisfied were you with the process of scheduling your assessment?	82%	18%	0%	0%	0%
How satisfied were you with the information that the PECO energy advisor provided to you?	71%	7%	18%	0%	4%
How satisfied were you with the energy efficiency upgrades or equipment that was installed in your home during the assessment?	71%	14%	11%	0%	4%
How satisfied were you with the assessment report?	82%	9%	5%	0%	5%
How satisfied were you with the contractor that installed the major energy efficiency upgrades or equipment?	100%	0%	0%	0%	0%
How satisfied were you with the rate the contractor charged to complete your project?	75%	0%	25%	0%	0%
How satisfied were you with the PECO Smart House Call program overall?	57%	29%	11%	0%	4%

Source: Participant telephone survey

Among those who expressed dissatisfaction with the audit, respondents cited reasons such as not receiving the desired information, not feeling informed about the audit, and concern regarding problems with the equipment. Also, two respondents felt the audit was misleading, and another felt it was not of value, as shown in Table 4-22.

Table 4-22: Reasons for Dissatisfaction with Audit

AUDIT: Why were you dissatisfied with...	Did not receive desired information	Was not informed about the audit	Thought there was a problem with equipment	Believes audit to not be of value	Audit misleading
...the information provided by PECO when you first contacted PECO about receiving an audit?	1	0	0	0	0
...the information that the PECO energy advisor provided to you?	0	0	0	1	1
...the audit report?	2	0	0	0	1
...the PECO Smart House Call program overall?	3	0	0	0	0

Source: Participant telephone survey

Some assessment participants expressed dissatisfaction for similar reasons. As shown in Table 4-23 below, two respondents said they felt the assessment was not of value.

Table 4-23: Reasons for Dissatisfaction with Assessment

ASSESSMENT: Why were you dissatisfied with...	Did not receive desired information	Was not informed about the assessment	Thought there was a problem with equipment	Believes assessment to not be of value	Assessment misleading
...the information provided by PECO when you first contacted PECO about receiving an assessment?	0	0	1	0	0
...the information provided by PECO when you first contacted PECO about receiving an assessment?	0	1	0	0	0
...the information that the PECO energy advisor provided to you?	0	0	0	1	0
...the assessment report?	0	0	0	1	0
...the PECO Smart House Call program overall?	1	0	0	0	0

Source: Participant telephone survey

Participants overwhelmingly give Energy Advisors one of the top two rankings in terms of the clarity with which they explain the assessment/audit report. As shown in Table 4-24 below, the majority of respondents, 83 percent, gave the highest rating to their Energy Advisor in terms of clarity of explanation, and 96 percent of respondents gave a rating 4 or higher.

Table 4-24: Satisfaction with Energy Advisor's Explanation of Report

Rating	Assessment	Audit	All
1 - Not explained	0%	0%	0%
2	5%	0%	2%
3	0%	3%	2%
4	14%	13%	13%
5 - Extremely well explained	81%	84%	83%

Source: Participant telephone survey

On average, as shown in Table 4-25 below, participants feel that what they received through the assessments and audits is about on par with what they paid. This is an interesting finding, given that the actual money saved from the program measures in the long run will likely far exceed what they paid for the audit.

Table 4-25: Participants' Valuation of the Audit

Audit ($100)			
Value		n	%
Valued less than price	$0	3	7%
	$1-$25	--	0%
	$26-$50	3	7%
	$51-$75	2	5%
	$76-$100	10	24%
Valued exceeding price	$101-$150	5	12%
	$151-$200	5	12%
	Over $200	11	26%
Don't know		3	7%

Source: Participant telephone survey

In the case of assessment participants, approximately 65 percent of respondents said the assessment was worth more than what they paid. Almost 20 percent of respondents said that the $50 assessment was worth more than $200 to them, as shown in Table 4-26.

Table 4-26: Participants' Valuation of the Assessment

Assessment ($50)			
Value		n	%
Valued less than price	$0	--	0%
	$1-$25	4	14%
	$26-$50	6	21%
Valued exceeding price	$51-$75	4	14%
	$76-$100	2	7%
	$101-$150	2	7%
	$151-$200	3	11%
	Over $200	5	18%
Don't know		2	7%

Source: Participant telephone survey

Respondents who said they had been provided with additional recommendations for ways to save energy beyond the items that were directly installed were asked if they contacted a contractor to pursue that work. Most audit participants noted that they have hired a contractor to install the major measures recommend in their audit reports. Among those audit participants who hired a contractor, approximately 70 percent said they hired one of the contractors from PECO's approved residential retrofit contractors list. In most cases, respondents called more than one of these contractors before deciding which one to

use. Assessment participants also noted having hired contractors to install EE measures, despite the absence of a program incentive for taking this action. In most of these cases, respondents selected a contractor whom they already knew (see Table 4-27).

Table 4-27: Calls to Contractors

	Audit			Assessment		
	Yes	No	Don't know	Yes	No	Don't know
Did you hire a contractor to install the recommended energy efficiency upgrades or equipment?	13	3	--	4	2	--
Was the contractor that you hired from PECO's participating contractors list?	9	4	--	1	3	--
Did you need to call more than one contractor from PECO's list of participating contractors before you decided whom to use to do the installation?	5	3	1	--	1	--

Source: Participant telephone survey

Respondents report high levels of satisfaction with the contractors whom they have hired for measure installations. While two respondents noted that they chose to use a contractor that they normally work with rather than select from the PECO-approved list, no respondents indicated dissatisfaction with the selection of PECO participating contractors. Of the 17 respondents who reported having hired a contractor to install the recommended EE upgrades or equipment, 100 percent said the contractor completed the work in a timely fashion.

As shown in Table 4-28 below, while the majority of respondents had no specific suggestions for changes to the audit/assessment reports, 8 audit participants and 10 assessment participants had suggestions for additional information to include in the reports. Among assessment-level participants, the most common suggestions were to provide a more detailed report with additional information about ways to save energy and money and with more information specifically about wall insulation. Recipients of the audit reports offered similar suggestions.

Table 4-28: Participants' Suggested Additions to Audit and Assessment Reports

Suggestions	Audit	Assessment	Total
No additional information	25	10	35
Walls/insulation	2	2	4
More detailed assessment	1	2	3
Ways to save energy	1	2	3
Ways to save money	1	2	3
Air flow/leakage information	1	1	2

Suggestions	Audit	Assessment	Total
Lighting	1	1	2
Energy efficiency contractors	1	0	1
Don't know	4	0	4

Source: Participant telephone survey

A moderate number of respondents said that they have experienced benefits that go beyond energy cost savings from the energy efficient equipment that they installed. The most common non-energy benefit mentioned, as shown in Table 4-29 below, was an increase in the comfort of their homes. Respondents also mentioned reductions in noise levels, improved aesthetics, better quality of light, and the benefits of being better educated about the energy-using systems in their home.

Table 4-29: Benefits Cited Beyond Energy Cost Savings

Benefits	Audit	Assessment	Total
Comfort	3	3	6
Noise levels	2	0	2
Aesthetics	1	0	1
Lighting, quality of light	0	1	1
Educational benefits	1	0	1

Source: Participant telephone survey

Across audit-level and assessment-level participants, the majority of survey respondents note that they are likely to recommend the PECO SHC program to others, as shown in Table 4-30.

Table 4-30: Likely to Recommend SHC Program to Others

Are you likely to recommend the PECO Smart House Call program to others?	Assessment		Audit		All	
	n	%	n	%	n	%
Yes	25	89%	36	86%	61	87%
No	3	11%	6	14%	9	13%

Source: Participant telephone survey

Of those who said they are not likely to recommend the program to others, respondents indicated that they felt it was too expensive or that they did not see the overall value of the program. Two respondents mentioned that they had not seen savings in their energy bill, as shown in Table 4-31.

Table 4-31: Reasons Cited for Not Recommending SHC Program to Others

Reason	Audit		Assessment		All	
	n	%	n	%	n	%
Too expensive/not helpful/not worth it	4	10%	1	4%	5	7%
Did not see value of program	3	7%	2	7%	5	7%
Did not see savings	1	2%	1	4%	2	3%

Source: Participant telephone survey

There is distinct value in tracking the role of the SHC program in raising customers' awareness of and participation in other Smart Ideas programs, as it speaks to the potential for the SHC program to serve as a lever for increased customer participation across the portfolio.

As shown in Table 4-32 below, most respondents noted that their Energy Advisor made them aware of other Smart Ideas programs. However, 50 percent of audit respondents and 36 percent of assessment respondents reported either that their Energy Advisor had not made them aware of other Smart Ideas programs, or that they were not certain one way or the other about whether their Energy Advisor had discussed other Smart Ideas programs with them. While the evaluation team believes the mentioning of these other programs is already woven into protocols for the Energy Advisors, these numbers indicate that emphasis on, and potentially details associated with, expected savings from participating in other Smart Ideas programs can and should be increased.

Table 4-32: Aware of Other Smart Ideas Programs from Energy Advisor

Response	Assessment		Audit		All	
	n	%	n	%	n	%
Yes	18	64%	21	50%	39	56%
No	7	25%	14	33%	21	30%
Don't know	3	11%	7	17%	10	14%
All	28	100%	42	100%	70	100%

Source: Participant telephone survey

Of the 39 respondents who said they had been made aware of other Smart Ideas programs, just over half said they plan to participate in one or more additional programs, while another 8 percent say they do not know, as shown in Table 4-33.

Table 4-33: Number Planning to Pursue More Smart Ideas Programs

Planning to Pursue more Smart Ideas Programs?	Audit	Assessment	Total
Yes	12	8	20
No	8	8	16
Don't know	1	2	3

Source: Participant telephone survey

As shown in Table 4-34 below, the most commonly cited Smart Ideas program among those respondents who said they expect to participate in additional Smart Ideas programs was the SAR program, with 35 percent of respondents. This is followed by the SAS program at 22 percent and the SHR program at 9 percent.

Table 4-34: Smart Ideas Programs that SHC Participants Plan to Pursue

Response:	Audit	Assessment	Total
PECO Smart Appliance Recycling	4	4	8
PECO Smart A/C Saver	2	3	5
PECO Smart Energy Saver	0	1	1
Heat pump (program)	2	0	2
None of these	1	0	1
Don't know	5	1	6
Total n for this question	12	8	20

Source: Participant telephone survey

Slightly more than half of survey respondents report having made changes in their EE related habits since their audit or assessment was conducted. Among the 36 (51 percent) respondents who reported having made changes in their energy efficient habits since their audit or assessment was conducted, by far the most common behavior or habit change that respondents mention having undertaken is to turn down their thermostat during daytime and nighttime hours. Across audits and assessments, 28 respondents, or 40 percent of the overall sample, report having made this change. Other commonly cited behavior changes, especially for audit participants, include turning off electronics when not in use and turning off lighting when not in use. In all cases but one, respondents said they expect to make these habit changes *permanent*. Results are shown in Table 4-35.

Table 4-35: Behavior Changes since Energy Audit or Assessment

Behavior Changes	Audit	Assessment	Total
Turn down the furnace thermostat to at or below 68 degrees during the day and 58-60 degrees at night during cooler months	16	12	28
Turn off your computer, printer, TV and other electronics when you're not using them	4	4	8
Turn off/unplug appliances & electronics	6	1	7
Turn off lights	2	1	3
Replace furnace or heat pump filters before and after the heating season	1	1	2
Turn down water heater	1	1	2
If you have a heat pump, turn the thermostat down no more than 10 degrees F or 12 degrees C at night	0	1	1

Source: Participant telephone survey

Most homeowners said they have no children in their house. This was more common in households that participated in the audit than the assessment, as shown in Table 4-36 below. The largest number of children in any households surveyed was four.

Table 4-36: Number of Children 18 Years or Under

Number of Children	Assessment		Audit		All	
	n	%	n	%	n	%
0	11	50%	25	66%	36	60%
1	2	9%	5	13%	7	12%
2	3	14%	6	16%	9	15%
3	3	14%	1	3%	4	7%
4	2	9%	.	0%	2	3%
REFUSED	1	5%	1	3%	2	3%
All	22	100%	38	100%	60	100%

Source: Participant telephone survey

The age group most commonly represented in both the assessments and audits was 61 to 70 years old. The second most common age group was respondents in their thirties, followed by respondents in their seventies, as shown in Table 4-37.

Table 4-37: Age of Survey Respondent

Age	Assessment		Audit		All	
	n	%	n	%	n	%
Under 30	1	4%	2	5%	3	4%
31 to 40	5	18%	9	21%	14	20%
41 to 50	2	7%	2	5%	4	6%
51 to 60	3	11%	7	17%	10	14%
61 to 70	10	36%	10	24%	20	29%
71 to 80	4	14%	7	17%	11	16%
81 to 90	1	4%	4	10%	5	7%
Over 90	1	4%	.	0%	1	1%
REFUSED	1	4%	1	2%	2	3%
All	28	100%	42	100%	70	100%

Source: Participant telephone survey

In terms of education level attained, the largest group both for assessment and audit participants was those who completed a bachelor's degree. The second most common was those who completed a graduate degree, followed by those who completed some college or trade school, as shown in Table 4-38.

Table 4-38: Education Level Attained

Education Level	Assessment		Audit		All	
	n	%	n	%	n	%
High school graduate	.	0%	2	5%	2	3%
Some college/trade school	5	18%	5 .	12%	10	14%
Bachelor's degree	11	39%	22	52%	33	47%
Graduate degree (master's or PhD)	10	36%	12	29%	22	31%
REFUSED	2	7%	1	2%	3	4%
All	28	100%	42	100%	70	100%

Source: Participant telephone survey

For both assessment- and audit-level participants, the most common response in terms of years lived in the home was zero to 5 years. The next most common response was more than 20 years. These two

groups accounted for 60 percent of participants or more for both assessment and audit level participants, as shown in Table 4-39.

Table 4-39: Years Lived in the Home

Years	Assessment		Audit		All	
	n	%	n	%	n	%
5 years or less	11	39%	15	36%	26	37%
6 to 10 years	5	18%	7	17%	12	17%
11 to 15 years	2	7%	6	14%	8	11%
16 to 20 years	--	0%	3	7%	3	4%
More than 20 years	10	36%	10	24%	20	29%
REFUSED	--	0%	1	2%	1	1%
All	28	100%	42	100%	70	100%

Source: Participant telephone survey

Out of the 70 program participants who completed the survey, three qualified as low-income participants. Four others preferred not to answer questions about income. Based on the respondents who answered the question, the low-income participation rate in SHC is approximately 4.6 percent, as shown in Table 4-40.

Table 4-40: Low-Income Participation

Size of Household	Income Below...	No	Yes	Refused/Skip
1	$17,000	10	0	0
2	$23,000	30	1	2
3	$29,000	11	0	0
4	$35,000	9	1	0
5	$41,000	2	0	0
6	$47,000	1	1	0
Refused		0	0	1
Don't know		0	0	1
% Total		**90%**	**4%**	**6%**

Source: Participant telephone survey

In terms of lowering barriers to program participation, a substantial number of customers both at the audit and assessment levels, regardless of income level, note that they would take advantage of low-interest loans if they were available to help them finance energy saving projects, as shown in Table 4-41.

Table 4-41: Interest in Inexpensive Loans

Response	Yes	No
Low-interest loans through a bank	22	48
Low-interest loans paid through utility bill	26	44

Source: Participant telephone survey

Program Material Review

The implementer provided the evaluation team with samples of marketing materials, Energy Advisor training materials, and sample audit and assessment reports. This section presents the evaluation team's review with an eye toward their completeness, their effectiveness from an education standpoint, and possible areas for improvement.

The main participant receivable from the PECO SHC program is the Energy Advisor's assessment or audit report. The audit report is provided to the customer after the Energy Advisor has completed the audit and consists of five sections. These include an introduction to the report, a breakdown of the customer's estimated energy use, a summary of the products installed in the customer's home during the home audit, a list of quick and cheap actions customers can take to save energy in the home, and the list of recommended EE measures with a breakdown of estimated costs and available incentives, followed by descriptions of each recommended measure.

The evaluation team generally found the audit report to be an effective document that can be refined and improved. The document appropriately sets the context at the outset with the characterization of home energy consumption by end use. Installed and recommended measures are clearly labeled, including quantities and, in the case of recommended measures, estimated costs with and without incentives. The photos that accompany descriptions of the recommended measures are a useful reference for context.

Areas where the audit report is less effective center on clear labeling and the sequence in which information is presented. Current energy use in the home by end use is shown with a pie chart, but the same colors are used in some cases when referring to more than one home component. The list of quick and cheap home changes for energy savings is located in the middle of the audit report, which disrupts the flow of information somewhat regarding the program measures and also runs the risk of letting these suggestions get somewhat lost amid the other information in the report. In the section on cost associated with installing the recommended program measures, there is little information to give the homeowner context for whether a given measure is worth the investment for them. The list of PECO-approved contractors for the recommended measures is separate from the list where the recommendations are made.

The assessment report is provided to the customer after the Energy Advisor has completed the assessment. The report consists of a comprehensive listing of EE measures, including a detailed description of each measure. Customized comments from the Energy Advisor appear at the bottom of the report with recommendations on which measures or actions would best suit the customer. While the descriptions of each measure in the assessment report are comprehensive, they are difficult to digest. This is partly due to the lack of a clear, concise, and methodological layout of the measures and descriptions.

The evaluation team reviewed the slide presentation, "Proactive Transactions," which is used for training the Energy Advisor team. The presentation covers customer interactions, including the intake, audit, closing, and follow-up. The training emphasizes building trust, and it provides tips on developing and projecting a professional image, understanding how to listen and react to customer feedback and body language, and how to promote the other Smart Ideas programs. It focuses on educating the customer using examples and analogies and on promoting an understanding that EE improvements represent investments in one's home and in lower bills. Trainees receive a hardcopy guide and are asked to provide feedback on the effectiveness of the training. All told, it is an effective and professionally structured training document, and the Navigant evaluation team has no recommendations to change it.

Similarly, the evaluation reviewed an SHC flyer that shows a doctor's stethoscope on a house and found the flyer to be effective and targeted at an appropriate level of detail for its purpose. The graphics draw the viewer in, and the text explains the program effectively and concisely. The text is also effective in characterizing the cost, value, and features that distinguish an assessment from an audit. The evaluation team has no recommendations for changing this material.

The evaluation team visited the PECO webpage for the SHC program and reviewed it in the context of the overall Smart Ideas website. The evaluation team found that the Smart Ideas programs overall currently have relatively low visibility on the PECO website, and it is not immediately clear how to navigate from the Smart Ideas website to the SHC program page. Once participants find the program page, it is easy to overlook the "Residential Programs & Rebates" drop-down menu.

Program Manager & Implementer Interviews

This section presents results from the program manager and program implementer interviews. Views that the program manager and program implementer have expressed are summarized thematically in this section and are followed by a set of recommendations that emerge from the dialog.

PY5 marks the first year of the SHC program's existence. Stakeholders and the public have been aware of similar programs in other regions and wanted something similar in PECO service territory. A residential audit program such as the SHC program offers a number of useful benefits. For example, it presents an ideal opportunity to raise awareness of PECO generally and of PECO's energy conservation efforts via one-

on-one interactions with customers in their homes. The program has high exposure for PECO to promote its EE commitments and efforts.

From the outset, a central goal of the SHC program has been to operate a smooth program rollout that focuses on achieving high customer satisfaction and keeping that satisfaction high. The program experienced a delayed start in PY5 by three months relative to the earliest plans, but this was in part due to keeping focused on a smooth launch to the program from the customer perspective. Rather than start the program at full speed, the program managers and implementers have sought to understand the market in terms of what people want and put emphasis on a smooth customer enrollment process and smooth project execution. PECO has sought to leverage its own extensive knowledge of its customers with the CSP's 30 years of experience implementing EE programs to build an excellent, consistent, and steadily growing program.

The program design itself has been steady since its inception. Contractors can charge a set price for a given piece of work. A goal of the program has been to join forces with and engage the contractor community rather than foster a dynamic of competition. Having a third-party CSP manage face-to-face interactions with the customer means that the CSP can give customers their honest savings opinions and are not perceived as trying to sell the customer on equipment upgrades that may not be in their best interest. As part of this, the expected energy savings and resulting payback period that the Energy Advisor quotes to the customer come from the CSP's proprietary residential energy modeling tool, EM Home, and are totally independent from the TRM-based savings calculations that underlie reported program savings for each measure. The measure mix in the program is steady, though PECO may add candelabras to the current set of twists, globes, and LEDs that are available.

One change to the program design that is under consideration is a shift to offer the audit not only to PECO's electric heat rate customers, but also to PECO's other customers. This may take a toll on cost effectiveness for the program overall, as any savings from the building envelope and HVAC maintenance measures for these (predominantly gas heat) customers will not lead to lower electricity consumption. However, the tradeoff may be worthwhile if it represents a tradeoff with overall PECO customer satisfaction.

The program is marketed to customers via a number of channels with the overall goal of building a base awareness of the program. PECO asks during the intake call how the customer learned of the program. The most effective channel seems to be word of mouth from satisfied customers. PECO conducts direct mailers, including postcards and letters, as well as bill inserts. The program ramped up its marketing in late January 2014, several months after program launch, once the program was underway and its structure was generally stabilized. At that point the number of bill inserts sent out in a given marketing effort increased from approximately 60,000 to approximately 200,000. CSG also sometimes staffs a table near the lighting aisle of Lowe's and Home Depot stores or at home show events in exhibit halls in order to engage customers in conversation and education about the program and its benefits.

PECO and CSG also market the program to contractors. They held an event for contractors in which they described the specifics of the program. At this event, 45 contractors expressed interest in being considered for the PECO-approved contractors list for SHC. CSG chose 11 of these as the first cohort of PECO-approved contractors to be listed on the SHC website, based on their geography, skillsets, verified insurance, and their willingness to meet the program requirement of set pricing.

Based on feedback PECO has received, customers are highly satisfied with the program to date. PECO performs a call-back to customers after the onsite visit as part of their quality assurance process, and customers have provided consistently positive feedback. PECO has been conscientious about the customer experience. They are focused on it, and they continually ensure that the implementer remains focused on it. The positive feedback reflects that both CSG and PECO spend the time to make sure there are not major snags at the beginning of the program.

Energy Advisor and Contractor Interviews

Results from the program contractor interviews are presented in this section. The results are grouped into topics covered in the interviews. Recommendations stemming from these interviews are in the recommendations section of this report.

Contractor Perspectives

The set of program contractors is a highly qualified group of professionals, all with North American Training Excellence (NATE) certification. As noted in discussion of the participant telephone survey results, program participants have been highly satisfied with and appreciative of the program contractors. Most of the contractors have been in business for over 30 years and have both broad and specific expertise in the services they perform. Overarching feedback from the contractors is that the SHC program is an excellent program and fills a need; there are few other existing resources that help homeowners learn what they should do and where the best value for their dollar lies.

Contractors generally compliment the overall structure of the program and describe it as a good deal for the consumer. In particular, contractors note that PECO does a great job focusing on the success of the contractors as part of PECO's own success and the success of the program. PECO structures the program as a team environment with shared objectives, and PECO makes a point of asking what they can do to help the contractors and to facilitate contractors' success. Contractors also note that PECO has focused the program well by simultaneously emphasizing increased comfort and energy efficiency to the customer. The incentives seem well aligned between PECO, CSG, the contractors, and customers for an overall smooth flowing process that leads to increased energy efficiency and comfortable, happy customers. Contractors note that in many cases they are able to develop ongoing relationships with customers through the SHC program and other Smart Ideas programs, which increases their return business and their business via referrals.

The biggest single complaint from contractors at the time of the interviews was the relatively slow flow of work to date. Some are surprised that, even with the natural expected time delay, the number of audits performed and the good deal on a heat pump tune-up through the program, have not led to more calls. However, most contractors noted an uptick in the flow of program work as of May and June 2014.

Contractors described having received training mostly in the form of webinars to cover program logistics and paperwork as well as some in-person visits from CSG representatives to answer questions and talk over program details. They also received training in the particular details and quality levels of work expected through the program, as well as the necessary measurements and other performance indicators needed to fill out the program paperwork. Contractors generally noted that the training they received was effective and thorough, and they were impressed with the high quality of work that is emphasized and expected through the program. On a voluntary basis, one contractor mentioned having gone onsite during a program audit to watch a blower door test and to notice the information collected by the Energy Advisor and their interactions with the customer. Instructors were described as thorough and prepared, if a little dry.

By way of criticism, contractors expressed that a bit too much of the program training currently takes place via PowerPoint slides. Contractors noted that descriptions of onsite installation protocols and equipment performance measurements are inherently somewhat abstract and open to interpretation when presented in a set of bullet points on slides. Contractors stated that increasing the emphasis on a combination of video-based training using real-world equipment and hand-on onsite training would help convey a direct and unmistakable message about the necessary steps to be taken onsite. They also noted that the professionalism of the training resources for contractors could be enhanced through a modest amount of video editing and that CSG should focus on making sure the training takes place in a timely fashion relative to when the work will be performed.

Contractors note that the selection of measures in the program is sensible. Multiple contractors commented that the heat pump maintenance measure, in particular, is an excellent value at the program price and should be pursued by just about anyone with a heat pump. Feedback regarding the program measure mix generally touched on ways the program offerings could be expanded, and these are summarized in the recommendations below.

Contractors consistently provide feedback that the program is not sufficiently marketed. Contractors also note that they themselves could serve as more effective program marketing resources if they were equipped to do so. While word of mouth among satisfied participants is currently the most powerful and effective form of program marketing, many PECO customers who would qualify are not aware of the SHC program. There are marketing opportunities to address this that mirror the SHC program's personal touch.

Contractors uniformly praised the program coordinator at CSG as excellent, with a quick turnaround and excellent follow-up communication. However, at a general level, a few contractors noted that they had a hard time keeping up with program changes and updates to requirements or specifications.

Contractors note that their copies of the program policies and technical details easily fall out of date. This is due in part to the relatively fast pace of changes to the program in its early stages as the wrinkles are worked out and consistent patterns of operation fall into place.

According to contractors, the description of measures in the audit reports is sometimes vague, and this sometimes makes it necessary for the contractor to go to the customer's house before developing the scope of work and bid, so as to understand and see clearly the nature of the work involved. There is an important potential miss between the Energy Advisors and the contractors when a job that ultimately requires a fair amount of time and resources by the contractor is put under the heading of a measure with a small cost associated with it in the audit report. For example, one contractor described having seen a measure listed on the audit report with a total cost of $14, but it later became clear that the intended work was for air-sealing the whole garage and weather-stripping the door. Contractors also note that the cost of a feasibility study, if necessary, is left out of the audit report.

Some contractors complain of feeling uninformed about the program's design overall, its relationship to other Smart Ideas programs, changes in the program's design or particulars over time, and specific history and job status of individual customers. According to one contractor:

"It feels like we are in a vacuum. There's not a lot of information about the program available to us. So we don't know how it's doing. We don't know how the program is really marketed, because we don't understand it. I've never understood why the program is restricted to residential heating customers. It seems to me the program is going to have difficulty meeting its goals in the way the program is currently structured. We have no idea in terms of the number of customers served and the number of customers going into the pipeline. We don't know how to make recommendations, because we don't know how the program is doing. We would like to be in the loop, not just in isolation."

Contractors noted favorably that PECO informs them whether a quality assurance check will be performed on a given piece of work. These quality assurance checks yield helpful information to the contractors, such as suggestions for follow-up with a customer and suggestions on how best to insulate or air seal a given section of a house. In the words of one contractor, "That was the best training, just learning with their inspector. We send our field managers to those inspections. I don't think it could get better than that."

Contractors are generally aware of the existence of other Smart Ideas programs, especially the appliance rebates program, but are not aware of the full array of programs. They are also not aware of many of the details regarding program eligibility and available rebates for the other programs. They recognize that customers may qualify for multiple programs, and they would like to increase their ability to offer more of their own services in helping customers take advantage of multiple Smart Ideas programs.

The PECO-approved contractors are a well-selected group of highly experienced professionals with detailed expertise and long years of developing strong customer relationships. The SHC program could leverage that experience in a number of ways that simultaneously improve program services provided to

customers while making program participation a smoother, more intuitive, and better integrated experience for the contractors.

Energy Advisor Perspectives

Energy Advisors generally note that the training has been thorough and effective. All Energy Advisors received BPI (Building Performance Institute) certification (which was a requirement of the program) as well as safety training. Training included an overview of building science, as well as a few days of training in the use of CSG's proprietary energy modeling software, EM Home. Training classes also covered topics about interacting with PECO customers, such as using an appropriate sales approach, and how to take technical data from the assessment or audit and turn it into a set of practical concepts, ideas, and suggestions to which homeowners can relate. Other training classes gave an overview of all Smart Ideas programs in the residential portion of PECO's portfolio, in terms of the incentives available and eligibility requirements. Energy Advisors performed home visits in practice houses, such as those of associates and coworkers, before going to customer homes.

Areas in which Energy Advisors say training can be improved center around a few key themes: added/changed items in the leave-behinds that stay with homeowners, increased emphasis on visual examples in the training using videos and onsite field training, and ongoing education opportunities.

Energy Advisors are quick to emphasize that the price of an assessment or audit is fair relative to what customers receive. At the same time, Energy Advisors note that the scope of measures covered in the program sometimes feels narrow, which limits projected savings for the homeowner. Examples of measures that advisors would like to recommend but that are not incentivized include using a whole-house approach, duct insulation, insulating a garage ceiling (for comfort benefits as much or more than energy savings), and crawl space and basement insulation. Another effect this has is that the advisors end up splitting their recommendations across two lists, one with associated program incentives and one without, and the customer inevitably focuses on the incentivized measures and dollar amounts.

Also, Energy Advisors note that assessment participants can be left a little "high and dry." Through the assessment, participants may become interested in pursuing work beyond the direct-install measures, but there is no incentive to push them to do so.

Energy Advisors offered a number of recommendations for additional materials or edits to materials that are left behind with homeowners following their audit or assessment. It would no doubt be overwhelming to leave all of the materials listed below with customers, but the suggestions below could inform a process of thinking through the whole suite of materials that are left with the customer and increasing their overall value and applicability.

Materials that are left with customers following an audit or assessment leave some room for confusion regarding next steps and available resources. There is room for increased complementarity between

materials left with customers and online resources for them to gain clarity on program measures, opportunities, and their likely impacts.

A central aspect of program evaluation is assessing program impacts, or NTG ratio. Documented instances of program spillover directly influence the NTG ratio. The SHC program encourages customers to consider EE investments that go beyond what is incentivized and claimed in reported program savings in a number of ways. For example, Energy Advisors refer to customers buying and installing more CFLs and LEDs than the program provides, directly as a function of having participated in the program. Thinking through and executing on a strategy to provide more quantitative and verifiable documentation of spillover cases would facilitate the program getting credited for these impacts in program attribution analysis.

The SHC marketing literature currently focuses on the energy savings and associated monetary savings that result from EE investments. Benefits associated with increased comfort of the home are also mentioned, but they are not emphasized at the same level as the energy benefits. The comfort-related benefits can be significant in some cases and may be a strong motivator for some potential program participants. PECO and the program implementer should consider emphasizing the comfort benefits more in the marketing literature and perhaps decrease the emphasis on expected savings benefits.

Energy Advisors describe the logistics of the program as generally sensible, with solid support for getting answers to their questions and equipping them with useful information for home visits, but with periodic interruptions and inconsistencies that may be emblematic of a new program. Energy Advisors note some inefficiency in the forms that must be filled out by hand, in some cases repeating the same information across forms, and subsequently entering that information into a computer. Technical glitches in the mapping software and overall program network have caused some delays and outages, which disrupt the flow of information both in terms of program updates and in terms of learning specific customer information prior to a home visit.

A number of Energy Advisors expressed a clear desire for more feedback on their effectiveness and follow-through with the homeowners they visit. As one Energy Advisor put it, "I'm not getting any feedback on the audits I'm conducting. It would be nice to get a sense of which ones and how many have had major work completed. Right now I'm in the dark about my success rate. If I'm not getting homeowners to follow through with major measures, then I need to adjust my approach." Another auditor noted that although there is a spreadsheet in the implementer's shared drive that keeps track of audits, the auditor must look up their own recommendations by name and date and compare with the actions the participant has taken in order to track the status of a given participant's actions.

Advisors note that they point out opportunities for participation in the other Smart Ideas programs but that doing so does not feel like a formal component of what they need to do. Advisors describe feeling well educated and oriented on recommending the refrigerator recycling program but not the other programs. As one advisor put it, "I'm not educated enough on the other programs to really answer." As one Energy Advisor noted, "the more training we can get on this the better."

In the interview process, Energy Advisors noted actions the program could be taking. Energy Advisors describe a number of best practices that are already in place. For example, there is a lot of knowledge sharing. Advisors noted that CSG provides a weekly opportunity for Advisors to write about specific situations they have encountered in the field, and these write-ups are distributed to all of the other Advisors. Advisors also have an informal, continuing open forum on interesting or challenging cases seen in the field

Tracking System Assessment

Because the Phase II tracking system was in development at the same time that the SHC program was initially developed and launched, the evaluation team had the opportunity to provide iterative feedback on the design of the tracking system during its development. This enabled the evaluation team to confirm that tracked data supports accurate program reporting and program evaluation. The program tracking system is expressly designed to enable savings estimation based on the algorithms for each measure in the 2013 Pennsylvania TRM. It also tracks the dates on which all program milestones are met and so can be used to assess processing efficiency.

The tracking data system is organized into program files that represent four nested levels of information. One file is dedicated to customer contact information and premise-level data, and the remaining three files track information at the project level, the measure level, and the invoice level, respectively. Files are linked by a common project number. Data collected at the customer data level and the measure level are expressly designed to enable savings estimation based on the algorithms for each measure in the 2013 Pennsylvania TRM.

In the tracking system review, the evaluation team found that the appropriate variables are tracked and are shown in clear terms, with the meaning and source of input values clearly marked. All variables needed for TRM-based calculation of energy and demand savings are shown clearly in the tracking data along with section and page number from the Pennsylvania TRM. The organization of data across separate tabs for customer, project, measure, and invoice is clear and intuitive, with consistent use of shared variables across tabs facilitating straightforward merges of the data as needed for analytical purposes.

While the layout and organization of the tracking system is intuitively clear, comprehensive, and easily navigable, it appears that the algorithms used in SIDS to generate reported savings values for three program measures are inaccurate. Specifically, the energy and demand savings algorithms for ASHP Maintenance, Attic and Wall Insulation, and Insulation-Air Sealing appear inconsistent with the TRM and/or IMP for a given measure. Details on the inconsistencies observed for these three measures, and their likely sources, are provided in the Gross Impact Results section of this report. Also, in addition to inaccuracies in the overall algorithms, there are individual records in the tracking data for the Insulation-Air Sealing measure where the tracking data has missing values for one or more variables needed in the energy and demand savings algorithms, even though the reported energy and demand fields for these records are populated. Finally, as noted in the Verification and Due Diligence section below, PECO made

adjustments to the participant count in PY5Q2 to match the SIDS data, but these adjustments were not supported by the evaluation team's review of the number of unique program participants in the tracking data.

The evaluation team does not recommend any edits to the overall design of the tracking system. The only comments relevant to changes in the tracking system are a function of needed updates to the algorithms and data completeness underlying some measure savings calculations, and these are addressed in the Gross Impact Results section.

Program Theory Review

The structure of the SHC program aims to overcome several barriers in its successful implementation. These barriers include the high up-front cost associated with home EE measures, a lack of customer awareness of the program, a lack of understanding about the significant savings opportunities associated with investing in EE, and a lack of customer awareness of who best to contact for assistance with EE improvements.

Elements in the SHC program's design directly address these barriers and are designed to yield program outcomes that can be categorized as short-term, intermediate-term, and long-term outcomes. For example, the program incentives directly lower the up-front cost of EE incentives. The program's marketing efforts, across diverse channels, raise customer awareness of the program and its offerings. Building a qualified and responsive team of Energy Advisors and PECO-approved residential retrofit contractors supports effective program implementation at every level. Educational efforts during the Energy Advisor's walk-through and via the reports and other print materials left with customers enhance customers' understanding of the long-term energy and financial savings achievable through investments in having an energy-efficient home. Also, personal contact with Energy Advisors and PECO-approved contractors gives customers confidence in finding appropriate professionals for the work that they need. Interactions with well-informed Energy Advisors and contractors also increase customer awareness of other Smart Ideas programs for which they may qualify.

Short-term outcomes from these program activities include increased customer awareness of the program and qualifying measures, decreased up-front costs of efficiency investments, increased trade ally awareness of the program, and effective implementation of program measures. Intermediate-term outcomes include increased customer awareness and appreciation of the financial value and increased comfort associated with home EE. Other intermediate-term outcomes include an increased ability for PECO to manage the program toward its savings goals via trade ally promotion of qualifying measures to customers and participation by qualifying customers in other Smart Ideas programs. Long-term outcomes of the program include valuable public exposure for PECO's commitment to EE and personalized service, and the increased ability for PECO to manage the overall size and reach of the SHC program. The following sets of bullet points express these ideas succinctly.

The SHC program aims to overcome the following barriers:

- High first cost associated with home EE measures
- Lack of understanding or awareness about savings opportunities
- Lack of understanding about the economic value of investing in EE
- Low awareness of the program and its offerings
- Mistrust of overly sales oriented utility staff or other staff
- Overwhelmed feelings associated with finding a good contractor

The SHC program overcomes those barriers by engaging in these activities:

- Program marketing
- Building a team of highly experienced and competent contractors
- Building a team of well-trained and responsive Energy Advisors
- Providing rebates/incentives on direct install (DI) measures
- Providing rebates/incentives on building shell measures for RH customers

Expected outcomes include the following:

Short-Term Outcomes

- Customers participate in the program at the assessment or audit level
- Customers learn about the energy using systems in their homes
- Customers have DI measures installed and are informed about building shell measures, both incentivized and nonincentivized, that are most appropriate for their particular home
- Customers have major measures/building shell measures installed by a program-approved contractor
- Customers learn about additional Smart Ideas programs for which they may qualify

Intermediate-Term Outcomes

- Customers enjoy increased comfort and savings in their homes
- Customers build trust with PECO and with the contractors
- Customers enroll in other Smart Ideas programs for which they qualify
- Satisfied customers continue to spread the word about the program

Long-Term Outcomes

- PECO gets valued exposure for its commitment to EE.
- PECO gains an increased ability to manage the program toward its savings goals.

Success in these outcomes will help PECO with its overall portfolio goals and will increase the sense of the SHC program having a unique ability to influence participation rates in the other residential programs in PECO's portfolio.

4.5 Recommendations for Program

Findings from the impact and process evaluations point toward opportunities to improve several aspects of the SHC program. Recommendations center on several themes, including program marketing, facilitating the documentation of program spillover, improving the flow of information to contractors and Energy Advisors, and increasing cross-program promotion. Specific recommendations, with detailed actions to support those recommendations, are as follows and are listed in Table 4-42:

- **Recommendation #1**: PECO should consider modifying how the program is marketed to customers, to target the most relevant customer segments, and anticipate and overcome potential barriers to participation. Specific actions to consider include:
    - Increasing the emphasis on non-energy benefits from SHC participation as a marketing resource.
    - Reaching out to homeowners associations, especially those with a high concentration of electric heat rate customers, and offering to give presentations about the SHC program at meetings.
    - Describing and advertising available financing options to all potential SHC participants more clearly.
    - Designing marketing resources to increase customers' appreciation of the excellent value that an assessment or audit represents. Because there is very little visual change to a home as a result of the direct-install measures that take place, a concerted marketing and educational effort is required to help customers appreciate the value they have received.
- **Recommendation #2:** CSG, with oversight from PECO, should track program spillover more precisely, which may yield higher program NTG. Specific actions to focus on include:
    - Tracking specific, verifiable energy saving actions that fall outside the bounds of the formal program measures. For example, assessment participants who are motivated by the program to reach out to contractors and have major measure work done without a program rebate represent a spillover opportunity if they are documented. Similarly, audit participants who work with contractors to make additional EE investments beyond the formal program measures represent an additional opportunity to document program spillover.
    - Equipping program participants to educate themselves and find the resources they need to maximize the EE of their home by:
        - Making the description of all program measures available electronically.
        - Creating short videos on the energy impacts of measures such as air sealing and making these available on the Smart Ideas website.

- **Recommendation #3:** CSG, with oversight from PECO, should improve the flow of information for contractors. Specific elements to focus on include:
    - Developing a website in place of the typical binder that tracks technical requirements and program policies, is easily searchable, and is kept up-to-date. This resource should be designed to make it easier for program contractors to stay abreast of program policies, specifications, and customer status.
    - Creating a central, online information source where contractors can see if a given customer had an audit or assessment done, since in some cases a customer doesn't know whether they have received an assessment or an audit, and that changes which incentives they are eligible for.
    - Developing an online tool to help contractors cross-check a program participant's rebate application with program requirements in order to facilitate smooth approval.
- **Recommendation #4:** PECO should look to for ways to more effectively facilitate the role of contractors as a marketing arm for the program. Specific elements to focus on include:
    - Giving contractors the chance to see the full array of program marketing materials.
    - Providing contractors with program marketing and informational brochures that they can hand out to their customers.
    - Adding each contractor's logo to program brochures that they can leave with customers to meet their own marketing objectives and program marketing objectives at the same time.
    - Exploring possibilities for how a participating contractor could offer a complete package to the client that takes advantage of savings from all relevant PECO programs.
    - Cultivating synergy with the vendor community, such as a structure where vendors could offer to pay for the SHC audit as a way of increasing the attractiveness of their offer when making a sale on a heat pump or other technology related to the program.
- **Recommendation #5**: CSG, with input from PECO and Navigant, should make better use of SHC's unique position to influence cross-promotion of all Smart Ideas programs in the residential portfolio. Specific actions to consider include:
    - Providing better and more thorough education to Energy Advisors and contractors about the other Smart Ideas programs, including eligibility criteria, typical energy savings, and rebate amounts.
    - Setting a formal expectation that Energy Advisors and contractors let homeowners know the specific incentives that are available through other Smart Ideas programs for relevant measures.
    - Providing the full list of other Smart Ideas programs with descriptions of incentives and eligibility criteria, and having the Energy Advisor either leave this with all customers or hand out as needed.
    - Tracking SHC customers' participation in other Smart Ideas programs over time via tracking data analysis by customer number and secondarily by any verbal references to the SHC program in customer and trade ally interviews for other programs. This can serve

as a means of gauging the SHC program's effectiveness as a lever and the particular programs that SHC participants pursue.

- **Recommendation #6:** CSG, with oversight from PECO, should keep increasing the use of hands-on, onsite, and video-based training in favor of PowerPoint style training for both Energy Advisors and contractors and do so in a way that is well-timed relative to when the work will be performed. Specific elements to focus on include:
    - Using more videos that directly demonstrate what needs to be done onsite, in favor of PowerPoint slides.
    - Pairing videos with more frequent optional onsite training opportunities.
    - Extending an open, optional invitation for contractors to see an energy audit take place.
    - Increasing the frequency of refresher training courses, with more advance notice for training events and timing these appropriately relative to when the work will be performed.
    - Developing resources for self-training and for self-guided review of concepts on the part of Energy Advisors and contractors and potentially making these available through the internal CSG learning and development site.
- **Recommendation #7:** CSG, with oversight from PECO, should improve the flow of information for Energy Advisors to increase their effectiveness. Specific actions to focus on include:
    - Making information available to Energy Advisors earlier regarding details of a household such as number of occupants, size of home, and primary concerns expressed by the homeowner.
    - Providing Energy Advisors with well-organized, easily accessible, and potentially automated notifications on which customers move ahead with major work, so Energy Advisors can receive feedback on their own effectiveness and how they might adjust their approach. This is helpful even if there is no additional action expected on the part of the Energy Advisor.
    - Changing the program structure such that Energy Advisors actively make a point of following up with audit participants to see if they have pursued any of the contractor-installed major measures and to ask if there are any other questions they can answer. This may serve several purposes, including increasing customer participation in the major measures, fostering a sense that the Energy Advisors are invested in the homeowners whom they have helped, and providing a feedback loop to the Energy Advisors that will help them hone their communications.

Table 4-42: SHC Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: To better manage program participation to meet Phase II planned program goals, PECO should consider modifying how the program is marketed to customers, to increase the program's appeal, target the most relevant customer segments, and anticipate and overcome potential barriers to participation. Specific actions to consider include: • *Increasing the emphasis on non-energy benefits from SHC participation as a* marketing resource. • Reaching out to homeowners associations, especially those with a high concentration of electric heat rate customers, and offering to give presentations about the SHC program at meetings • Describing and advertising available financing options to all potential SHC participants more clearly • Designing marketing resources to increase customers' appreciation of the excellent value that an assessment or audit represents. Because there is very little visual change to a home as a result of the direct-install measures that take place, a concerted marketing and educational effort is required to *help customers appreciate the value they have received.*	Implemented (in process). PECO will focus on increasing the program's appeal, targeting the most relevant customer segments. PECO will reach out the homeowners associations to give presentations on SHC. We are promoting AFC financing option until change and increase in rate; CSG will roll out Financing Partnership in the near future to offer to our customers. To increase customer appreciation of the assessment or audit value, the report has been modified to reflect $0.145/kWh rather than the previous $0.10/kWh from the past.
Recommendation 2: CSG, with oversight from PECO, should track program spillover more precisely, which may yield higher program NTG. Specific actions to focus on include: • Tracking specific, verifiable energy saving actions that fall outside the bounds of the formal program measures. For example, assessment participants who are motivated by the program to reach out to contractors and have major measure work done without a program rebate represent a spillover opportunity if they are documented. Similarly, audit participants who work with contractors to make additional EE investments beyond the formal program measures represent an additional opportunity to document *program spillover.* • Equipping program participants to educate themselves and find the resources they need to maximize the EE of their home by: • Making the description of all program measures available electronically • Creating short videos on the energy impacts of measures such as air sealing and making these available on the Smart Ideas website.	Being considered. PECO will work with Navigant to put more emphasis on tracking program spillover more accurately by reaching out to customers after their assessment to find out if they are further interested in any other EE investments. Provide extra information in form of brochures, links to recourses and videos on Smart Ideas website at the time of audit to educate customers about *the multiple impacts of EE in their home.*
Recommendation 3: CSG, with oversight from PECO, should improve the flow of information for contractors. Specific elements to focus on include: • Developing a website in place of the typical binder that tracks technical requirements and program policies, is easily searchable, and is kept up-to-date. This resource should be designed to make it easier for program contractors to stay abreast of program policies, specifications, and customer status. • Creating a central, online information source where contractors can see if a given customer had an audit or assessment done, since in some cases a customer doesn't know whether they have received an assessment or an audit, and that changes which incentives they are eligible for. • Developing an online tool to help contractors cross-check a program *participant's rebate application with program requirements in order to* facilitate smooth approval.	Being considered. • *Develop a website that tracks any* changes in technical requirements and program policies – Contractors are provided with an M&I; in the past, we have only made 1 change which is submitted through ABS team and sent as an Addendum to contractors- hard copy and electronically with signed delivery. Working with the PECO legal team to look into the ability to share customer information electronically. • Create an online data source where contractors can see if a given

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
	customer had an audit or assessment done –working with the PECO legal team to look into the ability to share customer information electronically. • Help contractors cross-check a program participant's rebate application against program requirements prior to submission - This is conducted in house by CSG's Program Coordinator. • Make information available earlier regarding details of a household - CSG provides details about the household to energy advisors prior to the appointment. • Provide energy advisors with automated notifications on which customers move ahead with major work – Process in place effective Oct 1, 2014. • Have energy advisors follow up with audit participants regarding major measures. This can increase customer participation in the major measures, foster positive relationships with customers, and provide a feedback loop to the energy advisors on their effectiveness. – We have a personalized/individualized follow up process for 30-60-90 days touch points to reinforce recommendations and remind of incentives and expiration. • Mapping software – CSG experienced a software issue months back that affected the advisors drive time to and from appointments; the process has since been corrected.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 4: PECO should look to for ways to more effectively facilitate the role of contractors as a marketing arm for the program. Specific elements to focus on include: • Giving contractors the chance to see the full array of program marketing materials. • Providing contractors with program marketing and informational brochures that they can hand out to their customers. • Adding each contractor's logo to program brochures that they can leave with customers to meet their own marketing objectives and program marketing objectives at the same time. • Exploring possibilities for how a participating contractor could offer a complete package to the client that takes advantage of savings from all relevant PECO programs. • Cultivating synergy with the vendor community, such as a structure where vendors could offer to pay for the SHC audit as a way of increasing the attractiveness of their offer when making a sale on a heat pump or other technology related to the program.	Being considered. PECO will provide materials (brochures, door hangers, digital tools) to contractors to help them promote the program, reaching out on a quarterly basis for updates, ideas, and inventory check. Researching possibility to co-brand material and direct mail tactics and cultivate synergy with vendors.
Recommendation 5: CSG, with input from PECO and Navigant, should make better use of SHC's unique position to improve cross-promotion of all Smart Ideas programs in the residential portfolio. Specific actions to consider include: • Providing better and more thorough education to Energy Advisors and contractors about the other Smart Ideas programs, including eligibility criteria, typical energy savings, and rebate amounts. • Setting a formal expectation that Energy Advisors and contractors let homeowners know the specific incentives that are available through other Smart Ideas programs for relevant measures • Providing the full list of other Smart Ideas programs with descriptions of incentives and eligibility criteria, and having the Energy Advisor either leave this with all customers or hand out as needed • Tracking SHC customers' participation in other Smart Ideas programs over time via tracking data analysis by customer number and secondarily by any verbal references to the SHC program in customer and trade ally interviews for other programs. This can serve as a means of gauging the SHC program's effectiveness as a lever and the particular programs that SHC participants pursue.	Being considered (in process). PECO will provide more thorough education to energy advisors and contractors about the other Smart Ideas programs, with specific information about eligibility criteria, savings and rebates. Assemble program descriptions and measure related materials for customers to review.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 6: CSG, with oversight from PECO, should keep increasing the use of hands-on, onsite, and video-based training in favor of PowerPoint style training for both Energy Advisors and contractors and do so in a way that is well-timed relative to when the work will be performed. Specific elements to focus on include: • Using more videos that directly demonstrate what needs to be done onsite, in favor of PowerPoint slides. • Pairing videos with more frequent optional onsite training opportunities • Extending an open, optional invitation for contractors to see an energy audit take place • Increasing the frequency of refresher training courses, with more advance notice for training events and timing these appropriately relative to when the work will be performed • Developing resources for self-training and for self-guided review of concepts on the part of Energy Advisors and contractors and potentially making these available through the internal CSG learning and development site.	Being considered. PECO will continue to evolve both technical and sales training for energy advisors and participating contractors. Implementing the recommendations such as video based training, open house audits, development of self-guided training. Also working on plan to do process training for contractors on a quarterly basis with knowledge base testing.
Recommendation 7: CSG, with oversight from PECO, should improve the flow of information for Energy Advisors to increase their effectiveness. Specific actions to focus on include: • Making information available to Energy Advisors earlier regarding details of a household such as number of occupants, size of home, and primary concerns expressed by the homeowner • Providing Energy Advisors with well-organized, easily accessible, and potentially automated notifications on which customers move ahead with major work, so Energy Advisors can receive feedback on their own effectiveness and how they might adjust their approach. This is helpful even if there is no additional action expected on the part of the Energy Advisor. • Changing the program structure such that Energy Advisors actively make a point of following up with audit participants to see if they have pursued any of the contractor-installed major measures and to ask if there are any other questions they can answer. This may serve several purposes, including increasing customer participation in the major measures, fostering a sense that the Energy Advisors are invested in the homeowners whom they have helped, and providing a feedback loop to the Energy Advisors that will help them hone their communications.	Being considered (in process). We are continuously looking for more methods of improving the flow of information for Energy Advisors Currently conducting an update on tablet software and CSR software. Will consider making the household information available before the audit as well as provide the CSP with some form of notification about additional interests in EE work by following up with the customer after the audit or assessment to learn about their experience and gather valuable feedback.

Source: Navigant analysis and PECO

4.6 Financial Reporting

Overall cost-effectiveness for SHC in PY5 is low, at 0.38. This is driven by the fact that overall verified program participation and savings are only approximately 55 percent of the PY5 goal, due to a delayed program start and the resulting delay in building momentum for participation in this new program. Cost-effectiveness is also driven down by the fact that SHC is a new program in PY5, with high administrative, management, and technical assistance costs associated with the high level of customer interactions and individually tailored nature of the SHC program design. A breakdown of the program finances is presented in Table 4-43.

It is worth noting that in the direct install component of SHC, low-cost measures such as CFLs, low-flow showerheads, faucet aerators, installed in this program are free to participants. As such, consistent with the PA PUC TRC order, the costs associated with purchase and installation of these measures are treated as a program delivery cost, and thereby, no incremental costs or incentive values are detailed.

Table 4-43: Summary of SHC Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	$73	$73
EDC Incentives to Trade Allies	$0	$0
Subtotal EDC Incentive Costs	**$73**	**$73**
Design & Development	$0	$0
Administration, Management, and Technical Assistance[1]	$1,739	$1,739
Marketing[2]	$150	$150
Subtotal EDC Implementation Costs	**$1,889**	**$1,889**
EDC Evaluation Costs	$0	$0
SWE Audit Costs	$0	$0
Total EDC Costs[3]	$1,961	$1,961
Participant Costs[4]	$250	$250
Total NPV TRC Costs[5]	**$2,139**	**$2,139**
Total NPV Lifetime Energy Benefits	$724	$724
Total NPV Lifetime Capacity Benefits	$55	$55
Total NPV TRC Benefits[6]	**$815**	**$815**
TRC Benefit-Cost Ratio[7]	**0.38**	**0.38**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

5 Smart Builder Rebates

The PECO Smart Builder Rebates (SBR) program is intended to accelerate the adoption of energy efficiency in the design, construction, and operation of new single-family homes by leveraging the U.S. Environmental Protection Agency's (EPA's) ENERGY STAR Homes certification. The program provides rebates for new homes that achieve ENERGY STAR certification. A base rebate of $450 is offered per home, plus $0.10 per kWh of savings achieved.

5.1 Program Updates

The SBR program is new for PY5. The program launched in February 2014, though only two homes were completed in PY5. The focus of activities in the first year of the program revolved around recruiting and education builders, raters, and HVAC contractors for program participation.

5.1.1 *Definition of Participant*

The target market for participation in the SBR program is primarily residential builders. All newly constructed residentially metered single-family electrically heated homes in PECO's service territory using ENERGY STAR air-source or ground source heat pumps as their primary source of heat are eligible to participate. A participant in the SBR program is defined as a home achieving ENERGY STAR certification through the program.

5.2 Impact Evaluation Gross Savings

The impact evaluation consisted of desk reviews of project REM/Rate files and building simulation modeling. As only two projects were completed in PY5, both projects were fully evaluated. Navigant used two main approaches for evaluating projects:

1. **Desk Review**. Navigant reviewed REM/Rate models and prescriptive measures (lighting, domestic hot water) for compliance with the 2013 PA TRM. This desk review made use of tracking data, measure savings calculations, and REM/Rate model files submitted by Raters. REM/Rate models that reported energy and demand savings from heating and cooling measures were reviewed for accuracy and compliance with program requirements. Prescriptive measure calculations were reviewed for compliance with TRM specifications.
2. **Whole-Building Modeling**. Navigant used the EnergyGauge® software to independently calculate energy and demand savings for both project homes. Models were created with identical home characteristics (e.g., wall construction, roof construction, window U-factors, and window-to-wall area) derived from extracts of project REM/Rate files. The annual energy and demand savings associated with the program homes were calculated as the difference between the baseline and as-built simulation results. Peak demand savings were extracted directly from the EnergyGauge hourly simulation results during PECO's peak period.

The sampling strategy for impact evaluation activities in PY5 is outlined in Table 5-1 below.

Table 5-1: SBR Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
ENERGY STAR Home	2	90/10	2	2	Desk review
ENERGY STAR Home	2	90/10	2	2	Energy Modeling
Program Total	2	90/10	2	2	

Source: Navigant analysis

The two building projects that were completed in PY5 achieved 5.27 MWh energy savings and 0.001 MW of demand savings in the residential sector, as shown in Table 5-2.

Table 5-2: Phase II SBR Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	2	5.3	0.001	$1.33
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	2	5.3	0.001	$1.33

Source: Navigant analysis

Desk Review Results

Navigant reviewed REM/Rate models, tracking data, prescriptive measure savings calculations (lighting and DHW) and supporting files for compliance with the 2013 PA TRM. REM/Rate is the standard software used by the home energy rating system (HERS) industry to calculate energy savings and document compliance with ENERGY STAR standards for certification. Data reported in REM/Rate models was complete, matched tracking system records, and met all program requirements. Savings estimates for lighting measures were also calculated correctly according to TRM protocols. However, Navigant found that DHW electric savings are currently being calculated using an algorithm that is different from the PA TRM protocol. All data needed for calculation of DHW savings per the TRM is collected by the CSP, ICF, in REM/Rate files; therefore, Navigant was able to calculate the TRM verified savings for this evaluation. ICF's algorithm estimates savings were 88 kWh/year, while the PA TRM estimates savings of 55 kWh/year.

The difference between the TRM verified savings and ICF's standard protocol savings (33 kWh/home) is reflected in the program realization rate.

Modeling Results

The 2013 PA TRM requires heating and cooling savings from new homes to be calculated using RESNET-accredited building simulation software. ICF calculates energy and demand savings by importing building specifications from rater-submitted REM/Rate files into a proprietary hourly simulation model called Beacon. ICF's reason for using Beacon instead of REM/Rate is that REM/Rate is unsophisticated in the way it models HVAC equipment and it is not an hourly simulation model, and therefore cannot calculate demand on coincident peak hours. Navigant agrees with this assessment and chose to use the EnergyGauge® software (also an hourly DOE-2 model) for the SBR impact evaluation.

To independently verify Beacon energy and demand savings for the two PY5 program homes, Navigant created identical models using both the EnergyGauge software and REM/Rate. The EnergyGauge software was used as the primary method of savings verification because it is a RESNET-accredited DOE-2 model (one of only five) that provides hourly simulation results for peak demand savings calculation. ICF does not actually calculate savings from the REM/Rate models submitted by raters (using Beacon instead), so Navigant also ran each REM/Rate model to compare results against the DOE-2 models. All models were created with identical home characteristics (e.g., wall construction, roof construction, window U-factors, and window-to-wall area) derived from extracts of project REM/Rate files. The baseline home for each model was set with specifications from the 2009 International Energy Conservation Code (IECC) for Climate Zone 4, which is the relevant energy code for Philadelphia.

Navigant found very close alignment between results generated from Beacon and EnergyGauge, which is not surprising since they are both DOE-2 models that run similar calculations. Savings generated from REM/Rate, however, were found to be significantly higher for both energy and demand, as seen in Table 5-3. All models were in close agreement for cooling energy savings, though REM/Rate produced different heating savings as expected. REM/Rate also produced a very different result for demand savings, due to the fact that these estimates are not coincident with PECO's system peak since REM/Rate does not allow for hourly simulation.

Table 5-3: Comparison of HVAC Savings Generated from Different Modeling Software

End-Use Category	Beacon Energy Savings (kWh)	Beacon Peak Demand Savings (kW)	EnergyGauge Energy Savings (kWh)	EnergyGauge Peak Demand Savings (kW)	REM/Rate Energy Savings (kWh)	REM/Rate Demand Savings (kW)
Heating	3,261	0.00	3,196	0.00	3,968	0.00
Cooling	743	0.71	832	0.76	841	1.40
PY5 Total	**4,004**	**0.76**	**4,028**	**0.82**	**4,809**	**1.40**

Source: Navigant analysis

The two building projects that were completed in PY5 achieved 5.27 MWh of energy savings and 0.001 MW of demand savings in the residential sector. Overall, the program achieved gross realization rates of 0.99 for energy and 1.08 for demand based on TRM verification methods, as shown in Table 5-4 and Table 5-5.

Table 5-4: Program Year 5 SBR Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
ENERGY STAR Home	5.3	0.99	5.2	0.5	0
Program Total	5.3	0.99	5.2	0.5	0

Source: Navigant analysis

Table 5-5: Program Year 5 SBR Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
ENERGY STAR Home	0.001	1.08	0.001	0.5	0
Program Total	0.001	1.08	0.001	0.5	0

Source: Navigant analysis

5.3 Impact Evaluation Net Savings

Navigant will conduct an NTG evaluation in PY6 when the program has sufficient participation to warrant analysis.

5.4 Process Evaluation

5.4.1 Analytical Methods

This section describes the analytic methods and data collection activities implemented as part of the PY5 process evaluation of the SBR program.

Program Theory and Logic Model

Navigant developed a Program Theory and Logic Model in order to develop a sound understanding of how the program is designed to operate and how program activities lead to desired program outcomes. This includes identifying the key program barriers, program activities, targeted outcomes, and key performance indicators (KPIs).

Tracking System and Verification and Due Diligence Review

The methods for verification and due diligence included interviews with PECO administration and implementation staff and review of the tracking system and project REM/Rate files. The purpose of the due diligence review was to determine whether project requirements had been properly adhered to and project files appropriately completed and whether the quality assurance/quality control (QA/QC) activities are adequate and unbiased.

Data Collection Methods

The principal data sources contributing to the process evaluation of the PY5 SBR program are listed below:

- Program-Tracking Database: Navigant relied upon quarterly extracts from the tracking database to conduct the review of tracking data for the impact evaluation.
- REM/Rate Files: Navigant reviewed rater-submitted inputs to the REM/Rate modeling files to verify that program requirements were met.
- Staff Interviews: Navigant conducted in-depth interviews with the PECO program manager and the ICF program manager. The interviews focused on marketing and outreach activities, implementation strategies, data tracking, and program management and identified areas for program improvement.

Sampling Strategy

Navigant conducted verification and due diligence file reviews for both participating projects using a batch extract of inputs from all REM/rate models submitted. REM/rate models contain all data needed to verify that homes were built to program specifications. In-depth interviews were conducted with key PECO and implementation staff that have been instrumental to the delivery of the SBR Program. These interviews were to be used by the evaluation team to collect all necessary data regarding program startup and implementation, as well as to discuss research areas of particular interest to program and implementation staff. Table 5-6 provides the detail for the process evaluation activities.

Table 5-6: SBR Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Population Size	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
ENERGY STAR Homes	3	N/A	3	3	100%	Staff Interviews
ENERGY STAR Homes	2	N/A	2	2	100%	REM/Rate File Review
Program Total	2	N/A	2	2	100%	

Source: Navigant analysis

5.5 Recommendations for Program Improvement

5.5.1 Impact Findings and Recommendations

The two building projects that were completed in PY5 achieved 5.27 MWh energy savings and 0.001 MW of demand savings in the residential sector. Overall, the program achieved gross realization rates of 99 percent for energy and 108 percent for demand based on TRM verification methods, as shown in Table 5-7.

Table 5-7: Program Year 5 SBR Summary of Impact Evaluation Results

Reported Gross Energy Savings (MWh/yr)	Realization Rate	Verified Gross Energy Savings (MWh/yr)	Reported Gross Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)
5.3	0.99	5.2	0.001	1.08	0.001

Source: Navigant analysis

Navigant reviewed REM/Rate models, tracking data, prescriptive measure savings calculations (lighting and DHW) and supporting files for compliance with the 2013 PA TRM. Data reported in REM/Rate models was complete, matched tracking system records, and met all program requirements. Savings estimates for lighting measures were also calculated correctly according to TRM protocols. However, Navigant found that DHW electric savings are currently being calculated using an algorithm that is different from the PA TRM protocol. All data needed for calculation of DHW savings per the TRM is collected by ICF in REM/Rate files; therefore, Navigant was able to calculate the TRM verified savings for this evaluation. ICF's algorithm estimates savings of 88 kWh/year, while the PA TRM estimates savings of 55 kWh/year. The difference between the TRM verified savings and ICF's standard protocol savings (33 kWh/home) is reflected in the program realization rate.

- **Recommendation #1**: Use the PA TRM algorithm for domestic hot water heater savings calculations in PY6.

5.5.1 Process Findings and Recommendations

5.5.1.1 Marketing, Education and Outreach

Program staff had a significant network of existing contacts to draw from in PECO's service territory. New contacts were also made with homebuilders, primarily through outreach efforts at industry meetings (home building association and HVAC associations), a program kick-off meeting, and through face-to-face meetings with builders and raters. SBR program staff joined PECO staff at PECO booths during large contractor meetings, when opportunities arose, to cross-promote the SBR program with other PECO programs. The program was also marketed through e-mail newsletters, informational packets, and the program website. Raters also provided a helpful channel for outreach to builders and in some cases the

program was able to facilitate the connection between raters and new builders. These efforts resulted in the certification of 10-15 HVAC contractors, 5 builders, and 8 new HERS raters in PY5. The only training conducted in PY5 was an Energy Star New Home sales training. Program staff have no plans for technical training on homebuilding concepts aside from ENERGY STAR trainings offered through DOE and in-field technical assistance provided through the program QA/QC process. The rationale for this is the assumption that the program orientation combined with technical support provided through the QA/QC process will be sufficient for training builders and contractors on building to ENERGY STAR standards.

- **Recommendation #2:** Closely monitor QA/QC results and conversations with raters, builders, and contractors to verify the assumption that no additional technical training is required. In light of program staff findings that many local builders/contractors lack knowledge of ENERGY STAR building practices, combined with the lack of enforcement of code requirements, it is possible that some additional training may be necessary. Consider additional technical training or support for any program requirements that are found to be troublesome for builders and/or HVAC contractors.

5.5.1.2 Program Barriers

Program staff have identified several barriers to participation, aside from builders' unwillingness to build electrically heated homes. For builders and HVAC contractors with little existing knowledge of ENERGY STAR building practices, meeting program requirements can seem complicated and overwhelming. For some of these builders, the incentive amounts are viewed as being too little compared to the additional cost of meeting program requirements (which can be especially labor intensive while transitioning from standard building practices).

Many builders and contractors also don't fully understand the benefits of the ENERGY STAR requirements (especially non-energy benefits) or how to sell these benefits to potential customers at a premium. Builders and contractors are also wary of the multitude of inspections required for ENERGY STAR certification. These inspections are viewed as a hassle that will delay the construction schedule. The cost of training needed to achieve certification for HVAC contractors and the cost of paying a HERS rater to certify the homes are also barriers to entry.

The recommendations from this section include the following (and are listed in Table 5-8):

- **Recommendation #3**: Consider including additional information in program marketing materials and/or presentations that outlines the estimated costs of meeting key program requirements. A simple list of program requirements, along with associated cost estimates, could demystify the program and demonstrate that the program is not as costly as expected. This could be enhanced through educational materials that offer suggestions on the most cost-effective methods for meeting ENERGY STAR standards. Builders have some flexibility about which building strategies to employ in meeting ENERGY STAR performance standards. For instance, significant reductions

in building air leakage beyond program requirements can be used as a cost-effective trade-off to more costly mechanical equipment upgrades, while still achieving certification. New program builders could benefit from lessons learned elsewhere about the most cost-effective ways of meeting program requirements. Further research could be conducted using energy modeling to determine the most cost-effective methods for achieving certification.

- **Recommendation #4**: The time and expense of gaining credentials presents a significant barrier to entry that the program could help to overcome by providing financial assistance with training and/or certification. This could be in the form of a short-term promotional bonus for builders or contractors that fit certain requirements, who are willing to commit to contributing a significant number of new homes to the program.
- **Recommendation #5**: Consider including an additional performance pathway that is less stringent than ENERGY STAR. This performance path could be tailored to the market, to include most ENERGY STAR requirements initially, while transitioning over time (as builders are educated) to include those more stringent ENERGY STAR requirements that builders struggle with initially. This strategy has been employed by many programs around the country and has the additional benefit of contributing to market transformation as the program educates builders to perform at a higher level.

Table 5-8: SBR Program Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Use PA TRM algorithm for domestic hot water heater savings	Implemented. Updated software to reflect 2014 TRM.
Recommendation 2: Monitor quality control results to ensure no additional technical training is required for participants	Implemented. Ongoing one on one training conducted. Monitor and review takes place during Inspections.
Recommendation 3: Consider providing additional information to contractors on the actual costs of achieving certification and the most cost-effective methods	Implemented. In our outreach and on the website materials we provide cost of certification and methods of obtaining.
Recommendation 4: Consider providing some form of financial support to contractors for achieving credentials required for program participation	Being considered. On a case by case basis, evaluating the cost to an HVAC contractor.
Recommendation 5: Consider an additional performance pathway that transitions contractors into the ENERGY STAR program	Rejected. This would take away from out desired objective to promote whole home design efficiency approach. Being Considered to include Energy Star cooled homes.

Source: Navigant analysis and PECO

5.6 *Financial Reporting*

Table 5-9 shows the inputs and results of the cost-effectiveness analysis for the SBR program in PY5. The program achieved a TRC ratio of 0.02. The low TRC ratio found in PY5 is due to low participation. The TRC should improve dramatically in PY6 with more participation, though may still be low due to the high incremental cost of ENERGY STAR homes relative to the energy savings.

Table 5-9: Summary of SBR Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	1	1
Subtotal EDC Incentive Costs	1	1
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	247	247
Marketing[2]	0	0
Subtotal EDC Implementation Costs	247	247
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	248	248
Participant Costs[4]	5	5
Total NPV TRC Costs[5]	**252**	**252**
Total NPV Lifetime Energy Benefits	6	6
Total NPV Lifetime Capacity Benefits	1	1
Total NPV TRC Benefits[6]	**6**	**6**
TRC Benefit-Cost Ratio[7]	**0.02**	**0.02**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

6 Low-Income Energy Efficiency Program

The LEEP continued in PY5 operating much as it has since the program's inception, while continuing to explore ways to broaden and deepen program impacts. In Component 1, centered on providing in-home audits, education and the direct installation of energy efficiency measures, the numbers of audits have decreased overall, and auditors often find there are few eligible in-home measure opportunities. Furthermore, where CFLs are installed, the downward trend of the number of CFLs installed per home continues.

6.1 Program Updates

- The Low-Income Energy Efficiency Program (LEEP) did exceed its savings goals for program year 5 (PY5) by achieving 122 percent of its savings goals. The PY5 program goals were 13,732 megawatt-hour (MWh) savings, and the program achieved 16,764 MWh savings.
- CFLs continued to account for 88 percent of total program savings in PY5.
- The LEEP increased service to renters in Component 4, refrigerator replacement, and is working to increase the program's reach to renters more broadly.
- PECO is addressing program design issues, such as moving to an energy use intensity-based (EUI-based) usage standard for program eligibility to address the most inefficient homes.

Overall satisfaction with the home visits was high among Component 1 and Component 4 participants, and all participants reported general high levels of satisfaction with the measures received through the program.

6.1.1 Definition of Participant

The LEEP serves income-eligible customers with a variety of measures intended to make their electricity bills more affordable. Most LEEP participants have only electric base load uses; most depend on natural gas as their heating fuel, thereby limiting the measures that may be provided to them. The target markets heavily overlap, with the possible exception of recipients of CFLS under Component 3—in community-based events, where usage information would not be accessible. Some PY5 Component 4 participants, who had previously participated in Component 1, were not eligible for refrigerator replacement at the time of their Component 1 participation because of their renter status, but they are essentially all the same market. The LEEP Components and their target markets are described in Table 6-1 below and in the text below.

Table 6-1: LEEP Components

Component	Target Market	Measures
1	PECO residential customers with a household income at or below 150% of the FPL*. Household usage levels must exceed 600 kilowatt-hours (kWh) per month for electric baseload customers (500 kWh for Customer Assistance Program [CAP] rate customers), and 1,400 kWh per month for electric heating customers.	Audits conducted. Direct installation of measures. Extra CFL bulbs installed. Other major measures as appropriate, such as refrigerators.
2	*PECO customers who will participate in LIURP during PY1- PY5.*	*Additional CFL bulbs installed.*
3	Income-qualifying PECO residential electric customers (distributed through PECO- and other community sponsored events).	CFL bulb distribution.
4	Income-qualifying PECO residential customers eligible to participate in other energy efficiency programs.	Refrigerator and freezer replacements.

*For the purposes of meeting PECO's 4.5% low-income savings requirement, PECO will only count savings generated by households at or below 150% of the Federal Poverty Income Guidelines.

Source: PECO LEEP program documentation

Market for Component 1: PECO residential customers with a household income at or below 150 percent of the FPL[15], plus LEEP requirement of household usage levels that exceed monthly average usage of 600 kWh per month for electric base load (500 kWh for Customer Assistance Program [CAP] low-income discount rate customers) for non-electric heating customers and 1400 kWh per month for electric heating customers. PECO will focus primarily on residential customers with a household income at or below 150 percent of the FPL for this program. The definition of high-use customers may change depending on the results of the ongoing programs.

Market for Component 2: PECO customers who participate in LIURP during PY5-PY7.

Market for Component 3: PECO residential electric customers with a household income at or below 200 percent of the FPL participating in community events for low-income residents.

Market for Component 4: PECO residential customers, homeowners and/or tenants, with a household income at or below 200 percent of the FPL that do not meet the LEEP usage requirement for weatherization services. Low-income new construction units are excluded from being eligible.

[15] LIURP's limit is up to 200 percent of the FPL.

6.2 Impact Evaluation Gross Savings

Prior to calculating verified savings, Navigant analyzed the tracking database to determine the reported participants, gross energy savings, and gross demand reduction. Because LEEP is a low-income-focused program, all participants and savings for the program belong to the low-income sector, as shown in Table 6-2 below.

Table 6-2: Phase II LEEP Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0	0
Low-Income	33,087*	14,127*	1.1*	0
Small Commercial and Industrial	0	0	0	0
Commercial and Industrial	0	0	0	0
Government, Nonprofit, and Institutional	0	0	0	0
Phase II Total	**33,087**	**14,127**	**1.1**	**0**

* Included participants and savings from all LEEP Components

Source: Navigant analysis of PECO LEEP PY5 tracking database

Navigant conducted a TRM-based engineering review of the program tracking database, coupled with information gathered from telephone survey verifications, to calculate verified gross savings values. The evaluation team conducted the engineering review using the entire population of projects in the tracking database. The telephone survey verifications were conducted on a sample of participants. Table 6-3 and Table 6-4 below show the verified energy and demand savings, respectively, by component and component type.

Table 6-3: Program Year 5 LEEP Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Electric Base Load - Basic	1,375	1.73	2,380	95.8%	1.3%
Electric Base Load - Major	17	84.66	1,399	96.3%	0.8%
Electric Heat - Basic	1,833	0.08*	138	96.8%	0.4%
Electric Heat - Major	532	1.96	1,041	99.9%	0.2%
Component 2	764	1.14	869	95.5%	1.8%
Component 3	8,448	1.15	9,755	100.0%	0.0%
Component 4	1,159	1.02	1,182	100.0%	0.0%
Program Total	**14,127**	**1.19**	**16,764**	**99.1%**	**0.2%**

*PECO's tracking database records Electric Heat Basic savings based upon the number of audits performed, regardless of whether the audits resulted in basic measure installations. However, of 897 audits performed in PY5, only 169 resulted in basic measure installations. Accounting for that circumstance results in the 0.08 realization rate.

Source: Navigant analysis of PECO LEEP PY5 tracking database

Table 6-4: Program Year 5 LEEP Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Electric Base Load - Basic	0.078	2.21	0.174	95.8%	1.0%
Electric Base Load - Major	0.003	52.99	0.152	96.3%	0.4%
Electric Heat - Basic	0.232	0.06	0.014	96.8%	0.2%
Electric Heat - Major	0.116	2.18	0.253	99.9%	0.0%
Component 2	0.044	1.13	0.050	95.5%	1.8%
Component 3	0.492	1.15	0.569	100.0%	0.0%
Component 4	0.147	1.02	0.150	100.0%	0.0%
Program Total	**1.113**	**1.22**	**1.361**	**99.1%**	**0.2%**

Source: Navigant analysis of PECO LEEP PY5 tracking database

The verified gross energy savings for Component 1's individual component types differ greatly from the reported savings. One of the reasons for this is that, in prior years, Component 1 gross savings were calculated using a billing analysis. PY4's billing analysis results were then applied to PY5.

Table 6-5 below shows a comparison of average savings per customer by using the PY4 billing analysis and by using the TRM-based approach for Component 1.

Table 6-5: LEEP TRM and Billing Analysis Savings Comparison

Component Type	PY4 Billing Analysis Savings (kWh/Customer)	PY4 Billing Analysis Savings (kW/Customer)	PY5 TRM Savings (kWh/Customer)	PY5 TRM Savings (kW/Customer)
Electric Base Load - Basic	167	0.008	340	0.021
Electric Base Load - Major	27	0.004	1,747	0.073
Electric Heat - Basic	2,490	0.447	815	0.014
Electric Heat - Major	1,786	0.154	2,324	0.091

Source: Navigant PECO LEEP PY4 analysis and Navigant analysis of PECO LEEP PY5 tracking database

Additionally, 2,877 records in the tracking database were incorrectly assigned to the Component 1 "Measure" component type. These records should have been assigned to either Electric Base Load – Major or to Electric Heat – Major component type but were not. Navigant was able to assign them to the correct component type for use during verified gross savings calculations, but no ex ante savings were recorded in the tracking database for these records. This drastically reduced the ex ante savings for Component 1 as a whole and especially for the "Major" measure designations.

During the analysis of the tracking database, Navigant found that 22 refrigerators were recycled through Component 4 with no replacement. These measures did not have recorded energy or demand savings in the tracking database.

Navigant found that with the exception of Component 4, all components of the program achieved less energy and demand savings in PY5 than in PY4. Overall, energy savings have fallen by approximately 43 percent in PY5 as compared to PY4. This is largely due to the reduced number of LEEP participants in PY5. There were 8 percent fewer Component 1 audits in PY5 than in PY4, 26 percent fewer Component 2 participants in PY5 than in PY4, and 47 percent fewer CFLs distributed through Component 3 in PY5 than in PY4. However, Component 4 participation rose by 252 percent from PY4 to PY5.

Navigant calculated CFL savings using the TRM-prescribed method and a method that includes HVAC interactive effects. Table 6-6 below compares the total LEEP PY5 verified gross savings using both methodologies.

Table 6-6: PY5 LEEP Verified Results with Lighting Interactive Effects

Fuel Type	Reported Gross Savings	PY5 Verified Gross Savings	PY5 Verified Gross Savings with Interactive Effects[1]
MWh	14,125	16,764	16,894
MW	1.1	1.4	1.5

[1] Verified Gross Savings with interactive effects factors for energy and demand of 1.010 and 1.228, respectively, to residential lighting savings. This is in contrast to the TRM, which has no IE factors for residential lighting.

Source: Navigant analysis

6.3 Impact Evaluation Net Savings

Because LEEP is a low income program and neither Free Ridership nor spillover are presumed effects, Navigant the NTG ratio is 1.0, as he net savings are equal to the gross savings.

6.4 Process Evaluation

Navigant performed LEEP process evaluation using the following methods:

- Interviews of the PECO and implementation program managers
- Review of educational program educational materials
- Ride-along observations of 10 homes receiving Component 1 audit/education visits
- A participant survey of a total of 121 program participants from Components 1, 3 and 4.

The evaluation team conducted a participant survey for both verification (impact) and process purposes. As described below and shown in Table 6-7, a sample was drawn representing each of the program components. The verification segments of the survey focused on whether the measures reported for each component were actually installed (Components 1 and 4) or were received. For direct installed measures, the survey established an in-service rate through questions determining first whether CFLs, faucets, and aerators were installed as reported and second whether the participants removed any measures and, if so, reasons for removal.

For process purposes, participants were asked about several topics, including:

- Relevance and effectiveness of the education component
- Effectiveness and professionalism of the auditors/educators
- Usefulness of the educational leave-behind materials

Table 6-7: LEEP Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Component 1	8,967	80%	85/15	50	57	Process and Impact Analysis
Component 3	18,763	50%	85/15	50	50	Process and Impact Analysis
Component 4	1,864	90%	85/15	21	21	Process and Impact Analysis
Program Total	29.594	N/A	N/A	121	128	N/A

Source: LEEP Tracking Data, Navigant Analysis

When asked if the implementation contractor staff installed any energy saving measures during their visit, 87 percent (n = 54) of Component 1 respondents replied in the affirmative. This is identical to the installation rate that was reported by PY4 participants (87 percent, n = 38). The 13 percent of participants who did not receive energy savings measures likely also received non-energy savings measures, such as smoke detectors. All of the participants who had energy savings measures installed reported that the implementation contractor had installed CFLs during their visit. The Component 1 participants reported high levels of satisfaction with the CFLs installed through the program. The average level of satisfaction reported was 4.6. This is comparable to the PY4 satisfaction rating, which was 9.5 on a 1-to-10 scale.

The Component 1 participants were asked how useful the materials they received during their home visit were in helping them manage or reduce their energy bills. The respondents were asked to gauge the usefulness of the materials that they received on a scale from 1 to 5, with 1 representing materials that were not at all useful and 5 representing materials that were extremely useful. The average usefulness rating given was 4.3, and 59 percent of respondents rated the materials as "extremely useful".

Component 3 participants were asked about the CFLs that they received from the program. Eighty-two percent (n = 50) of Component 3 participants reported that they received CFLs from the program. On average, the participants reported receiving 4.2 lamps, which is lower than the reported PY4 rate of 6.3 lamps. However, the number of lamps installed remained fairly consistent, at 3.5 lamps per participant (compared to the PY4 installation rate of 3.8 lamps per participant).

Component 4 participants were asked a series of questions about the refrigerators that they had received through the program. All 21 of the Component 4 respondents reported that they did have a refrigerator installed by the LEEP, and 20 of them responded that the refrigerator was still installed and working. The one participant whose program refrigerator was no longer installed stated that the program refrigerator had stopped working and had to be replaced. The program participants were generally very satisfied with their refrigerators, giving them an average satisfaction score of 4.6.

Considering all components, the program's savings continue to be overwhelmingly in lighting (standard CFLs and increasing numbers of specialty bulbs), but the numbers of CFLs installed per home have been decreasing steadily as more program participants adopt this form of lighting. This circumstance extends to Components 2 and 3, as opportunities for adding CFLs decreases. Additionally, PECO reduced the number of audits in PY5 by about 11 percent because of the observed reduced opportunities per home and the high cost of placing auditors in the home. One consequence of these circumstances was that the PY5 program was underspent approximately $800,000, with a budget of $6.7 million. The only counter trend has been in Component 4, where installations increased by 250 percent over program year 4 (PY4).

PECO has taken several steps to broaden and deepen program impacts in response to prior evaluations and its own analyses, including:

- Extending refrigerator and room air conditioner (AC) replacements to renters
- Beginning to develop an EUI approach to the usage eligibility requirement, which can better capture high electric use in smaller dwellings and provide better targeting for the program's offerings

Additionally, PY5 participant research found that about 5 percent of PY5 Component 1 participants who declared natural gas as their primary heating fuel actually use electric space heaters for half or more of their heating needs. Though a small percentage of current participants, this finding may indicate there is a significant customer group not being adequately served, especially if PECO develops an EUI standard for program service eligibility.

Navigant presented a preliminary findings memo with several ride-along observations and recommendations. Among the observations made during the ride-alongs, the evaluation staff noted that the CSP is generally installing program measures when and where appropriate. Regarding the installation of CFLs, Navigant staff observed that the CSP strictly followed the program guidelines to install CFLs only in sockets that are used for at least three hours per day. Of the ten homes visited, eight had installed at least one CFL prior to the audit. This indicates that low-income customers are purchasing or obtaining CFLs from other sources. Opportunities to install CFLs in high use sockets will likely continue to decrease in the coming years. On average, the CSP installed 3.1 CFLs per home.

The evaluation staff also noted that the Energy intensity (kWh/sq ft) varies widely across participants. Income-qualified customers with monthly average usage (MAU) greater than 500 kWh are eligible for participation in LEEP. Energy usage varies widely, even after normalizing by home square footage. The participants with the highest usage are not necessarily those with the largest homes. The evaluation staff also noted that space heating usage is high, even for customers who currently have gas service.

6.5 Recommendations for Program

Table 6-8 presents the recommendation for the LEEP Program.

Table 6-8: LEEP Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Include ex ante kWh and kW savings by measure for Component 1. This will provide a more accurate estimation of ex ante savings. PECO should take measures to correct this error for future program years to ensure that all ex ante savings are accounted for.	Implemented. Beginning PY6, the energy savings complies with the 2014 TRM for measures installed as part of audit.
Recommendation 2: Navigant recommends that recycled refrigerators with no replacement receive the TRM-deemed savings for this measure.	Implemented. PECO is counting the TRM-deemed savings for second refrigerators removed and recycled as part of the audit
Recommendation 3: PECO should examine billing data for indications of electric space heating in homes that are not on the electric space heat rate and also are listed as having natural gas or other fuels as their primary heating source. Additionally, PECO and the CSP, CMC should revise their intake data to ask specifically about electric space heater usage. Customers whose use of electric space heaters can be demonstrated as a substantial or major contributor to their space heat needs could then be treated as electric heating customers and provided appropriate base load and/or major measures.	Being considered. Data is being collected and analyzed to better understand extent of customers utilizing electric space heat as primary heat source.
Recommendation 4: PECO should consider the addition of a room air conditioning unit replacement measure as a means to increase energy savings for the program.	Implemented. PECO has expanded the replacement of room air conditioners to tenants as part of the audit.
Recommendation 5: ECO should take into consideration the recommendations from the preliminary Ride-Along observations memo, including adding shell improvements and ductless mini-split heat pumps to the program.	Being considered. PECO is determining the criteria, cost and savings for installation of ductless mini-split heat pumps. Additionally, PECO is working with CSP to implement recommendations as part of observation memo (e.g., energy intensity, electronic education, etc.)

Source: Navigant analysis

6.6 *Financial Reporting*

The LEEP is a cost effective program, with a calculated TRC of 2.01. A breakdown of the program finances is presented in Table 6-9.

Table 6-9: Summary of LEEP Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	5,896	5,896
Marketing[2]	75	75
Subtotal EDC Implementation Costs	5,971	5,971
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	5,971	5,971
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	5,971	5,971
Total NPV Lifetime Energy Benefits	10,750	10,750
Total NPV Lifetime Capacity Benefits	531	531
Total NPV TRC Benefits[6]	12,019	12,019
TRC Benefit-Cost Ratio[7]	2.01	2.01

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] *Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.* EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

7 Smart Energy Saver

The PECO SES program seeks to educate students about the benefits of EE through engaging information and fun, energy-saving activities. By reaching students at a young age, PECO expects that students will adopt energy-efficient habits early on and continue to engage in energy-efficient behavior throughout their lives. In addition, PECO expects that parents and guardians will also be educated about EE through their student's participation in the program, and that this education will affect their decision-making and energy usage behaviors.

In addition to changing behavior through education, the SES program encourages the installation of several types of low-cost, energy-efficient measures provided to each student through the PECO Smart Energy Saver kits. These measures provide simple and direct ways to save energy at the household level. Teachers encourage students to install the measures through school assignments and, because the measures are provided to students at no cost, PECO expects that participating households will be likely to install the measures.

The SES program consists of an energy-based classroom curriculum in which participating teachers instruct fifth through eighth grade students on energy-saving approaches that they can implement in their homes.[16] The program provides participating students with a take-home kit designed to raise awareness about how individual actions and low-cost measures can create significant reductions in electricity and water consumption. The SES website provides additional resources for teachers, students, and parents who participate in the program including a list of frequently asked questions, instructions, and videos on installing measures from the take-home kits, and kid-friendly energy-related websites that provide students with additional activities and information. Other utilities across the country also employ this type of program including DTE Energy and ComEd.

PECO hired a CSP, Research Action Programs (RAP), to implement the program and to distribute kits to participating teachers in schools throughout the PECO service territory.[17] RAP worked with PECO to identify and recruit fifth grade teachers into the program and then distributed curriculum materials and take-home kits to the teachers for use, free of charge. RAP also supplied a "slimmed down" version of the kits and materials to a second CSP, the National Energy Education Development (NEED) Project. NEED

[16] Curriculum aligns with Pennsylvania's Core Standards, as outlined at http://www.pdesas.org/Standard/PACore.

[17] The program assumes that students that attend schools within PECO territory are PECO customers.

distributed the slimmed-down kits via the PECO Energizing Education Program (PEEP) in sixth through eighth grade classrooms within PECO territory.[18]

In PY5, the program distributed "full" SES take-home kits that included four CFLs (two 13-W, one 18-W, and one 23-W), a low-flow showerhead, a faucet aerator, and one LED nightlight. The program also distributed slimmed-down PEEP kits, which included two 13-W CFLs and two LED nightlights. Each of these measures corresponds with a deemed value in the 2013 TRM and the program achieves energy savings from the installation of the items included in the take-home kit.

The program materials, and subsequently the teachers, encouraged students to install the measures included in the take-home kits at home, and complete an installation survey noting which measures they installed. Teachers who returned a certain percentage of their students' installation survey data received a grant for $50. The take-home kits also include information about PECO's EE programs, a list of low-cost/no-cost energy-saving tips, measurement tools for student use, and an evaluation card for parent/guardians to provide basic feedback on the program, as well as household contact information for follow-up surveys.

The PECO SES program aims to do the following:

- Lower student household energy consumption (i.e., generate energy savings) through the installation of EE measures
- Raise student awareness and understanding of their energy use and the role of energy- efficient technology and behaviors
- Motivate additional reductions in energy consumption through behavior change and participation in other PECO EE programs
- Encourage participants to view PECO as an ally in their efforts to reduce energy consumption

Through the implementer, RAP, the SES program distributes Smart Energy Saver kits to send home with students. The kits include activities and measures aimed at improving the efficiency of students' homes. The lessons presented in the classroom supplement the kit activities and encourage students to follow through in installing the efficiency measures. The outsides of the kits are branded to promote other PECO EE programs such as the PECO Smart Home E-Audit and PECO SAR. The full take-home materials include the following:

- LED Night-Light (1 for full kit, 2 for slimmed-down kit)
- 13-W CFL Bulbs (x2, full kit and slimmed-down kit)

[18] Navigant's evaluation includes analysis of installation survey and parent/guardian survey data from both full (SES) and slimmed down (PEEP) kit recipient households. Navigant also included PEEP participant teachers in its online teacher survey sample.

- 18-W CFL Bulbs (x1, full kit only)
- 23-W CFL Bulb (x1, full kit only)
- Kitchen Aerator (full kit only)
- High-Efficiency Showerhead (full kit only)
- Flow Rate Test Bag (full kit only)
- Electrical Tape (full kit only)
- Digital Thermometer (full kit only)
- Product Installation Instructions
- Parent's Quick Start Guide
- Parent/Guardian Evaluation Card
- Student Pre-Post Quiz
- Home Check-Up/Activities Survey
- Installation DVD
- Marketing piece to cross-promote other PECO EE programs

7.1 Program Updates

PECO launched this program in PY5 and did not make any major changes to the program offerings outlined in the Phase II plan.

7.1.1 Definition of Participant

PECO defines participation based on the number of take-home kits distributed. One kit is equal to one participant. For full kit distribution, the SES program primarily targets fifth grade students at schools located within the PECO service area. Based on its implementation experience across the country, RAP believes that students at the fifth grade level are at an optimal point of educational and social development. RAP feels that fifth grade students are advanced enough to understand and absorb the lessons and activities central to the program, as well as impressionable enough for the program to have an impact on their world view in terms of EE.[19] The program also targets sixth through eighth grade students with the slimmed-down PEEP kits. By sending efficiency measures and information home with students in the kits, the program is by extension targeting the parents and guardians of these students as an additional audience.

[19] Based on the implementer interview with RAP.

7.2 Impact Evaluation Gross Savings

Navigant estimates the gross savings for the SES program to be 1,848 MWh/year and 0.1 MW, less than the 4,300 MWh/year and 0.3 MW estimated in the ex ante calculations noted in Table 7-1.

Table 7-1: Phase II SES Reported Results by Customer Sector

Sector	*Participants*	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	12,584	4,300	0.3	0
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	12,584	4,300	0.3	0

Source: Navigant analysis of program tracking data

Using data captured via the student installation surveys and documented in the program tracking database, Navigant evaluated the program gross savings impacts based on the deemed values in the 2013 TRM. Through the installation surveys, the students provided information about how many and which of the take-home kit measures they installed in their home, as well as whether their water heaters use gas or electricity. After RAP received the returned installation survey data from participating teachers, RAP provided the data to PECO for transfer to Navigant. Using this information, the evaluation team quantified installation rates for each of the measures and calculated savings for each measure based on the algorithms outlined in the 2013 TRM. In this report, Navigant presents analysis results for each type of installed measure individually and in aggregate for the overall program.

Navigant verified that in PY5 RAP distributed 6,992 SES (full) kits and 5,592 PEEP (slimmed-down) kits. These 12,584 kits were distributed to 256 teachers across 122 schools. The SES and PEEP kits included a sampling of simple, do-it-yourself, EE measures. The full kit, the SES kit, included a variety of CFLs, an LED nightlight, low flow showerhead and faucet aerator. The PEEP kit, which was a slimmed-down kit only included CFLs and LED nightlights.

Table 7-2: SES Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
PEEP Participants	5,592	85/15	5,592	2,184	Gross Impact Evaluation
SES Participants	6,992	85/15	6,992	3,065	Gross Impact Evaluation
Program Total	12,584	N/A	12,584	5,249	

Source: Navigant analysis of program tracking data

The energy realization rate attributed to this program is 0.43, as indicated in Table 7-3and the peak demand realization rate attributed to this program is 0.27, as indicated in Table 7-4. The low realization rate for the SES program is attributable to the following two factors:

1. The in-service rate for all measures was lower than the TRM defined values.
2. The low-flow showerhead and the faucet aerator only have program-attributable savings if installed in homes with electric water heating.

Table 7-3: Program Year 5 SES Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.I.
13-W CFL	1,019	0.70	710	0.59	0.01
18-W CFL	210	0.48	101	0.40	0.03
23-W CFL	294	0.45	133	0.38	0.03
LED Night-Light	400	0.97	388	0.75	0.00
Low-Flow Showerhead	2,042	0.22	454	0.20	0.07
Faucet Aerator	336	0.19	63	0.19	0.09
Program Total	4,300	0.43	1,848	0.37	0.02

Source: Navigant analysis of program tracking data

Table 7-4: Program Year 5 SES Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.I.
13-W CFL	0.1	0.71	0.042	0.59	0.01
18-W CFL	0.0	0.47	0.006	0.40	0.03
23-W CFL	0.0	0.44	0.008	0.38	0.03
LED Night-Light	0.0	0.0	0.000	0.75	0.00
Low-Flow Showerhead	0.2	0.11	0.026	0.20	0.16
Faucet Aerator	0.0	0.38	0.014	0.19	0.04
Program Total	0.3	0.27	0.095	0.365	0.04

Source: Navigant analysis of program tracking data

When calculating the ex post program savings, Navigant updated some of the TRM defined variables based on available installation survey data. The standard TRM values used in the ex ante calculations were only changed when 1) the TRM dictates that data collection can be used to update values, and 2) when the evaluation team was confident in the data supplied by the installation survey. The next sections of this report present the calculations used for each measure and any changes that were made to the ex ante calculations to get to the ex post results. Additional results are provided for each measure to highlight the input changes that will be seen in the 2014 TRM. These additional results do not change the ex post calculations or the program realization rate for PY5, but they do provide an understanding of what the program evaluation may look like for PY6.

7.2.1 Energy and Peak Demand Savings from CFLs

In calculating energy savings for CFLs, the only adjustable input is the in-service rate. According to the TRM, the in-service rate for CFLs is 84 percent. The installation survey indicated that the in-service rate for the CFLs provided in the kits was lower than the default TRM value used in the ex ante calculation. The ISR for the three CFL measures, as verified through the installation survey and used in the ex post calculations, are indicated in Table 7-5.

One of the reasons that the ex post in-service rate is so much lower than the ex ante, or TRM dictated, in-service rate is because the TRM value reflects both actual installations and the percent of units planned to be installed within a year of the logged sample. The ex post in-service rate only accounts for the CFL bulbs installed on the spot. Many evaluations have pointed to the fact that measures such as CFLs will

continue to be installed if left in the home, so these measures may see higher ISR over time. The in-service rate used for this evaluation is the lower of the two options, but it is the only one verified through program data. Using the in-service rate as determined from the installation surveys likely underestimates the savings attributable to this measure over the total measure life.

Ex post calculations were completed for the CFL measures following the requirements of both the 2013 and 2014 TRM. The 2013 TRM, which serves as the basis for the PY5 savings calculations, calculates CFL energy savings without including HVAC interactive effects. The 2014 TRM, which will serve as the basis of the PY6 evaluation directs CFL energy savings calculations to include interactive effects. The energy savings by measure following the dictates of both the 2013 and 2014 TRM are presented in Table 7-5, only the ex post energy savings following the rules of the 2013 TRM are used in calculating program savings for PY5.

Table 7-5: Program Year 5 SES CFL Ex Ante and Ex Post Energy Savings

Stratum	Ex Ante In-Service Rate (2013 TRM)[20]	Ex Post In-Service Rate (Documented)[21]	Ex Ante Energy Savings per Measure (kWh)	Ex Post Energy Savings per Measure (2013 TRM) (kWh)	Ex Post Energy Savings per Measure (2014 TRM)[22] (kWh)
13-W CFL	84%	59%	41	28	31
18-W CFL	84%	40%	30	14	16
23-W CFL	84%	38%	42	19	21

Source: Navigant analysis of installation survey data, PA 2013 & 2014 TRMs

The only adjustable input in the peak demand calculation for CFLs was the in-service rate. Again, the TRM-defined in-service rate for CFLs is 84 percent, and the ISR found through the installation survey were much lower. The only difference in the calculation of peak demand between the 2013 TRM and the 2014 TRM is the CF. The CF definition for this measure is 5 percent in the 2013 TRM and 9.1 percent in the 2014 TRM. Table 7-6presents the peak energy savings by measure following the dictates of both the 2013 and 2014 TRM.

[20] The TRM In-Service Rate (ISR) for CFLs includes both the percent of actual installations and the percent of units planned to be installed within one year of the logged sample.

[21] The Ex Post In-Service Rate, gathered from the survey results, includes only the percent of actual installations.

[22] The only change between the Ex Post Energy Savings per Distributed Bulb calculated following the 2013 TRM versus those calculated following the 2014 TRM, is that the 2014 TRM calculation includes HVAC interactive effects. Both Ex Post Energy Savings per Distributed Bulb calculations use the Ex Post In-Service Rate.

Table 7-6: Program Year 5 SES CFL Ex Ante and Ex Post Peak Demand Savings

Stratum	Ex Ante In-Service Rate (2013 TRM)[23]	Ex Post In-Service Rate (Documented)[24]	Ex Ante Peak Demand Savings per Distributed Bulb (kW)	Ex Post Peak Demand Savings per Distributed Bulb (2013 TRM) (kW)	Ex Post Peak Demand Savings per Distributed Bulb (2014 TRM) (kW)
13-W CFL	84%	59%	0.00195	0.00138	0.00274
18-W CFL	84%	40%	0.00150	0.00071	0.00140
23-W CFL	84%	38%	0.00210	0.00093	0.00184

Source: Navigant analysis of installation survey data, PA 2013 & 2014 TRMs

The following is the recommendation from this section:

- **Recommendation:** With PECO's approval, the evaluation team could conduct surveys of previous year parent/guardian participants in PY7 and PY8 to better understand ISR for the CFL measures after one to two years.

7.2.2 *Energy and Peak Demand Savings from LED Night-Lights*

Two inputs to the energy savings calculation for LED night-lights were adjusted from the ex ante calculation to the ex post calculation, the wattage of the LED nightlight and the in-service rate. The 2013 TRM assumes that a 1-watt night-light replaces a 7-watt incandescent night-light. Navigant confirmed that the LED night-light distributed in the program kits was a 0.5-watt LED night-light. The change in wattage was therefore assumed to be 6 watts in the ex ante calculation and 6.5 watts in the ex post calculation. The 2013 TRM indicates an in-service rate of 84 percent for the LED night-light measure. The installation survey indicated an actual in-service rate for this measure of 75 percent. The effects of these changes between the ex ante and ex post calculations are illustrated in Table 7-7. There are no differences in the calculation of the LED night-light measure between the 2013 and 2014 TRM, so these tables present no 2014 predicted results.

[23] The TRM In-Service Rate (ISR) for CFLs includes both the percent of actual installations and the percent of units planned to be installed within one year of the logged sample.

[24] The Ex Post In-Service Rate, gathered from the survey results, includes only the percent of actual installations.

Table 7-7: Program Year 5 SES LED Night-Light Ex Ante and Ex Post Savings

	Ex Ante In-Service Rate (2013 TRM)	Ex Post In-Service Rate (Documented)	Ex Ante Energy Savings per Distributed Night-Light (kWh)	Ex Post Energy Savings per Distributed Night-Light (kWh)	Ex Ante Peak Demand Savings per Distributed Night-Light (kW)	Ex Post Peak Demand Savings per Distributed Night-Light (kW)
LED Night-Lights	84%	75%	22	21	0	0

Source: Navigant analysis of installation survey data, PA 2013 & 2014 TRMs

The energy savings attributable to LED night-lights assumes that the LED night-lights are replacing incandescent night-lights. Navigant has concerns about this assumption, especially in light of the high in-service rate for this measure. If the LED night-lights are installed and not replacing existing night-lights, this measure may actually attribute to load growth rather than providing energy savings. The installation survey for PY5 did not include a question to verify the TRM assumption that LED night-lights are replacing existing night-lights.

The following is the recommendation from this section:

- **Recommendation:** In a preliminary findings memo, Navigant recommended that RAP add a question to the PY6 installation survey to verify this assumption. RAP agreed with this recommendation and added a question addressing this concern to the PY6 installation survey. The PY6 impact evaluation will use the results of this additional survey question to differentiate actual measure savings from load growth.

7.2.3 Energy and Peak Demand Savings from Low-Flow Showerheads

The calculation of energy savings from low-flow showerheads uses two TRM defined inputs that are different for single-family and multi-family (MF) homes: the number of people living in the home and average number of showers in the home. The ex ante calculations for low-flow showerheads assumed that these measures were all installed in MF residences, as the MF calculations include the most conservative inputs. Navigant was able to verify through the installation survey the proportion of single-family and MF residences that received kits. The ex post calculations are therefore based off of the proportional distribution of single-family and MF homes in the population. Of the 6,992 low-flow showerheads distributed by the SES program, Navigant estimates that 76 percent were distributed to single-family homes and 24 percent were distributed to MF homes.

The SES program design dictates that savings for low-flow showerheads can only be claimed when they are installed in homes that use electric water heating. The ex ante calculations assume that all low-flow showerheads are installed in homes with electric hot water heating. Navigant was able to determine from the installation survey that this assumption was not in fact true. Table 7-8indicates the percentage of homes in the population, split between SF and MF residences, which received kits and have electric water

heating. The numbers of homes indicated in Table 7-8are the total number of homes that can attribute any energy savings for the low-flow showerhead measure to the program total.

Table 7-8: Low-Flow Showerhead Installations in Homes with Electric Heating

	Total Low-Flow Showerheads Distributed by Building Type	Percentage of Homes Receiving a Low-Flow Showerhead with Electric Water Heating	Number of Homes Receiving a Low-Flow Showerhead with Electric Water Heating
Low Flow Showerheads (SF)	5,295	48%	2,545
Low Flow Showerheads (MF)	1,697	52%	879

Source: Navigant analysis of installation survey data

The ex ante calculations assumed that the energy-efficient low-flow showerhead had a flow rate of 1.5 gpm. The installation survey asked a question to confirm or deny this assumption. However, the data collected in the installation survey was limited and there were concerns about its validity. No changes were made to the assumption that the low-flow showerhead had a flow rate of 1.5 gpm based on the results of the installation survey.

Other than the changes in inputs related to SF homes and electric water heating, the only additional input that was changed was the in-service rate. The ex ante calculation assumed an in-service rate of 100 percent. Navigant determined from the installation survey that the in-service rate for the low-flow showerhead measure was actually much lower. Table 7-9 presents the in-service rate used in the ex post calculations. The in-service rate reported in Table 7-9 is not the in-service rate for the entire population, but the in-service rate specifically for those homes with electric water heating.

Table 7-9: Low-Flow Showerhead Ex Ante and Ex Post Energy Savings

	Ex Ante In-Service Rate (2013 TRM)	Ex Post In-Service Rate (Documented)[25]	Ex Ante Energy Savings per Distributed Showerhead (kWh)	Ex Post Energy Savings per Distributed Showerhead (kWh)
Low Flow Showerheads (SF)	100%	40%	292	134
Low Flow Showerheads (MF)		44%		129

Source: Navigant analysis of installation survey data, PA 2013 & 2014 TRMs

[25] The Ex Post In-Service Rate presented here is based off the reduced population of only those homes with electric hot water heating.

The calculation of peak demand savings for the low-flow showerhead measure is the result of an Energy to Demand Factor applied to the calculated energy savings. This means that any adjustments made to the energy-saving calculation are also reflected in the calculation of peak demand savings. Other than the adjustments already discussed, no additional adjustments were made between the ex ante and ex post peak demand savings. Table 7-10 presents the resulting peak demand savings.

Table 7-10: Low-Flow Showerhead Ex Ante and Ex Post Peak Demand Savings

	Ex Ante In-Service Rate (2013 TRM)	Ex Post In-Service Rate (Documented)[26]	Ex Ante Peak Demand Savings per Distributed Showerhead (kW)	Ex Post Peak Demand Savings per Distributed Showerhead (kW)
Low Flow Showerheads (SF)	100%	40%	0.03	0.00492
Low Flow Showerheads (MF)		44%		0.00521

Source: Navigant analysis of installation survey data, PA 2013 & 2014 TRMs

The TRM methodology and inputs for calculating savings from low-flow showerheads sees some dramatic changes between the 2013 TRM used for the PY5 calculations and the 2014 TRM, which will be used for the PY6 calculations. To inform PECO in expectation of these upcoming TRM changes, the data collected in the PY5 installation survey was used with the 2014 TRM methodology to estimate savings for PY6. Table 7-11 indicates the calculation inputs that see changes between the 2013 and 2014 TRMs.

Table 7-11: Differing Input Values from the PA 2013 and 2014 TRMs for Low-Flow Showerheads

TRM Input	2013 TRM Value	2014 TRM Value
Number of Persons/Home (SF/MF)	2.7/1.8 persons	4.7/4.8 persons[27]
Average gallons of hot water used for showering per person per day	11.6 gallons	N/A
Average time of shower usage per person per day	N/A	7.8 minutes
Average number of showers per person per day	N/A	0.6 showers/day
Average temperature of water used in the shower	105°F	101°F
Deemed[28] Energy Savings (SF/MF)	335 kWh/292 kWh	311 kWh/271 kWh
Deemed Peak Demand Savings (SF/MF)	0.0307 kW/0.0268 kW	0.0249 kW/0.0217 kW

Source: 2013 PA TRM & 2014 PA TRM

[26] The Ex Post In-Service Rate presented here is based off the reduced population of only those homes with electric hot water heating.

[27] The 2014 TRM allows the value for the number of persons per home to be updated by survey data. The values presented here for both single-family and multi-family reflect the results of the PY5 installation survey.

[28] The deemed values here are savings per unit and do not include the complication of in-service rate. These values are not therefore comparable to the ex ante and ex post savings per distributed measure shown above.

One of the most drastic changes between the 2013 TRM inputs and the 2014 TRM inputs is the change in the number of persons assumed per home for both SF and MF residences. The 2013 TRM indicates three different values for persons per household, a SF value, a MF value, and a blended value. Table 7-12 presents these three TRM values. In the 2013 TRM, this number is a fixed, defined value. The 2014 TRM, however, allows for an adjustment of the number of people per household from collected data.

The installation surveys associated with the SES kits asked questions about the number of children and adults in each household. Navigant determined that, for households who received kits through this program, the average number of persons was 4.7 for a SF household and 4.8 for a MF household, as indicated in Table 7-12. It makes sense that the average number of persons per household is much higher for the population associated with the SES program, than in the overall population, because a characteristic of these homes is that they have at least one school-age child. The results of this analysis informed the calculation of energy savings based on 2014 TRM values, and presented in Table 7-12.

Table 7-12: Persons per Household, and TRM and Program Values

	TRM Value	Program Value *(SES Installation Surveys)*
Single Family	2.7	4.7
Multi-Family	1.8	4.8
Blended	2.6	4.7

Source: Navigant analysis of installation survey data

Applying the 2014 TRM defined calculations to the PY5 survey installation data, results in slightly different savings numbers for both SF and MF installations. Table 7-13 shows the resulting energy savings attributable to low-flow showerheads applying both the 2013 and 2014 TRM methodologies to the PY5 installation survey data.

Table 7-13: Persons per Household, and TRM and Program Values

	2013 TRM Energy Savings per Measure Distributed (kWh)	2014 TRM Energy Savings per Measure Distributed (kWh)	2013 TRM Peak Demand Savings per Measure Distributed (kW)	2014 TRM Peak Demand Savings per Measure Distributed (kW)
Low-Flow Showerheads (SF)	134	87	0.00492	0.00277
Low-Flow Showerheads (MF)	129	140	0.00521	0.00496

Source: Navigant analysis of installation survey data

As can be seen from this analysis, per-unit energy savings for the low-flow showerheads will significantly decrease in PY6 for those installed in SF applications and will slightly increase in MF applications due to the 2013 and 2014 TRM differences. Additionally, peak demand savings will decrease for both SF and MF

applications due to the TRM differences. PECO should account for this expected difference in their portfolio management assumptions.

7.2.4 Energy and Peak Demand Savings from Faucet Aerators

Similar to low-flow showerheads, the energy savings for faucet aerators can only be claimed when they are installed in homes that use electric water heating. Again, the ex ante calculations assume that all faucet aerators were installed in homes with electric hot water heating. Navigant was able to determine from the installation survey that the actual percentage of homes with electric water heating was 49 percent of the population. Of the 6,992 faucet aerators distributed by the SES program, Navigant estimates that 49 percent (3,428) were distributed to homes with electric water heating.

Other than the change in input related to electric water heating, the only additional input that was changed for the ex post calculations was the in-service rate. The ex ante calculation assumed an in-service rate of 100 percent. Navigant determined from the installation survey that the in-service rate for the faucet aerator measure was in fact 38 percent. The differences in the energy savings from the ex ante to the ex post calculations are indicated in Table 7-14.

Table 7-14: Faucet Aerators Ex Ante and Ex Post Energy and Peak Demand Savings

	Ex Ante In-Service Rate (2013 TRM)	Ex Post In-Service Rate (Documented)	Ex Ante Energy Savings per Distributed Aerator (kWh)	Ex Post Energy Savings per Distributed Aerator (kWh)	Ex Ante Peak Demand Savings per Distributed Aerator (kW)	Ex Post Peak Demand Savings per Distributed Aerator (kW)
Faucet Aerators	100%	38%	48	18	0.0	0.0

Source: Navigant analysis of installation survey data

Again, similar to the low-flow showerhead measure, the TRM methodologies and inputs for faucet aerators are very different between the 2013 and 2014 TRMs. To inform PECO in expectation of the upcoming TRM changes, Navigant again used the 2014 TRM methodology and inputs along with the PY5 installation survey data to estimate the savings for PY6. Table 7-15 indicates the calculation inputs that see changes between the 2013 and 2014 TRMs.

One of the important methodology differences between the 2013 and 2014 TRMs is the assignment of space type to the faucet aerator. Different input values are used if the faucet aerator is installed in a kitchen faucet compared to it being installed in a bathroom faucet. If space type is unknown, the 2014 inputs are based off a blended value; this blended value offers the best comparison to the calculations

performed using the 2013 TRM methodology. Table 7-15 indicates the inputs that are affected by the space-type difference defined in the 2014 TRM.

Table 7-15: Differing Input Values from the PA 2013 and 2014 TRMs for Faucet Aerators

TRM Input	2013 TRM Value	2014 TRM Blended Value	2014 TRM Kitchen Value
Average baseline aerator flow rate	1.2 GPM	2.2 GPM	2.2 GPM
Average post-measure flow rate	0.94 GPM	1.5 GPM	1.5 GPM
Average time of hot water usage per person per day	9.85 minutes	6.1 minutes	4.5 minutes
Average number of persons per household	2.6 persons	4.7 persons	4.7 persons
Average temperature differential between outgoing mixed faucet water and supply water	35°F	32.8°F	38°F
Average number of faucets in home	3.5	3.8	1
Percentage of water flowing down the drain	79.50%	79.50%	75.00%

Source: 2013 PA TRM & 2014 PA TRM

Applying the 2014 TRM defined calculations to the PY5 survey installation data, results in slightly different savings numbers for faucet aerators. Table 7-16 shows the resulting ex post energy and peak demand savings that could be attributable to faucet aerators under both the 2013 and 2014 TRM methodologies. The calculations used in Table 7-16 utilize the PY5 survey data, so they include both the low in-service rate and occurrence of hot water heating.

Table 7-16: Calculated Energy Savings Attributable to Faucet Aerators Using 2013 and 2014 TRM

	2013 TRM Energy Savings per Unit Distributed (kWh)	2014 TRM Energy Savings per Unit Distributed (kWh)	2013 TRM Peak Demand Savings per Unit Distributed (kW)	2014 TRM Peak Demand Savings per Unit Distributed (kW)
Faucet Aerators (installed anywhere)	18	18	0.00167	0.00233
Faucet Aerators (installed in kitchen)	18	55	0.00167	0.00713

Source: Navigant analysis of installation survey data

As can be seen from this analysis, per-unit energy and peak demand savings for the kitchen faucet aerators will significantly increase in PY6. PECO should account for this expected difference in their portfolio management assumptions.

7.3 Impact Evaluation Net Savings

In the context of the SES program, a free rider is defined as a participant that would have purchased and installed the measures in their home even if they had not received the measures through the take- home kit. Free ridership should be verified by confirming whether the measures in the take-home kit were installed, and whether the participating household was considering installing the measures prior to participating in the program. This information would ideally be collected via either the student installation survey or the parent/guardian phone survey. As stated in the SWE guidance memo on the "Common Approach for Measuring Free-riders for Downstream Programs" (December, 2013), "where the respondent was not even considering the measures before being contacted by the program, the total free-ridership score was set to 0." Spillover, or the level of the program's influence on energy-saving actions taken after participation in the program, should also be assessed via the student installation survey or the parent/guardian phone survey.

The parent/guardian surveys included a battery of questions to inform free-ridership and spillover calculations, while the measure installation rates were collected via the student installation surveys.[29] However, the low number of survey responses collected via the parent/guardian surveys was not sufficient to develop net savings estimates; therefore, Table 7-17 and Table 7-18 are not applicable for this program.

Table 7-17: SES Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted [30] to Achieve Sample
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant

[29] Upon approval from the SWE, Navigant did not use the SWE's uniform survey battery and analysis method for this program.

[30] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

Table 7-18: Program Year 5 SES Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	*Estimated Free* Ridership	Estimated Participant Spillover	NTG Ratio	Observed *Coefficient of* Variation or Proportion	*Relative* precision
N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant

7.4 Process Evaluation

The SES program process evaluation included a review of program materials, interviews with program managers and RAP, an online survey of a representative sample of participating teachers, and a small number of surveys with participating parents/guardians to identify qualitative trends among customer satisfaction and experience with the program. The process evaluation explored the following research objectives as noted in the evaluation plan:

- What changes can PECO adopt to minimize differences between planning estimates, reported gross savings, and verified gross savings?
- How can PECO properly manage program participation rates to more precisely contribute to annual compliance requirements?
- Do participant households adopt recommended behavioral changes after receiving the kits?
- What are the barriers to installing measures included in the take-home kits?
- What are the barriers to students returning the installation surveys?
- How satisfied are parents of student participants with the program?
- How satisfied are parents of student participants with the PECO?
- How satisfied are participating teachers with the program?

7.4.1 Program Theory and Logic Model

Program theory and logic models are critically important to programs that primarily target market effects, such as the SES Program. Navigant worked closely with PECO and RAP staff to develop a detailed understanding of the intended program approach, including the hypothesized cause-and-effect relationships. Navigant developed a program theory and logic model to document this information and presented it to PECO in memo format. Activities under this task included a review of the program's materials and planning documents, interviews with PECO program staff members Irene Ngo and Elizabeth Finocchio, an interview with RAP's Lee Moran, and several work sessions with Irene Ngo to confirm the accuracy of the model's content and structure.

This section presents a high-level summary of the program theory and logic model memo developed by Navigant as part of the PY5 evaluation. Navigant presented the memo to PECO on May 2, 2014. This

section includes a summary of the resources, activities, outputs, and outcomes associated with the SES program, and documented in detail in the memo.

PECO uses utility ratepayer funds to implement the SES program and the program relies on staff resources from both PECO and the program implementer, RAP. PECO maintains a dedicated program manager to oversee program activities and engage in consistent communication with the implementer. In addition to the program manager, PECO's manager of marketing provides guidance on program materials and promotional modules, while the communications and legal departments ensure that all communications are accurate and in line with corporate guidelines and legal requirements. RAP manages a call center to handle participant inquiries about the program. The program also faces external influences that can help or hinder achieving anticipated outcomes. In some cases, student families may have existing opinions about EE or conservation that could affect their willingness to engage with the program. They might feel uncomfortable installing the measures or might be uneasy using unfamiliar products in their home. Additionally, the residence type of some students may prevent them from installing certain measures.

Activities implemented by the program include conducting outreach and recruiting teachers, assembling and distributing program materials, and collecting installation survey data and feedback from teachers, students, and parents/guardians. SES program outputs include the number of classrooms enrolled in the program, and the amount and the quality of participant survey data and feedback collected. SES program intended outcomes include participants installing the kit measures, participating households being aware of other PECO EE programs, participants being satisfied with the program, participating households being motivated to save energy, participating households pursuing additional energy conservation actions and investments, and participating households achieving energy savings.

7.4.2 Tracking System Review

Navigant reviewed the program data tracking system extract and provided feedback regarding improvements via preliminary findings. This feedback is also incorporated in this annual report. Additionally, Navigant used data from the program tracking database to develop the sample frames for the teacher and parent/guardian surveys.

The program tracking system maintained by and provided to Navigant by PECO was the primary data source for Navigant to evaluate both the distribution of kits and the installation of kit measures. The tracking system included information integral to Navigant's evaluation of the SES program, including the number and type of kits distributed; the number and type of kits received by each teacher and school; the responses from all installation surveys returned to RAP; and the calculation of ex ante savings. The first step in Navigant's impact evaluation of the SES program was a thorough review of the tracking database.

The tracking system was found to be complete and well organized, with the exception of the reporting of the installation survey data. Navigant encountered a few challenges while preparing the program tracking data for analysis and recommends that PECO organize data differently moving forward. The raw data

received by Navigant included a separate row for each survey question, which made the data file lengthy and difficult to summarize. Navigant was able to work with the data as it was provided for the PY5 evaluation; however, using the data provided in this form required hours of unexpected, additional work and created a greater opportunity for inaccuracies related to data transfer.

The following is the recommendation from this section:

- ***Recommendation:*** *In the preliminary findings memo Navigant provided the following* recommendation, which is already being implemented by RAP in anticipation of data collection for PY6: Instead of reporting the data with a separate row for each survey question, organize the data with one row for each unique survey respondent (by Survey ID), and a column for the answer each survey question. Benefits of the recommended organizational structure include the following:
    - Reduce the amount of time needed for analyzing the program data
    - Fewer repeated cells (e.g., Teacher ID, Survey ID, Teacher First Name, Teacher Last Name, School Name, Description)
    - Easier to summarize data (i.e., number of responses to each question)
    - Easier to see what questions have and have not been answered by each survey respondent
    - Limit mistakes in repeated answers to questions

In summary, it was easy for Navigant to determine the inputs used for all ex ante calculations from the tracking system. Additionally, Navigant was able to easily determine the total number of each type of measure distributed and to whom measures were distributed. Navigant reviewed the tracking system and found all inputs to match TRM dictated values and all calculations to be accurate.

Navigant surveyed the population of parents/guardians who mailed in an evaluation form included in the take-home kits and who had not opted out of being contacted for additional feedback. After validating contact information and opt-out preferences for these contacts, Navigant determined that there were only 102 valid contact records remaining. In light of the limited sample, interviewers left a voicemail with a call-back number to attempt to increase the likelihood of survey completion. Even with this effort, interviewers were only able to complete surveys with 12 parents/guardians. Navigant used these results to distill qualitative process findings, but was not able to make any adjustments to the installation rates because of the small sample size.

The following is the recommendation from this section:

- **Recommendation:** In the preliminary findings memo, Navigant made recommendations that RAP adjust the evaluation form to increase the likelihood that the program will receive more parent/guardian contact information and feedback on the form. Navigant's recommendations included the following: make the evaluation form more visible to the parents/guardians by placing

it at the front of the take-home kit insert window, and offer to enter those who return a card into a drawing for a $100 gift card incentive to parents/guardians for returning the evaluation form.

Navigant reviewed the student installation survey and recommended changes to the PY6 survey instrument to inform assumptions in the TRM and future free-ridership calculations, while maintaining an appropriate level of accessibility for students and their parents.[31]

The following is the recommendation from this section:

- **Recommendation:** A full list of the recommended installation survey changes was presented to PECO and RAP in the preliminary findings memo, and the evaluation team worked with RAP to make the necessary updates in time for the PY6 survey development deadline in early August 2014.

7.4.3 Verification and Due Diligence

Navigant conducted a high-level review of the program's operations to verify whether the program is functioning as intended. Data used to inform this review was collected via the staff and CSP interviews, the student installation surveys, the online teacher surveys, the parent/guardian surveys, and follow-up phone interviews with several teachers. During analysis of this data, the Navigant team looked for evidence of differences between the program theory and logic and actual program operations.

*The SES program supports teachers in encouraging participating students to complete and return a take-*home installation survey, which requires students to calculate rates of energy consumption throughout their home and install the kit's energy-efficient measures. Because the survey return rates dictated the ultimate size of the population used in the gross impact evaluation, PECO emphasized the need to return the surveys to teachers and students. For example, PECO offered a mini-grant of $50 to teachers who turned in installation surveys for at least 80 percent of participating students.

PECO distributed 12,584 take-home kits in PY5 and received 5,249 (42 percent) of the student installation surveys back from participating teachers. By comparison, similar school kit programs run by other utilities typically see an installation survey return rate of 60-80 percent. It is possible that the overall return rate will increase in subsequent program years as the program ramps up; however, we have determined that close to half (45 percent) of PECO's participating teachers did not return any surveys in PY5. This indicates that the relatively low overall return rate is a result of a large number of teachers not sending any of their students' installation surveys to the CSP despite the program offering the $50 incentive and providing a prepaid postage envelope.

[31] Navigant will consider whether to include parent/guardian surveys in its evaluation plan for upcoming program years. Parent/guardian surveys may provide more accurate installation data for the impact analysis.

The low installation survey return rate was recognized after the start of the summer break. Navigant did try to reach teachers in August to understand this low return rate, but was unable to contact enough teachers to understand this issue in detail. Through the small number of teachers that were reached, Navigant did, however, learn that the SES program is not always implemented as designed. The following are several anecdotal examples of this:

- One teacher who works in a high school (6-12 grades) indicated that the principal had concerns with the kits being distributed to students during the school day because of the danger posed by the glass light bulbs. Instead of distributing the kits to the students, that teacher distributed the kits with the associated Scantron forms to parents during a school-sponsored parent night. The teacher believes that a large number of the measures were implemented, as the parents seemed generally excited about the kits; however, a low percentage of the Scantron forms were actually returned and the teacher did not have a way to communicate with those parents who did not return the Scantron forms.
- A different teacher indicated that the Scantron forms were not filled out in class with the data from the workbooks; the Scantron forms were sent home with the students to be filled out at home.
- Finally, another teacher indicated that he worked as a science coordinator for seven fifth grade classes in his school. He worked with the program to get the kits for all the students in his school, but it was up to the classroom teachers to stress the importance of returning the surveys to their students. Even if RAP did follow up with him about unreturned surveys, communication had to go through another level in order to reach the teachers who were actually responsible for collecting surveys from their students. He explained that additional incentives were not likely to increase the response rate for his school, but thought that linking the kit materials to other forms that need to be returned, such as emergency contact forms or report cards, which usually occur at the beginning or end of the semester, could help to increase the response rate.

The stories presented here are not meant to indicate deep programmatic issues, but rather to serve as reminders that this program is only able to reach the students and parents through intermediaries (teachers) and as such is not always implemented exactly as expected; this consideration should be remembered for future evaluations of this program.

The following is the recommendation from this section:

- **Recommendation:** In response to the low installation survey return rate and these qualitative findings, Navigant recommends closely tracking the installation survey response rate in PY6 and plans to conduct teacher interviews during the PY6 evaluation if the return rate remains an issue. RAP should also offer an online option for completing the installation survey in addition to the paper survey. Offering an online survey would take the burden of returning the survey off the teacher and could help to boost the installation survey return rate. Unlike a Scantron form, online

surveys would also allow participants to provide their contact information and other information that does not fit into Scantron format.

7.4.4 Program Material Review

PECO provided the evaluation team with samples of program materials, including a full take-home kit, the teacher folder, and the student materials. The kits included additional educational materials including an instructional DVD, printed installation instructions, a "Parent's Quick Start Guide", parent/guardian evaluation card, and a pamphlet providing an overview of additional PECO residential EE programs. The teacher folder included a flyer advertising the $50 mini-grant, a copy of the Pennsylvania Common Core Standards for fifth grade, a return shipping label for the installation survey data, an "Extra Activities" booklet, a welcome flyer, a teacher book containing lesson plans, and a poster discussing "Where Electricity Comes From". The student materials included a "Pre/post quiz and home activities" worksheet, a parent informational flyer, a student pledge, a student "Certificate of Achievement", a student workbook, and a student guide.

As part of this evaluation, Navigant also reviewed the SES program website. This website provides additional resources for teachers, students, and parents who participate in the program. Resources include a list of frequently asked questions, instructions, and videos on installing measures from the take-home kits, as well as interactive, kid-friendly, energy-related websites that provide students with additional activities and information.

7.4.5 Program Management and Staff Interviews

Navigant conducted interviews with PECO program managers, and RAP program manager. Navigant developed interview guides using open-ended questions to allow for a free-flowing discussion between the interviewer and respondent and used experienced evaluation team members to conduct the interviews allowing the interviewer to delve more deeply into pertinent issues based on the respondents' knowledge of and experience with the program.

7.4.6 Teacher and Parent/Guardian Surveys

Navigant conducted an online survey of all participating teachers to gain an understanding of how the program operated, identify challenges to implementation, identify barriers to the return of the installation surveys, and assess teacher satisfaction. Navigant worked closely with PECO to ensure all email invitation and follow-up scripts, as well as the survey itself, adhered to PECO email communications guidelines. All 256 participating teachers received a link to the email survey, and Navigant sent two reminder emails asking teachers who had not yet completed the survey to do so before they began their summer vacation. A total of 70 teachers completed the survey.

Through a qualified survey house, Navigant conducted a phone survey of parents/guardians who mailed in an evaluation form included in the take-home kits and who had not opted out of being contacted for additional feedback. Navigant worked closely with PECO to ensure all phone scripts, as well as the survey itself, adhered to PECO email communications guidelines. Per the evaluation plan, Navigant intended to complete 70 surveys with contacts within this population; however, out of 12,584 participants, the CSP only received 190 parent evaluation forms. After validating contact information and opt-out preferences for these contacts, Navigant determined that there were 102 valid contact records remaining. In light of the limited sample, interviewers left a voicemail with a call-back number to attempt to increase the likelihood of survey completion. Even with this effort, interviewers were only able to complete surveys with 12 parents/guardians due to the small number of contacts available. Due to the relatively low completion rate for the parent/guardian phone survey, Navigant has chosen to not draw any quantitative conclusions from the survey results nor make any adjustments to the installation rates based on the survey results. Instead, this report focuses on the qualitative insights provided by the responses.

See Table 7-19 for details regarding the sampling strategy.

Table 7-19: SES Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
Teachers	N/A	256	0.5	85/15	256	70	100%	Online Survey
Parents / Guardians	N/A	190	0.5	85/15	70	12	6.3%*	Phone Survey
Program Total	N/A	446	N/A	N/A	326	82	N/A	N/A

* Denominator represents the parent/guardians who returned a parent/guardian evaluation card (n=190)

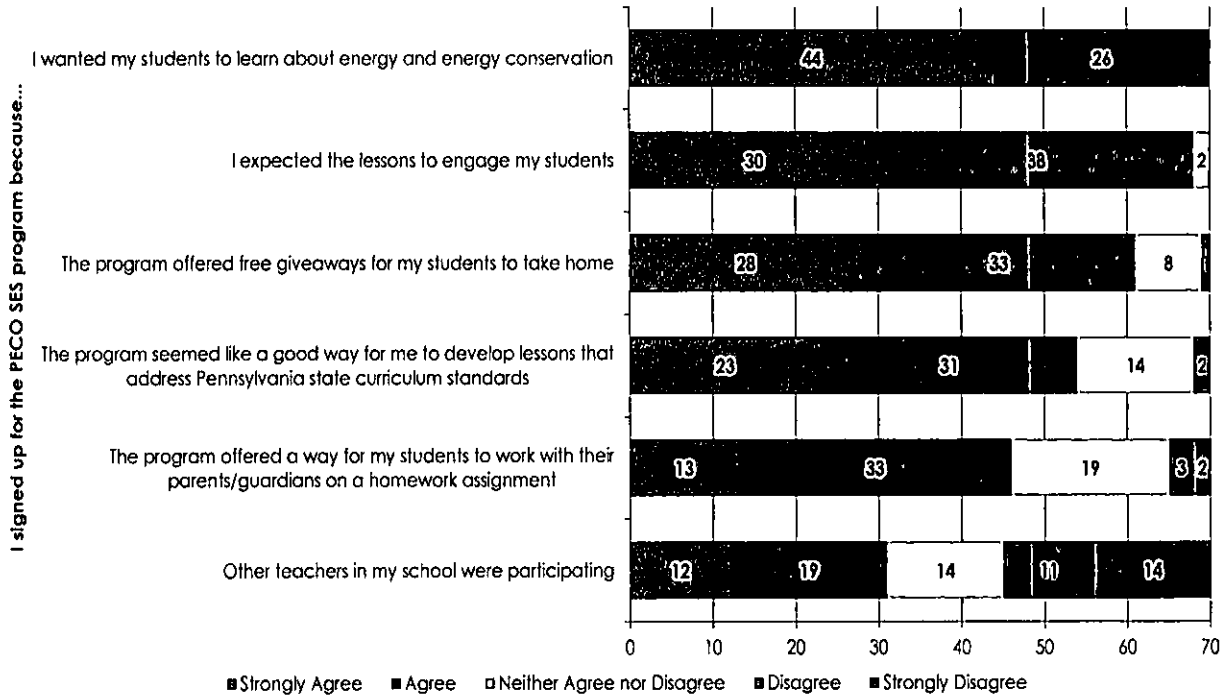
Source: Navigant analysis of program tracking data and survey disposition results

Teacher Motivation for Participating

Via the online survey, teachers reported that they signed up for the program because they wanted to engage their students and for them to learn about EE. The participation of other teachers at the school was a less motivating factor for most teachers. Navigant asked teachers to indicate their level of agreement with a series of statements in regard to the reason they signed up for the program. Figure 7-1 shows the results of this question. One 100 percent (n = 70) of respondent teachers either agreed or strongly agreed with the statement: "I signed up for the PECO SES program because I wanted my students to learn about energy and energy conservation." Similarly, 97 percent (n = 70) agreed or strongly agreed that they signed up with the program because "I expected the lessons to engage my students." Some teachers (n =14) strongly disagreed with the statement that they signed up for the program because their

colleagues had signed up. This indicates that teachers are very aware of and driven by the merits of the program, and are not simply participating out of solidarity with colleagues.

Figure 7-1. Teacher Agreement with Rationale for Signing Up for the Program (n = 70)



Note: This graphic shows combined findings from both SES and PEEP teacher participants.

Source: Navigant analysis of teacher survey results

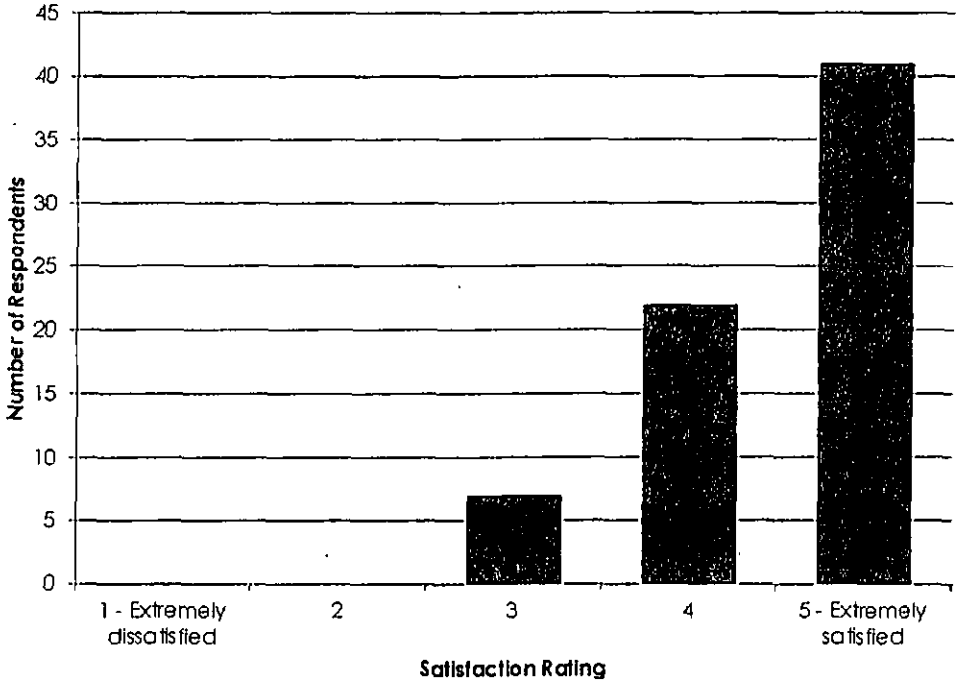
When asked what other reasons they had for participating, some teachers mentioned the benefits of having hands-on activities for their students (n = 6), and some reaffirmed the importance of passing along lessons of energy conservation to their students (n = 9). Three teachers additionally mentioned the convenience of having up-to-date, science-based information all in one place without having to develop the materials themselves.

Teacher Experience with the Program

Overall, teachers expressed high levels of satisfaction with the program, as shown in Figure 7-2. On a scale from one to five, 90 percent (n = 70) of respondent teachers rated their satisfaction with the overall

program at a four or higher. Fifty-nine percent (n = 70) indicated that they were "extremely satisfied" with the program. No respondents rated their satisfaction with the program below a three.

Figure 7-2. Satisfaction with the SES Program Overall (n = 70)



Note: This graphic shows combined findings from both SES and PEEP teacher participants.

Source: Navigant analysis of teacher survey results

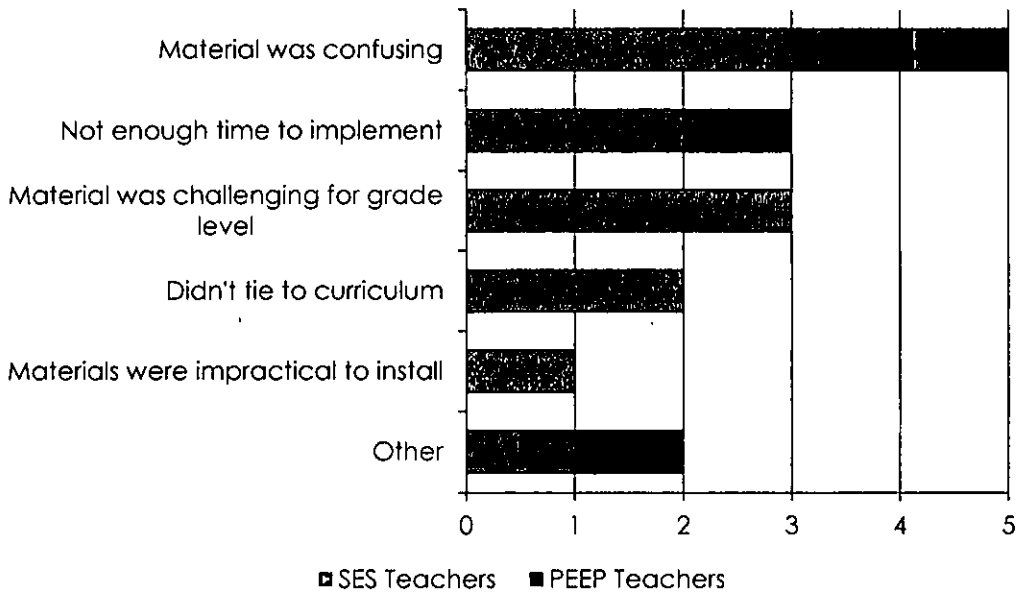
Navigant asked teachers to explain their reasoning behind the satisfaction rating they provided. An SES participant teacher who rated their satisfaction at a four wrote: "It is very kind, generous and proactive for PECO to design, implement and follow up with a program to conserve energy. As a fifth grade science teacher, it is great to see PECO enhance our curricula with an easy and very important message".

Even amongst comments from teachers who expressed high satisfaction with the program, a lack of sufficient time to implement all of the lessons and materials was a common theme. A PEEP teacher who rated their satisfaction at a five wrote: "So much support and supplies to carry out the program. Exciting to bring the added activities to our classes." The same SES teacher goes on to say that "unfortunately, there is not enough time in a teacher's day to do this program justice. Taking the time from our limited time of scheduled instruction, to fully implement the student surveys, books, parent communication is very difficult." This is in line with findings from a focus group RAP conducted with participating teachers in 2014, which found that despite high levels of satisfaction some teachers still felt that there was "almost too much" material to get through. Throughout the online survey, teachers consistently made comments

about a lack of time to implement materials throughout the survey, but three teachers commented specifically on this when asked about their satisfaction.

In total, 16 teachers offered negative or constructive feedback when asked to explain their program satisfaction rating. Figure 7-3 shows that of those 16, the most common complaint was that the lesson plan material was confusing, both for teachers and for students (n = 5). Three teachers additionally indicated the material was too difficult for the fifth grade level, while three stated that the program took too much of their time to fully implement. [32]

Figure 7-3. Reasons for Teacher Dissatisfaction (n = 16)



Note: "Other" includes one teacher who mentioned that they did not have enough books for all of the students, and another who simply stated that parents did not want to get involved in the home aspects of the program.

Source: Navigant analysis of teacher survey results

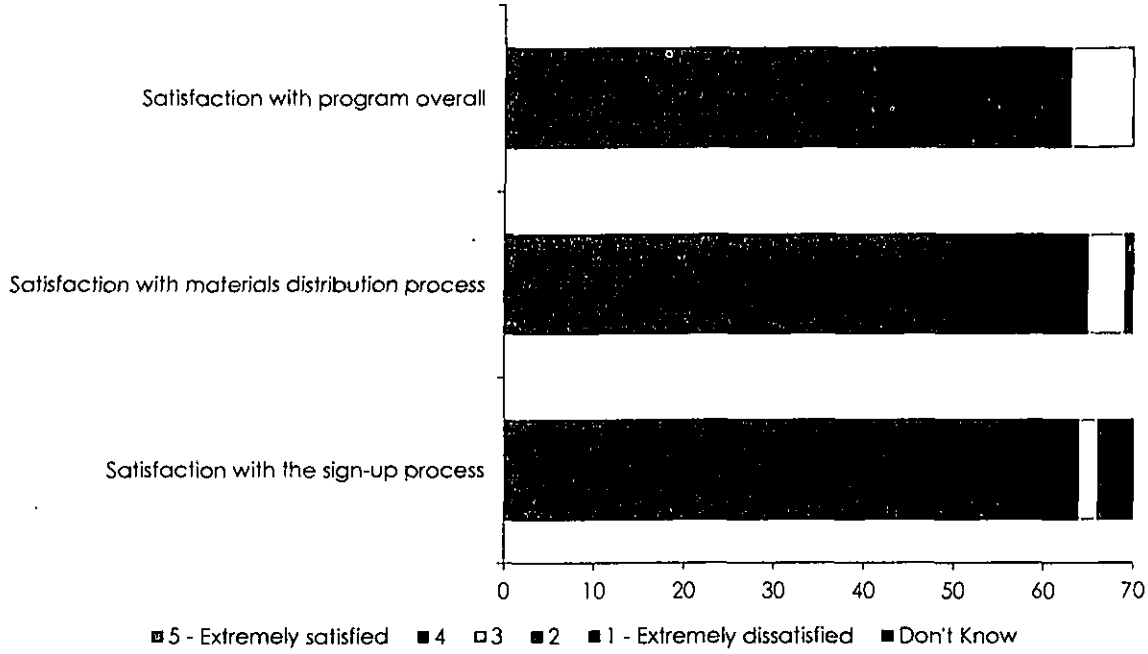
Teachers also reported high levels of satisfaction when asked about the sign-up and material distribution processes (see Figure 7-4). For the four teachers who indicated they did not know their level of satisfaction with the sign-up process, it was stated that a colleague handled the sign-up process. One SES teacher who rated their satisfaction with the materials distribution process at a 5 stated: "The representative was very helpful with explaining the program and the requirements. She was very friendly and understanding."

[32] One teacher mentioned specifically that the material was too difficult for students involved in the special education program.

Another SES teacher said: "Everyone that I have had contact with throughout this program has been very helpful and extremely supportive."

Six teachers offered suggestions for how to make the distribution process more satisfactory. Two teachers, one SES and one PEEP, mentioned that the organization of the boxes delivered to teachers was confusing and contained poorly labeled and mixed materials. [33] An SES teacher mentioned the materials went to another school and it took a while to get the materials back, while a PEEP teacher mentioned that some materials were missing. The remaining two teachers commented on the high volume of material that arrived (SES) and the amount of time required to organize the material (PEEP), respectively. They suggested that RAP communicate better with teachers so that they know what to expect and can properly prepare to receive the materials.

Figure 7-4. Teacher Satisfaction (n = 70)



Note: This graphic shows combined findings from both SES and PEEP teacher participants.

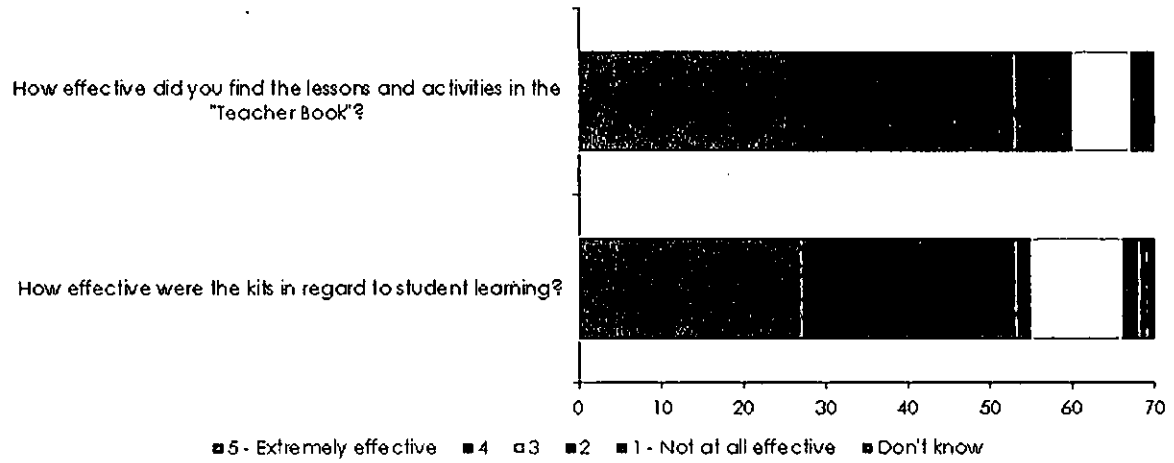
Source: Navigant analysis of teacher survey results

Teachers also provided high ratings when asked about the effectiveness of the program materials, including the lesson plans and take-home kits. Navigant asked teachers to rate the effectiveness of the lessons and activities in the "Teach Book" on a scale from one to five, where five is extremely effective.

[33] Boxes here does not refer to the program kits, but to the boxes used to transport all of the program materials to teachers.

Navigant additionally asked teachers to rate the effectiveness of the take-home kits in regard to student learning, with the results presented in Figure 7-5. Eighty six percent (n = 60) of teachers found the lessons and activities in the "Teacher Book" to be very effective, classified by a rating of a four or higher. Teachers found the kits to be slightly less effective in regard to student learning, with 79 percent (n = 55) of teachers rating this at a four or higher.

Figure 7-5. Effectiveness of Program Materials (n = 70)



Note: This graphic shows combined findings from both SES and Energizing Education teacher participants.

Source: Navigant analysis of teacher survey results

Most (51 of 70) teachers made comments indicating that the lessons were effective in engaging students and that the teachers found the materials easy to use and understand for both students and teachers. One SES teacher mentioned that the lesson plans were: "a great way to talk about the curriculum and then use the hands-on activities to engage the students." Another SES teacher mentioned that "students were engaged in the learning process and excited about doing the activities with their parents."

Of those teachers who found the materials to be less effective at engaging students, some (n = 11) indicated that the lessons were too long or complex to fit into a tight schedule (particularly given all of the snow days), or that more interactive content (less reading) would have engaged kids more (n = 4). One teacher mentioned the difficulty of having multiple activities going on at once. One SES teacher stated that, "for 5th graders, the materials need to be less detailed and dry. They also need to be interspersed with fun activities they can do independently after learning about a new concept so that they can solidify the information and I can tell who understood it and who needs more help."

Navigant asked teachers to provide suggestions for how PECO can improve the program lesson plans or activities and several themes emerged in the responses. Six teachers mentioned that having more hands-on activities would enhance the program experience, in particular including videos or links to websites that can provide additional or enrichment material. The evaluation team understands that this additional

material is already provided by the program via links located on the PECO SES website; however, given teachers' comments, it seems that not all teachers are aware of the resources available through the program online.

Two teachers recommended dividing program material into core lessons and secondary lessons so that teachers are better able to navigate the lessons when pressed for time. Although only two teachers made this recommendation, the evaluation team noted a strong theme of teachers feeling they did not having enough time to implement the program to its full potential. Currently, RAP divides program lesson plan materials into five- and ten-day options; however, both options take the same amount of hours to implement and differ only in the amount of days the material is spread over. The material provides no guidelines to help teachers distinguish between material that is most important and material that is less so, given high demands on classroom time.

Three teachers also suggested that PECO send a representative in to speak with the class about the importance of EE. These teachers felt that this would be a good way for students to connect with their local utility and become more engaged in the program. Four teachers also offered comments and suggestions in relation to specific lessons. One teacher recommended leaving additional space in the student workbook for students to answer the "Think & Apply" questions, while another requested that an additional quiz be included that could be used for a science grade, including multiple-choice questions that reference material from each of the lessons. Another teacher recommended adding a reflection page for each of the kit appliances so that students can write about what the savings mean to their particular family. Finally, one teacher mentioned that they had difficulty testing the voltage of the wind turbine for the wind turbine activity.

Eighty-four percent of teachers (n = 70) indicated that email is the best way to contact them, because they tend to check their email several times a day, and they are able to respond at their leisure, and because emails do not interrupt class time. Most teachers (79 percent; n = 70) were contacted by the program representative via email, with letters in the mail and phone calls occurring less often as a method of contact. Navigant recommends that RAP continue to use email as the primary method of communication with teachers. This is in line with the current approach used to reach teachers and requires no change on the part of the program.

The following are the recommendations from this section:

- **Recommendation:** Navigant recommends that RAP explore ways to enhance program materials to better emphasize the resources available online at the SES website. This might include a separate flyer that promotes the online resources or call-out boxes in the lesson plans to highlight the way in which an online resource ties back to the in-class activity. RAP should also explore this topic in any focus groups or discussions with teachers.

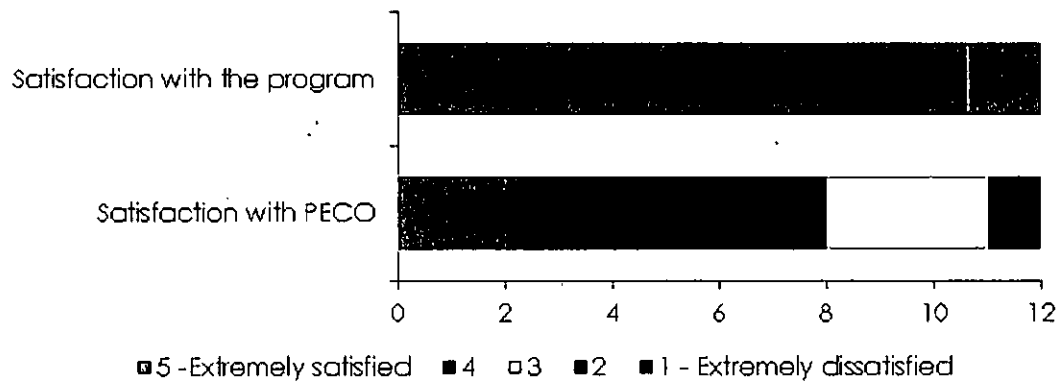
- **Recommendation:** Navigant recommends that RAP provide options for teachers to use a regular-length or shortened version of the lesson plan and activities. This division will assist teachers who are unable to dedicate the full-recommended time to the program lesson plans.

Parent/Guardian Experience with the Program

The small number of parents/guardians who responded to the phone survey expressed high levels of satisfaction with the program and with PECO overall, as shown in Figure 7-6. Of the 12 respondents, every parent/guardian surveyed rated the program as a 5 on a 1-5 scale, with five being extremely satisfied. One SES parent/guardian said, "This was a good learning experience to go through together. We were able to see by doing, testing the old products and comparing the differences with the new energy saver [products] so we were actually able to see that we were saving energy!"

Parent/guardian respondent satisfaction with PECO overall was not as high as their satisfaction with the program. Only two parents/guardians indicated that they are extremely satisfied with PECO, while four respondents rated their satisfaction with PECO at a three or lower. One satisfied respondent mentioned: "if I have any type of issue that is customer service related, I've always been highly satisfied. They've always tried to accommodate and fix the problem quickly, I don't have to wait on hold forever, I'm not having to call them [constantly to resolve it]...[truly] I don't find that I have a problem with PECO, so I'm quite satisfied. I love the educational program. I found that that was a very useful thing, [it allowed] bonding time with my child and I learned as much as she did [about saving energy]." A parent/guardian who was less satisfied explained their rating of a four by stating that: "their prices are sometimes higher than the other energy companies in the area. If the electricity goes out it normally takes them a while to get it back on. It normally takes from...like...two to three days, it's never anything that's resolved right away."

Figure 7-6. Parent/Guardian Satisfaction (n = 12)



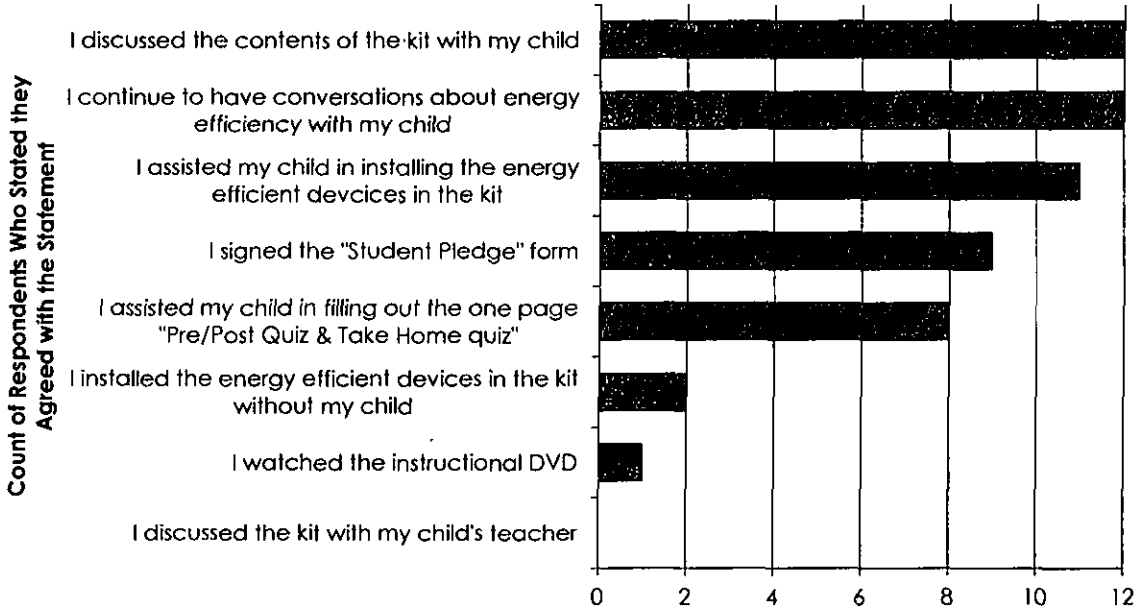
Note: This graph represents responses given by nine PEEP and three SES parent/guardian program participants.

Source: Navigant analysis of parent/guardian survey results

The take-home kits appear to be effectively engaging parents through the kit activities.[34] Navigant asked parents/guardians to indicate all of the ways that they engaged with the kits. Figure 7-7 shows that all of the parents/guardians indicated that they discussed the contents of the kit with their child, and all but one indicated that they assisted their child in installing the EE devices in the kit. A majority (67 percent; n = 12) of respondents indicated that they assisted their child in filling out the "Pre/Post Quiz & Take Home Quiz". Only one parent/guardian indicated that they watched the instructional DVD.

Figure 7-7 shows that all 12 respondents indicated that they have continued to have conversations about EE with their child since participating in the program. When asked what topics they've discussed with their child since participating in the program, parents/guardians provided a number of examples. Common themes include discussing that lights and televisions, for example, should be turned off when leaving a room, and that unplugging appliances (e.g., microwave, x-box, and television) when not in use is good practice. One parent mentioned discussing with their child that it costs money every time a light or faucet turns on.

Figure 7-7. Ways that Parents/Guardians Engaged with SES Kits (n = 12)



Source: Navigant analysis of parent/guardian survey results

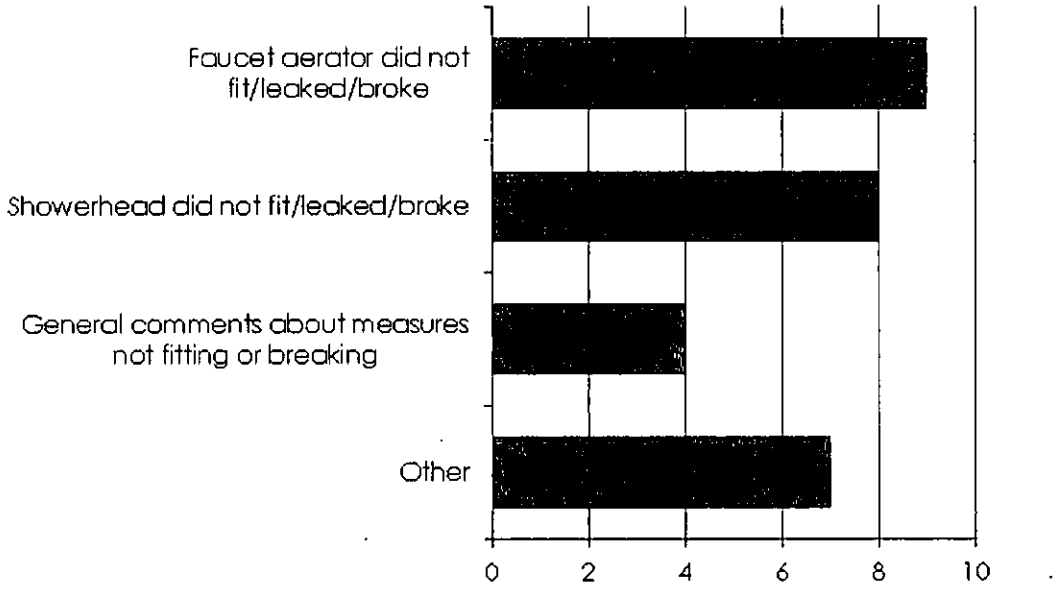
[34] *It is possible that these responses are biased due to the fact that parents/guardians who are more involved are* more likely to have returned the postcard with contact information about the program, and therefore are more likely to be interviewed.

Experience with Take-Home Kit Measures

When parent/guardian survey respondents chose not to install measures in the kits, their stated reasons were primarily due to already having the measure installed in the household. Three of the 12respondents stated that they already had CFL bulbs and therefore did not install all of the bulbs provided in the kit. One respondent indicated already having a low-flow showerhead.

The low-flow showerheads and the faucet aerators appear difficult for some participants to install. Seventy-six percent of surveyed teachers (n = 70) took home a kit for themselves and installed the measures. While most teachers did not experience any difficulty in installing the measures (76 percent; n = 70), four teacher respondents reported having some trouble with the low-flow showerhead. These respondents stated that the showerheads either leaked or would not fit onto on their appliances, and one respondent reported that they could not remove their old showerhead to install the new one. Another respondent added that the faucet aerator leaked. When asked if any of their students reported any difficulties installing the measures, 30 percent of teachers (n = 70) indicated that they were aware of difficulties encountered by their students. Figure 7-8 shows the most common complaints reported to teachers by students. Broke/leaky/ill-fitting faucet aerators and showerheads are the most common complaint received by teachers from students.

Figure 7-8. Problems with Measures Reported by Students (n = 21)



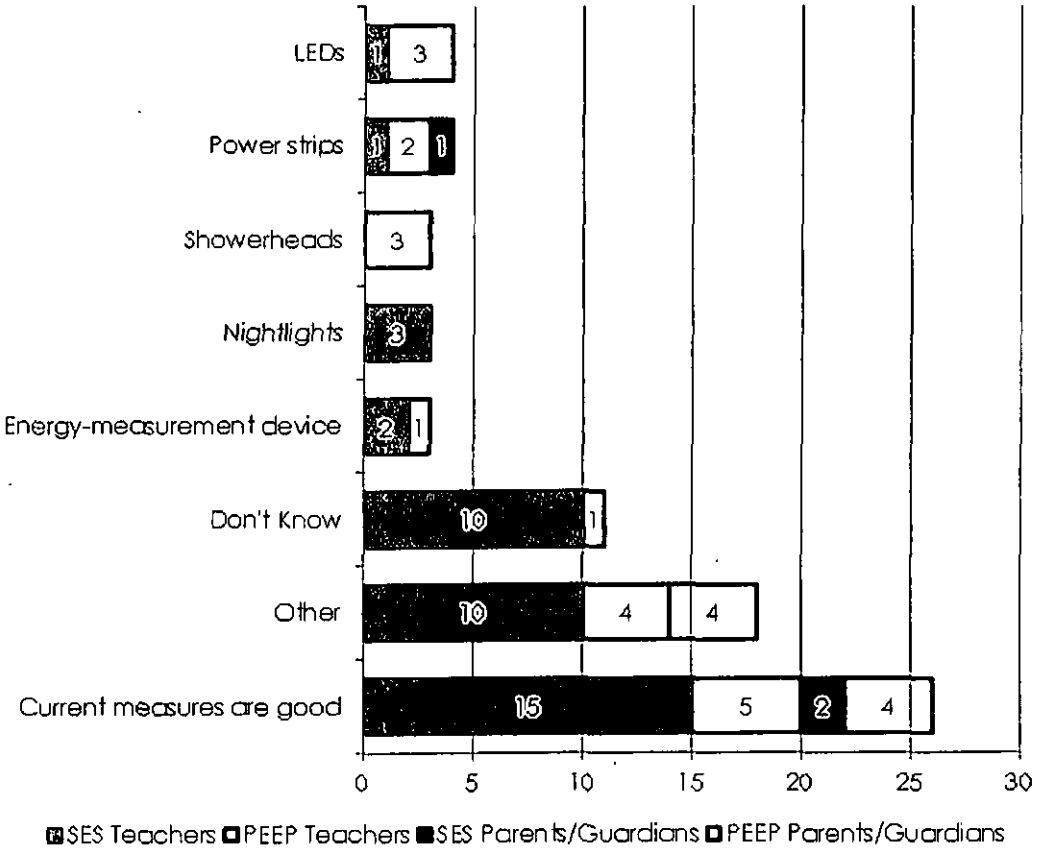
Note: multiple responses allowed

Source: Navigant analysis of teacher survey results

The majority of both teacher and parent/guardian survey respondents, indicated that they are pleased with the existing measures provided in the kit and would like to see the same measures included in

upcoming years. Figure 7-9 shows suggestions given by both teachers and parents/guardians in regard to what they would like to see included in future take-home kits. Twenty-six respondents stated that they like the measures currently provided in the kit and could not think of any additions. The most common suggestions for kit measures to add include showerheads (for the PEEP participants), LED bulbs, power strips, and night-lights. [35]

Figure 7-9. What EE products would you like to see included in the take-home kits in the future?



Note: The "Other" category includes a measure that addresses outdoor water use, door weather-stripping, a mini-solar panel for the classroom, a timer to turn off inactive lights, and two suggestions to include more light bulbs in general.

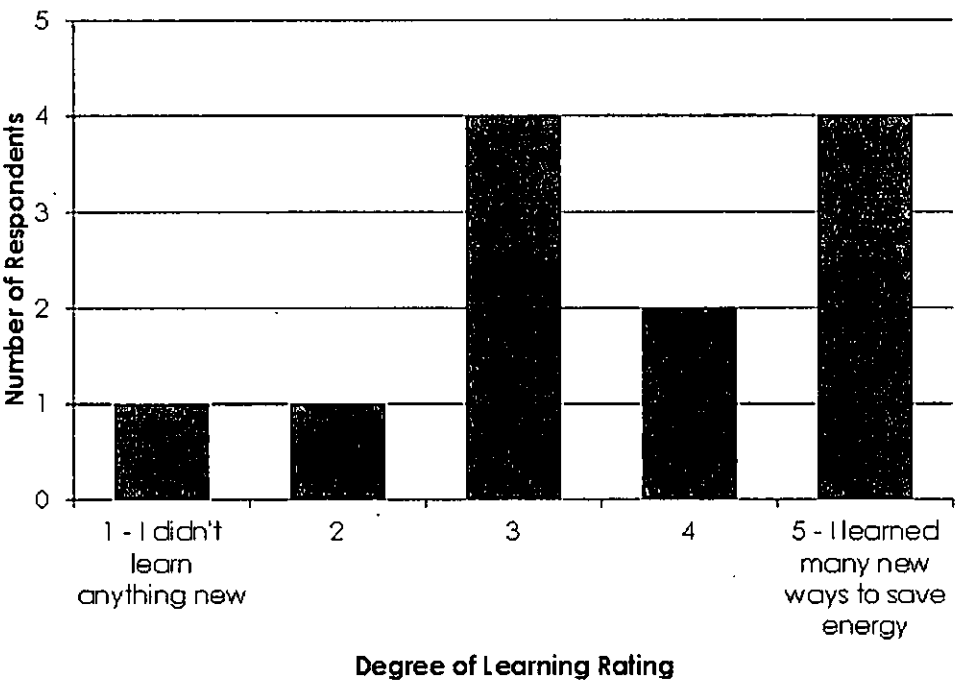
Source: Navigant analysis of teacher survey results (n = 61) and parent/guardian survey results (n = 11)

[35] The evaluation team acknowledges that both SES and PEEP kits contained LED night-lights. It is unclear from teacher responses if they are referring to the inclusion of additional night-lights, or if these particular teachers are unaware that the kit included this measure.

Program Influence on Awareness and Decision Making

Parent/guardian survey respondents indicated that they learned about new ways to save energy through participation in the program. Figure 7-10 shows that on a scale from one to five, where five is "I learned many new ways to save energy," half of respondents (50 percent; n = 12) rated their learning at a four or higher. Respondents shared various things they learned about saving energy. Three respondents commented specifically on the water savings achieved by the low-flow showerhead and the faucet aerators, others indicated satisfaction with the amount of energy saved by CFLs, and that their children were getting better about turning off lights and taking shorter showers. For those respondents who reported that they did not learn anything, or did not learn much, about new ways to save energy, a common explanation was that they had already been educated on the topic.

Figure 7-10. Extent to which Parents/Guardians Learned About New Ways to Save Energy (n = 12)

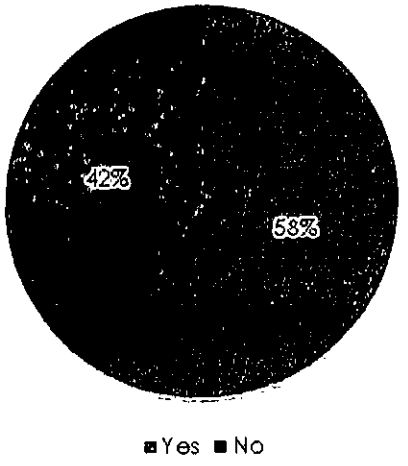


Source: Navigant analysis of parent/guardian survey results

Overall, parent/guardian survey respondents perceive the program measures to have a positive effect on their electricity bills, indicating that they believe EE has a tangible impact. Figure 7-11 shows that 60

percent (n = 12) of parents/guardians reported seeing a decrease in their electricity bill since participating in the program.

Figure 7-11. Did respondents notice a decrease in their electricity bill? (n = 12)



Source: Navigant analysis of parent/guardian survey results

To determine parent/guardian awareness of other programs, Navigant asked respondents if they knew of any other EE programs or rebates offered by PECO, besides the PECO SES/Energizing Education program. Awareness of other PECO EE programs among survey respondents was very low. Only 2 of the 12 respondents expressed familiarity with an additional program. One was aware of the Low Income Heating Energy Assistance Program (LI-HEAP) program while the other was aware of both the SAR Program and the SHC Program. The respondent who was aware of LI-HEAP reported learning about the program through their experience with the PECO SES kit. The other respondent learned of the two additional programs through a PECO bill insert. Both indicated that they planned on participating in programs in the future based on their experience with the SES program. These results may not representative of all participants, given the small sample size.

The following are the recommendations from this section:

- **Recommendation:** Navigant recommends that the program increase its cross-promotional efforts within the PECO SES program for PECO's other residential programs. Suggestions for achieving this are including a magnet or sticker with program information to better capture the attention of participants. Magnets and stickers are more likely to be put in a place that is visible for a longer period of time, and they stand out in comparison to the other paper materials. PECO should also identify and utilize other customer touch points within the program that would allow for Smart

Ideas program promotion. For example, PECO could mention the other programs in the parent letters, or include promotional modules in the student workbooks.

7.5 Recommendations for Program

Table 7-20: SES Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Conduct surveys of previous year parent/guardian participants in PY7 to better understand ISR for the CFL measures after one to two years.	Being considered. We currently conduct intercept surveys for our Cross Sector CFL program. The surveys have not been a successful vehicle for obtaining in-service rates for this program due to low participation and student involvement. Are there other ways of obtaining information for in-service rates?
Recommendation 2: A full list of the recommended installation survey changes was presented to PECO and RAP in the preliminary findings memo, and the evaluation team worked with RAP to make the necessary updates in time for the PY6 survey development deadline in early August 2014.	Implemented.
Recommendation 3: Instead of reporting the installation survey data with a separate row for each survey question, organize the data with one row for each unique survey respondent (by Survey ID), and a column for the answer each survey question.	Implemented.
Recommendation 4: Adjust the parent/guardian evaluation form to increase the likelihood that the program will receive more parent/guardian contact information and feedback on the form.	Implemented. • Drawing for a chance to win $100. • Added link on survey cards to give parents/guardian. • Opportunity to complete survey online. Navigant will need 70 completed evaluation forms to complete parent phone surveys.
Recommendation 5: Closely track the installation survey response rate in PY6 and conduct teacher interviews during the PY6 evaluation if the return rate remains an issue.	Being considered. • Increase communication with teachers to express importance of submitting the student surveys. • Monitor response rate by classroom in PY6. Findings showed that some classes had very low response rates in PY5.
Recommendation 6: Offer an online option for completing the installation survey in addition to the paper survey.	Rejected. The current approach collecting feedback from teachers is proved to me most reasonable and effective.
Recommendation 7: Enhance program materials to better emphasize the resources available online at the SES website.	Being considered. • SES URL printed on all program materials. • Plan to add language in teacher book to drive teachers to visit our website for additional online resources and activities.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 8: Provide options for teachers to use a regular-length or shortened version of the lesson plan and activities.	Being considered. • Teachers notified of program availability in August. This gives teachers the opportunity to fit program into their schedule. • Implemented for PY6 (based on teacher focus group feedback): • Removed 10-day optional curriculum, only 5-day curriculum offered. • Simplified book by moving definitions to the back of the student book. • Reduced the number of extra activities.
Recommendation 9: Increase cross-promotional efforts within the PECO SES program for PECO's other residential programs.	*Being considered. PECO has been* engaged in cross promotional efforts since inception of the program: • Cross promotion info is included in each kit design and highlights PSI programs with QR codes linking to PSI website. • Quick Start Guide includes a panel highlighting PSI programs. • PSI. URL printed on all program materials.

Source: Navigant

7.6 Financial Reporting

As Table 7-21 demonstrates, the SES program has achieved a TRC of 3.61, a higher ratio than expected in the program plan.

Table 7-21: Summary of SES Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	417	417
Marketing[2]	0	0
Subtotal EDC Implementation Costs	**417**	**417**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	417	417
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**417**	**417**
Total NPV Lifetime Energy Benefits	**1,330**	**1,330**
Total NPV Lifetime Capacity Benefits	**61**	**61**
Total NPV TRC Benefits[6]	**1,508**	**1,508**
TRC Benefit-Cost Ratio[7]	**3.61**	**3.61**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

8 Smart Usage Profile

The primary goal of the SUP program is to achieve cost-effective energy savings by helping residential customers understand their energy use and adopt energy-efficient behavior changes. Additionally, PECO uses the program as a tool to enhance customer engagement and encourage participation in other PECO EE programs. The SUP program is an opt-out program in which the implementer, Opower, enrolls participants in the program based on a randomized control trial (RCT) program design. Enrolled customers can opt out of the program by calling or emailing the program implementer.

The SUP program influences behavior change in customers by providing information in the form of an home energy rating (HER) mailed regularly to participants. The HERs provide participants with information about their recent energy use and compare the usage to that of similar homes. The HERs also provide participants with energy-saving tips, some of which are tailored to the participant's circumstances. This set of information has been shown in other studies to stimulate participants to reduce their energy use, creating average energy savings in the 1 to 2 percent range.

In addition to the printed reports, the program also sends abbreviated email reports to participants for whom PECO has an email address and who have not opted out of receiving email communication from PECO. The abbreviated email reports present the customer's energy usage from the previous month and compares it to that of similar homes. All participants also have access to an online web portal where they can track changes in their usage over time, establish energy-saving goals, and review tips for saving energy and money. The web portal is also available to non-participant PECO customers who sign up to access their bill online.

Energy savings (kWh) are the primary metric for gauging success and are determined via regression analysis. Savings from behavioral programs, such as the SUP program, are typically considered to have a one-year lifetime. Section A.2.c.2 of the Commission's Phase II Final Implementation Order indicates that savings are only counted for those measures for which the useful life is not expired at the end of the phase. Therefore, savings from the SUP program in PY7 will count towards PECO's compliance goals for Phase II, while program savings in PY5 and PY6 will not count towards the compliance goals. Navigant estimates program impacts in PY5 and PY6 for informational purposes only.

8.1 Program Updates

PECO launched this program in PY5 and did not make any major changes to the program offerings outlined in the Phase II plan.

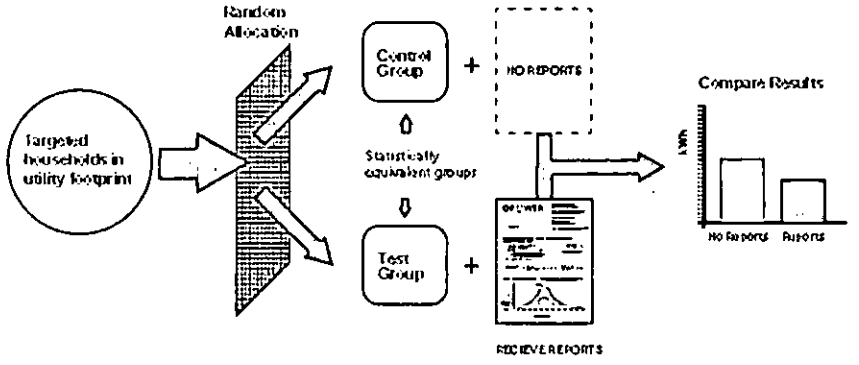
8.1.1 Definition of Participant

PECO defines participation based on the number of customer households assigned to the participant group. One treatment group home equals one participant. A key feature of the SUP program is the use of an RCT design, in which eligible customers are randomly assigned to participant and control groups.

Customers assigned to the participant group must opt out if they no longer want to receive the HERs. Due to random assignment, any difference in usage between participants and controls is a result of participation in the program. To ensure the program achieves the highest amount of savings possible, PECO defines SUP program target customers as high-use residential customers that receive electricity from PECO.[36] Additionally, at least 5 percent of the SUP program target population includes low-income customers to produce a target population that is representative of PECO's aggregate customer base.[37]

Prior to program launch in September 2013, the program implementer selected a representative sample of these target customers and randomly assigned them into either a treatment or control group; treatment group customers receive the HERs and control group customers do not.[38] The evaluation, measurement, and verification industry considers this RCT strategy to be the "gold standard" for enabling accurate evaluation of the impacts of behavioral programs. The RCT strategy also aids the implementer in monitoring progress towards program goals.[39] Figure 8-1 provides an overview of this enrollment process.

Figure 8-1: Overview of the Randomized Control and Treatment Group Program Design



Source: OPower White Paper No. 01 "Information-Enabled Energy Efficiency"

In September 2013, the implementer selected 44,803 PECO customers to enroll in an "initial wave" treatment group. This number of participants is slightly higher than PECO's reported participation of

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[36] PECO defines high usage as greater than or equal to 14,000 kWh per household per year.

[37] For the SUP program, PECO defines low-income customers as those who receive discounted rates via the PECO Community Assistance Program (CAP). For CAP eligibility requirements, see the PECO website at www.peco.com/CustomerService/AssistancePrograms/CAP/Pages/default.aspx.

[38] The web portal is available to all PECO customers, regardless of their enrollment in the SUP program. PECO does not have specific goals relating to customer engagement with the web portal.

[39] State and Local Energy Efficiency Action Network. *Evaluation, Measurement and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.* May 2012.

40,000 because the implementer enrolled a higher number of target participants in anticipation of lost savings from attrition. In June 2014, the implementer enrolled an additional 45,000 customers in a *"second wave" treatment group for PY6 and in June of 2015, the implementer will enroll a "third wave"* of 30,000 participants for PY7. The implementer will monitor participant attrition over the course of the program and introduce refill waves as needed to ensure the program achieves its energy-saving goals.

8.1.2 Validation of RCT

The SUP program follows an RCT design, consistent with the recommendations in the State Energy Efficiency (SEE) Action protocol. Eligible customers are randomly assigned to the participant and control groups. The SEE Action protocol recommends that an independent, third-party evaluator conduct this task to avoid potential conflicts of interest; however, this is not currently the industry standard. The program *implementer, OPower, randomly assigned customers to the participant and control groups for the SUP* program. Navigant previously conducted statistical tests on the billing data to check that monthly usage patterns are similar for the participant and control groups. Specifically, Navigant conducted statistical tests on the difference in the MAU for the participant and control households during the 12 months prior to the start of the SUP program. The results of the analysis validated that program households were randomly allocated across the treatment and control groups. The evaluation team delivered these results to PECO in a memo.

8.2 Impact Evaluation Gross Savings

PECO reported 2,247 MWh in gross energy savings for the PY5 program year, as shown in Table 8-1. Because this behavior program is assumed to have a one-year measure life, savings that accrue to this program are reported and verified each year, but decay to zero at the completion of the program year. Therefore, savings achieved in PY7 will count towards compliance targets, while savings achieved in PY5 and PY6 will not.

Table 8-1: Phase II Smart Usage Profile Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	40,000	2,247	0	0
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	0	0	0	0
Phase II Total	40,000	2,247	0	0

Source: Navigant analysis

The main methodological issue for the impact evaluation is to estimate the *counterfactual* energy use by households participating in the SUP program. Stated another way, the impact evaluation compares actual energy usage against the estimated energy that participating households would have used in the absence of the program. The program utilized an RCT experimental design, meaning that households were randomly allocated to the control and treatment groups. This eliminates the issue of selection bias that complicates the evaluation of many behavioral programs. The random assignment of households to the treatment and control groups means the control group should serve as a robust baseline against which the energy use of the treatment households can be compared to estimate savings from enrollment in the SUP program.

Navigant estimated program savings through the use of a linear fixed-effects regression (LFER) analysis. In the LFER model, average daily consumption (ADC) of kWh by participant and non-participant *k* in billing period *t*, denoted by ADC_{kt}, is a function of three terms:

- The binary variable Treatment, taking a value of 0 if household k is assigned to the control group, and 1 if household k is assigned to the participant group
- The binary variable Postt, taking a value of 0 if bill t is before the household's program start date and 1 if the bill is received on or after the program start date
- The interaction between these variables, Postt Treatment

This is referred to as a one-way fixed effects model because it includes a household-specific fixed-effects term. Equation 8-1 formally[40] presents the equation for this model.

Equation 8-1. One-Way Fixed Effects Regression Model

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Participant_k \cdot Post_t + \varepsilon_{kt}$$

where

ADC_{kt} = The average daily use in kWh for participant or non-participant *k* during billing cycle *t*. This is the dependent variable in the model.

$Post_t$ = A binary variable indicating whether bill cycle *t* is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).

$Participant_k$ = A binary variable indicating whether household *k* is in the participant group (taking a value of 1) or in the non-participant group (taking a value of 0).

[40] This equation corresponds to Formula 1.1 in Appendix C of *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*, published by the State and Local Energy Efficiency Action Network in May 2012.

α_{0k} = The household-specific fixed effect (constant term) for household *k*. The fixed-effect controls for all participant or non-participant-specific effects on energy consumption that do not change over time, such as the number of household members or the size of the dwelling.

α_1, α_2 = Regression parameters corresponding to the independent variables.

Three observations about the model specification deserve comment. First, the coefficient α_{0k} is the *household-specific fixed-effect that implicitly captures all participant-specific and non-participant-specific* effects on electricity use that do not change over time, such as square footage of the dwelling, number of occupants, and indoor temperature preferences, including those that are unobservable. Second, α_1 captures the average effect *among non-participants* of being in the post-treatment period. In other words, it captures the effects of exogenous factors, such as economic conditions, that affect all non-participants in the program period but not in the pre-program period. Third, $\alpha_1 + \alpha_2$ captures the average effect *among participants* of being in the post-program period, and so the effect directly attributable to the SUP program is captured by the coefficient α_2. In other words, this coefficient captures the *difference-in-difference* in average daily kWh use between the participants and non-participants across the pre-program and treatment periods. Consequently, the Difference-in-Differences (DID) statistic is considered the best indicator of program effects in a program evaluation. The evaluation team generated average savings for PY5 by multiplying the estimate of household average daily savings (α_2) by the average number of post days per participant. This estimate of average annual savings applies to households that remain in the program for the balance of PY5.

The one-way fixed-effects model is the preferred model used for reporting savings. As a check on the robustness of the savings estimates, Navigant also modeled SUP program savings utilizing a post-only model. Due to the experimental design of the program, the two models should generate very similar results. The second model uses post-enrollment program observations only and replaces the household fixed effect with the household's energy use in the same calendar month of the pre-program year to account for household-level variation in energy use. We refer to this model as the post-program regression (PPR) model. Formally, defining $Preconsumption_{kt}$ as household *k*'s energy use in month *t* and letting γ_t denote the fixed effect for month *t*, the model takes the form,

Equation 8-2. PPR Model with Monthly Fixed Effects

$$ADC_{kt} = \alpha_{ot} + \alpha_1 Preconsumption_{tk} + \alpha_2 Participant_k + \gamma_t + \varepsilon_{kt}$$

Participants and non-participants that moved out of PECO territory during PY5 were omitted from the regression analysis to estimate program effects, but were included in the estimate of total program savings. Navigant assumed that until a participant moves out, their program savings are equal to savings over the same period for participants that remain in the program for the balance of PY5.

Table 8-2: Smart Usage Profile Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
All	44,803	N/A	Program Census	Program Census	Billing analysis of program census
Program Total	44,803	N/A	Program Census	Program Census	N/A

Source: Navigant analysis

One of the ways in which the SUP program encourages participants to reduce energy consumption is by channeling them into other EE programs offered by PECO, notably the SAR, SHC, SHR, Smart Multifamily (SMF), and Low Income Energy Efficiency (LEEP) programs. Navigant investigated the effect of the SUP program on increasing participation in these five programs in order to account for the possibility of double counted savings (DCS). For each customer group and cohort, Navigant compared the change in the rate of participation for the treatment group and the control group in the pre-program year and PY5 via the DID statistic:

DID = (Treatment: Pre/Post change in # of participants as % of total HER participants) – (Control: Pre/Post change in # of participants as % of total control households)

The SHC and Smart Multifamily programs do not exist prior to the start of the SUP program. Therefore, the rate of participation in the pre-program year is set to zero for the DID calculation for both HER participants and control households. The evaluation team then multiplied the DID statistic by the number of treatment households to get the change in uptake for each of the five other PECO programs due to the SUP program. The change in participation in the other programs, referred to as "uplift", was then multiplied by the average participant savings for each program to estimate the total DCS. The calculation of the DID statistic and resulting program uptake was performed separately for each of the other five programs. From a theoretical standpoint, the DCS may be allocated to either the SUP program or to each of the other EE programs, since the savings would not have occurred in the absence of either program. Industry standard is to subtract the amount of the DCS from the behavioral program savings; Navigant followed this approach in the SUP impact evaluation. Following the guidance given in section 3.4.1 of the Phase II Evaluation Framework[41], if the 85 percent confidence interval around the estimated uplift includes 0, Navigant will conclude there is no evidence of uplift for a given program and will not adjust for DCS.

[41] The Statewide Evaluation Team, "Evaluation Framework: For Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs," June 30, 2013.

The SUP program allows participants to opt out of receiving HERs. Participants that opt out are part of the original RCT design, and therefore cannot be excluded from the regression analysis. Section 2.3.1 of the SEE Action protocol states:

> *The treatment group receives the program (but are allowed to opt out), and the control group does not receive the program (and are not allowed to opt in). Energy use data must be collected for all of the households in the control and treatment group, whether or not they opt out, in order to estimate energy savings without bias. If the households that opt out are excluded from the treatment group, as discussed in Section 3.2.4, then the results will suffer from selection bias: the households in the control group are no longer the same types of households as those in the treatment group.*

Navigant's analysis showed that 116 customers opted out of the SUP program in PY5, or approximately 0.26 percent. This rate is low compared to the evaluation team's experience evaluating other opt-out programs in their first year. After a participant opts out of receiving the HERs, they may continue to be influenced by their initial exposure to the program. Any savings that persist after the opt-out were counted in the regression analysis described in this report. Due to the RCT design, any savings by these opt-out customers are indeed attributable to the SUP program. In the likely event that savings decay after a participant opts out of receiving reports, this will lower the estimate of average savings.[42] Total program savings are calculated by multiplying the average savings by the number of participants; although the average estimate of savings may be slightly lower, the number of participants includes both active participants and those that have opted out of receiving reports. Inclusion of opt-out participants in the calculation of program savings is consistent with industry standard.

The verified ex post energy savings in PY5 were 3,068 MWh. A summary of verified ex post SUP program savings is shown in Table 8-3 and Table 8-4.

Table 8-3: Program Year 5 Smart Usage Profile Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
All	2,247	N/A	3,068	0	0%
Program Total	2,247	N/A	3,068	0	0%

Source: Navigant analysis

[42] The SEE Action protocol refers to this estimate of average savings as the "intent-to-treat" estimate.

Table 8-4: Program Year 5 Smart Usage Profile Summary of Evaluation Results for Energy

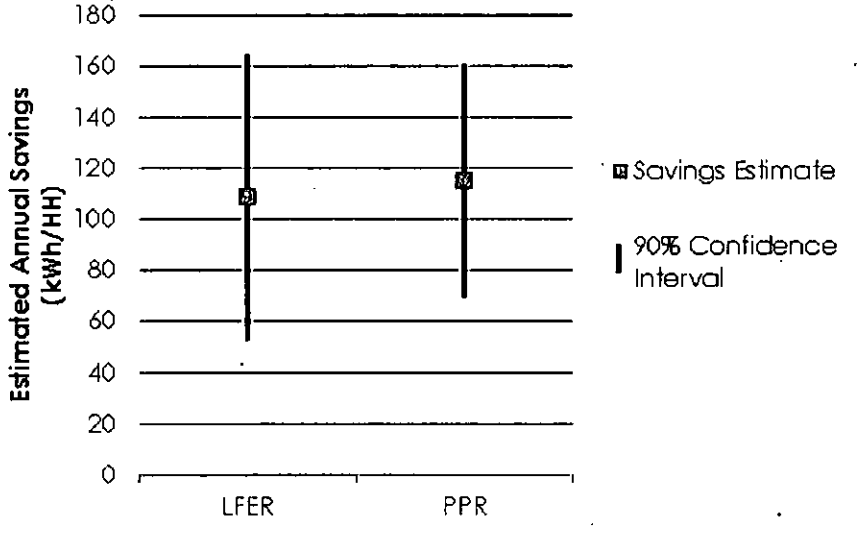
Type of Statistic	Evaluation Results
Number of Participants	44,803
Sample Size, Control	28,000
Percent Savings	0.55%
Standard Error	*0.17%*
Average Annual Savings per Customer (kWh)	71
Standard Error	*22*
Verified Gross Savings, Prior to Uplift Adjustment (MWh)	3,174
Standard Error	*1,004*
Savings Uplift in Other EE Programs (MWh)	106
Verified Gross Savings (MWh)	3,068

Note: All values are statistically significant at the 90% level.

Source: Navigant analysis

A visual representation of the savings and error bounds estimated by both models is shown in Figure 8-2.

Figure 8-2. PY5 SUP Energy Savings Estimates and Error Bounds



Source: Navigant statistical analysis of customer billing data

Navigant found the savings estimated by both models to be statistically indistinguishable. In both instances, the estimated savings value produced by one model lies well within the uncertainty band produced by the other model. The combination of the analyses using the one-way fixed-effects model and the PPR model shows that the savings estimates are robust for all customer groups.

The estimated savings rate of 0.55 percent per household is lower than Navigant typically finds for a mature program similar to SUP, but is in line with what is generally found for behavioral programs such as SUP that are still in their ramp-up phase. Previous evaluations have shown that it can take between 12 and 18 months for estimated savings to rise to the level one would expect to see from a mature behavioral program. For PY5 participants in the SUP program, the first HERs were received in early September. This means that participant households would have received reports for at most nine months of PY5. On average, a participant whose bill was included in the billing analysis for the SUP program would have been receiving reports for approximately four months, or between 25 and 33 percent of the way through the expected program ramp-up period. Therefore, the savings estimate of 0.55 percent per household is consistent with what the evaluation team would expect to find for a program at this stage.

PECO did not report any demand savings for the SUP program in PY5 and Navigant did not conduct an analysis of participant and control interval data to determine coincident peak demand savings for PY5, as shown in Table 8-5. Pending availability of interval data, Navigant will quantify coincident peak demand savings using hourly regression models in either PY6 or PY7. This analysis would require interval data for at least 8,000 participants and 8,000 controls. Due to the costs associated with this analysis, this task will only be conducted once during Phase II, either in PY6 or PY7 (depending on data availability).

Table 8-5: Program Year 5 SES Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
All	0	0	0	0	0
Program Total	0	0	0	0	0

Source: Navigant analysis

Navigant utilized the DID statistic to estimate the savings captured in the billing analysis for the SUP program that is already accounted for in the savings estimate for five other PECO EE programs: SAR, SHC, SHRs, Smart Multifamily, and Low Income Energy Efficiency programs. The inputs to and results of the DID calculation are presented in Table 8-6.

Table 8-6: Program Year 5 SES Double Counting Analysis Statistics

	LEEP	SAR	SHC	SHR	SMF
Median program savings (annual kWh per participant)	2,490	1,026	833	881	565
Number of treatment households	44,803	44,803	44,803	44,803	44,803
Rate of participation, PY5 (%)	0.33%	0.69%	0.55%	1.12%	0.44%
Change in rate of participation from pre-program year (%)	-0.35%	0.45%	0.55%	0.08%	0.44%
Number of control households	28,000	28,000	28,000	28,000	28,000
Rate of participation, PY5 (%)	0.36%	0.57%	0.45%	1.15%	0.45%

	LEEP	SAR	SHC	SHR	SMF
Change in rate of participation from pre-program year (%)	-0.39%	0.31%	0.45%	0.06%	0.45%
DID statistic	0.04%	0.14%	0.10%	0.02%	-0.01%
Change in program participation due to HER program	16	63	46	9	-5
Statistically significant at the 85% confidence level?	No	Yes	Yes	No	No
PY5 realization rate	N/A	0.99	1.09	N/A	N/A
Savings attributable to other programs (kWh)	0	64,305	41,666	0	0

Note: Median program savings are equal to the median kWh impact for SUP participants during the post-period.

Source: Navigant analysis

The resulting change in program participation due to the SUP program is multiplied by median savings per participant in the SAR and SHC programs to estimate the total amount of DCS. The uplift in participation in the SHRs, Smart Multifamily, and Low Income Energy Efficiency programs was not statistically different from 0 percent at the 85 percent confidence level. Therefore, according to section 3.4.1 of the Phase II Evaluation Framework, no DCS was calculated for these programs. In total, Navigant estimated that 105,971 kWh of savings included in the SUP billing analysis are double-counted in other PECO EE programs and have been deducted from the total estimated PY5 energy savings for the SUP program.

From a channeling perspective, the double-counting analysis suggests that the SUP successfully channeled 109 SUP participants into the SAR and SHC programs. Further, in discussions about these findings with the evaluation team, PECO confirmed that two of the HERs mailed in PY5 included promotional modules for the SAR and SHC programs (one mailing each). These correlations indicate that the SUP program is an effective program marketing tool for PECO to use as necessary.

The recommendation from this section includes the following:

- **Recommendation:** As PY7 approaches and the above savings forecast becomes more refined, there may be an opportunity to adjust total savings generated by SUP in PY7 relative to its program goals. Contingent on contractual obligations, Navigant recommends that PECO retain the ability to adjust the number of treatment customers in Wave 3, or the timing of their enrollment in order to manage program savings and costs to meet the plan goals depending on how forecasts are trending relative to PY7 program goals. An additional option would be to adjust the frequency of HERs for Wave 1 and Wave 2. Generally, an adjustment in the delivery rate of HER results has a limited, corresponding impact on the average rate of household savings.

8.3 Impact Evaluation Net Savings

Due to the RCT design of the SUP program, free ridership and participant spillover are incorporated in the results of the regression analysis. Section 2.2.2 of the SEE Action protocol states:

> *RCTs eliminate this free-rider concern during the study period because the treatment and control groups each contain the same number of free riders through the process of random assignment to the treatment or control groups. When the two groups are compared, the energy savings from the free riders in the control group cancel out the energy savings from the free riders in the treatment group, and the resulting estimate of program energy savings is an unbiased estimate of the savings caused by the program (the true program savings).*
>
> ...
>
> Participant spillover, *in which participants engage in additional energy efficiency actions outside of the program as a result of the program, is also automatically captured by an RCT design for energy use that is measured within a household.*

However, the RCT design does not account for non-participant spillover. Section 2.2.2 of the SEE Action protocol continues:

> [N]on-participant spillover *issues in which a program influences the energy use of non-program participants are not addressed by RCTs. In these cases in which non-participant spillover exists, an evaluation that relies on RCT design could underestimate the total program-influenced savings.*

Navigant's experience has shown that non-participant spillover is expected to be small for this type of program. It would be primarily driven by conversations that participants may have with non-participant PECO customers. The conservative approach used by Navigant is to assume that non-participant spillover is 0.00, and that the NTG ratio for the SUP program is 1.0. Therefore, Table 8-7 and Table 8-8 are not applicable to this program. As a result, the net and gross savings estimates are the same for the SUP program.

Table 8-7: Smart Usage Profile Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum *Boundaries*	Population *Size*	Assumed CV or Proportion in Sample Design	Assumed Levels of *Confidence* & Precision	Target Sample Size	Achieved *Sample Size*	Percent of Sample Frame *Contacted* to Achieve Sample
All	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: ?

Table 8-8: Program Year 5 Smart Usage Profile Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
All	N/A	N/A	N/A	N/A	N/A
Program Total[43]	N/A	N/A	N/A	N/A	N/A

Source: ?

8.4 Process Evaluation

Navigant conducted an abbreviated process evaluation in PY5 and will conduct an in-depth process evaluation in PY6. For PY5, Navigant relied on a review of program materials and interviews with key PECO and implementer personnel to formally document the details and processes of the SUP program in a program theory and logic model.

8.4.1 Program Theory and Logic Model

This section includes a summary of the resources, activities, outputs, and outcomes associated with the SUP program.

PECO uses utility ratepayer funds to implement the SUP program and the program relies on staff resources from both PECO and the program implementer, OPower. PECO maintains a dedicated program manager to oversee day-to-day program activities conducted by the implementer, provides call center support to handle customer inquiries about the program, and provides Information technology (IT) resources to assist in managing program data. In addition, PECO corporate communications staff provides guidance and approval on program materials and promotional modules. The program also faces external influences that can help or hinder achieving anticipated outcomes, but are beyond the program's direct control. For example, depending on economic conditions and energy prices, the participants may not be motivated to save money by lowering their energy use. In addition, competition for customer attention, political discourse surrounding EE&C, customer values and customer lifestyle all play a role in the program's ability to have an effect on participant behavior. The SUP directly addresses informational barriers, or barriers related to customer awareness and understanding of energy use and EE, as well as motivational barriers, or barriers related to customer motivation and willingness to adopt behavior changes.

Activities implemented by the program include aggregating, analyzing, and comparing usage data to similar households and to past usage, providing personalized tips suggesting specific ways to save energy, providing information about other PECO programs, and providing information about money-saving

[43] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

potential with tips. SUP intended outcomes include paper-based HERs sent to treatment group customers, email HERs sent to treatment group customers with email addresses on file, and a web portal that is accessible to all PECO customers. SUP intended outcomes include: participants being aware of and understanding their energy usage; participants being aware of actions they can take to save energy in their home; participants being motivated to save energy; participants engaging with the web portal; participants being satisfied with the program; participants pursuing energy-saving actions and investments; participants enrolling in other PECO programs; participants achieving electricity and demand savings; participants seeing and understanding the energy savings resulting from their actions and investments; and participants continuing to engage with PECO as an EE partner.

8.4.2 Tracking System Review

Navigant's review of the tracking data and billing data for the impact evaluation of the SUP program confirmed the total count of participant and control customers included in the RCT design. The billing data spanned the full PY5 program year as well as the pre-program period necessary to perform the billing analysis. The evaluation team determined that the rate of opt-outs designated in the program data was lower than average, but still consistent with reasonable expectations.

The evaluation team did find many records for the pre-program period that contained the same billing period, but multiple service point ID tied to the same utility account ID. In effect, this meant that there were frequently two bills for the same account ID in the same billing period. In collaboration with OPower, Navigant determined that this duplication was due to a historic data file provided to the implementer by PECO. The duplicate records were the result of customer accounts that became inactive after being selected for inclusion in the SUP program. As part of the data-cleaning process, the evaluation team flagged and removed the duplicate service points that had become inactive and were not meant to be part of the program evaluation.

The recommendation from this section includes the following:

- **Recommendation:** Navigant recommends that Opower provide further cleaning of the program billing data to remove records for irrelevant service point IDs that are associated with utility account IDs included in the data. This will reduce the risk of data processing errors in future program years when multiple customer waves will make the data set more complicated.

8.4.3 Verification and Due Diligence

Given that the validity of the RCT design for Wave 1 of the program has been previously confirmed, Navigant did not perform participant surveys as part of the PY5 evaluation of the SUP program. This is a common way to confirm that a sample of participating households are actually receiving HERs and taking energy savings actions as a result. Lacking participant surveys, the best methodology for confirming that

the SUP program is being implemented as designed is to statistically confirm that treatment households are saving energy as compared to the control households.

Given that the program is constructed and validated as an RCT, the energy use of treatment households should be the same as that for control households during the program year were the SUP program not being executed as designed. As described below in, Navigant did find statistically significant savings among treatment households through its evaluation of the SUP program. This finding statistically confirms that the program is being implemented, that treatment households are regularly receiving HERs, and that they are, on average, taking energy-saving actions as a result. Furthermore, this evaluation identified 6,468 customers that had opted out of the SUP program or otherwise became inactive. Data from these households was included in the evaluation for analytical purposes.

8.5 Recommendations for Program

The recommendations for the SUP program are listed in Table 8-9 along with the PECO status for each recommendation.

Table 8-9: Smart Usage Profile Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Contingent on contractual obligations, Navigant recommends that PECO retain the ability to adjust the number of treatment customers in Wave 3, or the timing of their enrollment in order to manage program savings and costs to meet the plan goals depending on how forecasts are trending relative to PY7 program goals. An additional option would be to adjust the frequency of HERs for Wave 1 and Wave 2.	Being considered. PECO is analyzing the options to control enrollments to better predict participation.
Recommendation 2: Navigant recommends that Opower provide further cleaning of the program billing data to remove records for irrelevant service point IDs that are associated with utility account IDs included in the data.	Implemented. Working with OPower to clean up billing and remove duplicates.

Source: Navigant

8.6 Financial Reporting

As Table 8-10 demonstrates, the SUP program is currently not cost effective, with a TRC ratio of 0.55. This is not surprising given that the program is in its ramp-up phase. As the savings rate increases over time, Navigant expects that the program's TRC ratio will improve.

Table 8-10: Summary of Smart Usage Profile Finances

	PYTD ($1,000)	*Phase II* ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	*0*	*0*
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	583	583
Marketing[2]	0	0
Subtotal EDC Implementation Costs	**583**	**583**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	583	583
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**583**	**583**
Total NPV Lifetime Energy Benefits	**319**	**319**
Total NPV Lifetime Capacity Benefits	**0**	**0**
Total NPV TRC Benefits[6]	**319**	**319**
TRC Benefit-Cost Ratio[7]	**0.55**	**0.55**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

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

[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.

[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.

[5] Total TRC Costs includes Total EDC Costs and Participant Costs.

[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.

[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

9 Smart AC Saver – Residential

In the Smart AC Saver program, PECO remotely cycles or shuts down a customer's central air conditioning (CAC) unit on short notice during times of peak demand. In return, participants receive financial incentives for allowing PECO to control their equipment. Conservation events are called during time periods that coincide with the highest peak demand.

A Digital Control Unit (DCU) is installed on participating residential customer CAC units. When activated by a control signal, the switches will not allow the equipment to operate for some predetermined portion of each hour. For the Smart AC Saver program, the compressor is shut down during an event while the fan continues to operate. This allows cool air to be circulated throughout the home while the compressor is disabled. The operation of the DCU is controlled through a digital paging network. CAC units are controlled for the four months during summer (i.e., June through September).

Participation in the Smart AC Saver program varies month to month based on participants dropping from the program for a variety of reasons, including moving, closing of businesses, etc. During PY5, PECO maintained a list of customers seeking to join the program and continually backfilled some of the participants who left the program. As of the end of PY5, PECO had 84,612 active DCUs representing 72,766 participating households.

Total verified gross savings were 71.1 MW for the residential Smart AC Saver program, which was 91 percent of the PY5 target of 78 MW. There are no energy savings goals for the Smart AC Saver program, and Navigant does not conduct an analysis of NTG or spillover for this program.

Program expenditures for the residential Smart AC Saver program in PY5 totaled $6.9 million, approximately 74 percent of the PY5 budget of $9.2 million. Navigant calculated the TRC benefit/cost ratio of the residential Smart AC Saver program in PY5 at 3.48. The program was cost effective in PY5.

9.1 Program Updates

PECO designed the Phase II Smart AC Saver program to call conservation events for fewer hours than in PY4. In PY5, PECO called three conservation events that totaled less than nine hours, compared to 15 conservation events in PY4 totaling 51 hours. PECO based events on reaching 95 percent of the 2013 forecasted peak and/or PJM Emergency Demand Response (DR) curtailment requests. In PY5, PECO registered a portion of their program load (approximately 40 MW) into the PJM Emergency DR program via their Curtailment Service Provider (CSP), Comverge, to offset program costs. In PY5, PJM called two of the conservation events, and PECO called the third conservation event.

In Phase II, the PECO Smart AC Saver program reduced the incentives paid to participants during the months of June through September from $30 per month to $20 per month. Program staff anticipated that the reduced incentive could cause some participants to drop from the program, but PECO was able to backfill participants from a list of customers who had requested to join the program.

9.1.1 Definition of Participant

For the purposes of reporting, a participant is defined as a single address.

9.2 Impact Evaluation Gross Savings

Impact Evaluation

In PY4, Navigant applied a deemed savings value to determine residential Smart AC Saver program impacts during event hours. Navigant analyzed interval data for a sample of participants to determine program impacts in the hour before and two hours following events.

Because there are no peak demand reduction targets for the Phase II EE&C Programs, Navigant proposed relying on the residential deemed approach to savings[44] to validate the results of the load study[45] that Comverge prepared to quantify residential program saving for PY5.

Gross Impacts

For the PY5 evaluation, the Navigant team utilized the PY4 residential deemed savings methodology and compared those results to the results that Comverge calculated for the PY5 curtailment season.

Gross Impact Results

In their Load Control Impact Evaluation Report[46] to PECO, Comverge reported that PECO called a total of three conservation events in PY5. In all three conservation events, the M&V population was also curtailed. Comverge utilized a load comparison approach to calculate the maximum hourly average reduction for the curtailment season of 0.68 kW for the residential segment. This corresponded to a total MW savings of 59.7 MW (71.1 MW adjusted for line losses) for the residential segment, with 87,780 active switches participating.

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[44] *Navigant PECO Act 129 – Phase I Research Report: Program Year 4.*

[45] *PECO Energy Company 2013 Load Control Impact Evaluation Report.*

[46] *PECO Energy Company 2013 Load Control Impact Evaluation Report.*

The Navigant team sought to validate Comverge's findings utilizing the deemed saving approach developed in PY4. The results of the residential population are illustrated below in Table 9-1.

Table 9-1: PY5 Residential Average Impact (kW)

Event Date	Hour Beginning	Average Impact (kW)	# of participating switches	Total Load Reduction (MW)
July 17, 2013	14	0.873	86,864	77.6
July 17, 2013	15	0.873	86,864	77.6
July 17, 2013	16	0.873	86,864	77.6
July 18, 2013	14	0.873	86,864	77.6
July 18, 2013	15	0.873	86,864	77.6
July 18, 2013	16	0.873	86,864	77.6
September 11, 2013	15	0.873	87,780	76.6
September 11, 2013	16	0.873	87,780	76.6
Average		**0.873**	**85,593**	**77.3**

Source: Navigant analysis

Program impacts were calculated by applying kW reduction values to all event hours (0.873 for residential).

The PY4 Navigant analysis calculated average impacts at WTHI = 83.2 and the hour from 4:00-5:00 p.m.

As illustrated in Table 9-2, Navigant's analysis yielded a higher average kW impact and total MW savings for the residential sector on a post-line-loss-adjusted basis.

Table 9-2: Comparison of Impact Results after Line Loss Adjustment

Savings Analysis	Average Impact (kW)	Total Load Reduction (MW)
Navigant Residential Analysis	1.04	92.1
Comverge Residential Analysis	0.810	71.1

Source: Navigant

Tracking System Review

Navigant reviews a tracking system data extract that PECO provides on a quarterly basis. This data extract includes detailed customer information and information on the CAC equipment and the type of control device that Comverge installed. The team has observed no issues with this tracking system to date.

Verification and Due Diligence

In previous program years, Navigant has conducted on-site verification visits as part of the verification and due diligence process. Because PECO obtained a switch operability study from Comverge in PY2,

which is suitable for load research studies submitted to PJM for five years , the team did not conduct any on-site verification visits in PY5.

Table 9-3 shows the reported participants, gross demand reduction, and incentives for the Smart AC Saver residential program. Due to the nature of the program, there are no reported gross energy savings.

Table 9-3: Phase II Residential Smart AC Saver Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	72,766	0	71.1	7,055
Phase II Total	72,766	0	71.1	7,055

Source: PECO program database

The residential Smart AC Saver program did not have a sampling strategy for PY5 and thus Table 9-4 is not applicable to this program.

Table 9-4: Residential Smart AC Saver Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Residential	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A

Source: PECO program database

In addition, because of the nature of the residential Smart AC Saver program, there are no evaluation results for energy, as shown in Table 9-5.

Table 9-5: Program Year 5 Residential Smart AC Saver Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Residential	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

The verified gross demand savings for the program are 71.1 MW, based on a realization rate of 1.0, as shown in Table 9-6.

Table 9-6: Program Year 5 Residential Smart AC Saver Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Residential	71.1	1.0	71.1	N/A	N/A
Program Total	71.1	1.0	71.1	N/A	N/A

Source: Navigant analysis and PECO

9.3 Impact Evaluation Net Savings

Navigant did not conduct research to determine free ridership for this program. Navigant assumes 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. Therefore, Table 9-7 and Table 9-8 are not applicable to this program.

Table 9-7: Residential Smart AC Saver Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[47] to Achieve Sample
Residential	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

[47] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

Table 9-8: Program Year 5 Residential Smart AC Saver Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Residential	N/A	N/A	N/A	N/A	N/A
Program Total[48]	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

9.4 Process Evaluation

For PY5, the evaluation team proposed a scaled down process evaluation for the Smart AC Saver program, given that there are no demand goals as part of Act 129 in Phase II. For PY5, the team sought to answer the following key researchable process questions for the residential program:

1. Has the program, as implemented, changed from last year? If so, how, why, and was this an advantageous change?
2. Are program incentive levels appropriate to maintain participation?
3. What is the influence of the incentive level on participation levels?

Process Evaluation

In its petition of the Pennsylvania PUC to continue the mass-market direct load control (DLC) program (i.e., the Smart AC Saver program) in Phase II, PECO stated the program was designed to preserve the residential DLC measure as a DR resource and to retain existing participants.

Furthermore, PECO desired to maintain the population of active load control devices by replacing customers that exited the Smart AC Saver program once the new program was implemented.

Conservation Events

Informal discussions with PECO program staff indicated conservation events in PY5 were anticipated to be far fewer in number than in PY4, and, in fact, only three conservation events were called in PY5, compared to 14 events in PY4.

[48] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Events were based on PECO reaching 95 percent of the 2013 forecasted peak and/or PJM Emergency DR curtailment requests. Additionally, a portion of program load (approximately 40 MW) was registered in the PJM Emergency DR Program via Comverge to offset program costs.

Continued Program Participation

PECO finished PY4 with 76,976 residential participants representing 89,407. At the end of PY5, PECO had 72,766 residential participants representing 84,612 DCUs.

By successfully recruiting new participants to backfill for those customers leaving the program, PECO has been able to retain 95 percent of its residential participant DCU count into the PY5 curtailment season.

Program Materials

The evaluation team reviewed the program's marketing and outreach materials available on the program's website at www.peco.com/SmartIdeas. The hyperlink redirects the user to an easy-to-navigate page that allows the customer to select from a number of residential and commercial programs and rebates. Information on the website includes frequently asked questions (FAQs), brief explanations of how the Smart AC Saver program works, and an easy-to-follow link to receive email conservation event notices.

Program Management and Staff Interviews

The Navigant team conducted informal discussions with program staff during PY5 to understand the reasons for resurrecting the program for PY5 and the goals for PY5, document conservation event days, and examine the plans for the future of the program in PY6 and PY7.

Participant Survey

No participant surveys were conducted during PY5 for the Smart AC Saver program.

On-Site Surveys

On-site surveys were not conducted for the Smart AC Saver program in PY5.

Sampling

The Navigant team applied the PY4 evaluation findings to verify the results of the impact study performed by the program CSP, Comverge in PY5. Navigant utilized the deemed savings research of PY4 which employed a sample of 85 participants. The PY4 results achieved the 90 percent confidence and 10 percent precision targets.

For the PY5 program year Comverge obtained a statistically representative sample from the population of enrolled Smart AC Saver sites for the residential program. In order to represent the population as closely

as possible, the M&V units were distributed by air conditioner tonnage and the number of AC units per premise.

The Navigant team relied on the Comverge sampling strategy when reporting savings for the Smart AC Saver program in PY5 and thus Table 9-9 is not applicable to this program.

Table 9-9: Residential Smart AC Saver Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
Residential	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

Program Theory and Logic Model

Though the evaluation team did not develop a program theory and logic model for the Smart AC Saver program, the program's barriers, activities, and outcomes are characterized below:

- Barriers – Customers seeking to participate in conservation events face the following:
  - No knowledge of peak demand times
  - No ability to cycle their ACs automatically during conservation events.
- Activities – The program actively engages in:
  - Marketing and lead generation
  - Customer screening for load control switch compatibility
  - Conservation events
  - Test events
- Outcomes – The outcome of these activities include:
  - Customer awareness of the program
  - Financial benefits of the program
  - Customer participation in conservation events
  - Correct operation of load control switches
  - Improved customer satisfaction with PECO
  - Demand savings for PECO

9.5 Recommendations for Program

Recommendation #1: PECO should utilize advanced metering infrastructure (AMI) data for the PY7 Smart AC Saver program impact evaluation. Assuming PECO continues to deploy its AMI during PY6, the Navigant team recommends that the PY7 year-end load study and estimation of residential savings be completed utilizing AMI customer data. We expect the sample size to be sufficiently large to evaluate this voluntary program. The Navigant team will check for any evidence of bias, make recommendations about whether bias is likely to be an issue in Phase III, and suggest ways to mitigate the bias if it is a possibility.

Table 9-10: Residential Smart AC Saver Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should utilize AMI data for the PY7 Smart AC Saver program impact evaluation.	Being considered. Currently the AMI meter installation is underway and scheduled to be finished prior to the beginning of PY7, which would allow PECO and the Smart A/C Saver program to adopt Navigant's recommendation for PY7.

Source: Navigant analysis and PECO

9.6 Financial Reporting

A breakdown of the program finances is presented in Table 9-11. The table indicates that the program was cost effective in PY5.

Table 9-11: Summary of Residential Smart AC Saver Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	-132	-132
Marketing[2]	7055	7055
Subtotal EDC Implementation Costs	**6923**	**6923**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	6923	6923
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**6923**	**6923**
Total NPV Lifetime Energy Benefits	18,013	18,013
Total NPV Lifetime Capacity Benefits	6,090	6,090
Total NPV TRC Benefits[6]	**24,104**	**24,104**
TRC Benefit-Cost Ratio[7]	**3.48**	**3.48**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] *Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.* EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

10 Smart Multi-Family Solutions - Residential

The purpose of the PECO SMF Solutions program is to increase awareness of energy savings opportunities in MF buildings and assist MF residents and building owners/managers to act on those opportunities. The program is designed for both MF property owners and MF customers. Existing commercial, residential, governmental, institutional, and nonprofit MF buildings, including master-metered common areas and individual tenant accounts, with four or more living units, are eligible to participate in this program.

This program is designed to encourage and assist customers by offering two main participation channels. The prescriptive channel offers incentives to MF property owners who install high-efficiency equipment in common areas. The measures offered in the prescriptive channel include Energy Star heat pump water heaters (incentives ranging from $200 to $350 per unit), exterior high-wattage, pin-based CFLs (incentives ranging from $10 to $40 per unit), T8/T5 fluorescent lamps and fixtures (incentives ranging from $0.25 to $12 per unit), common area air source A/C and heat pumps, common area packaged terminal air conditioners (PTACs) and heat pumps (incentives ranging from $25 to $80 per unit), and LED exit signs (incentives ranging from $15 to $25 per unit).

The direct install channel offers free TRM lighting and non-lighting measures, such as CFLs, low-flow showerheads, and low-flow faucet aerators to willing MF residents. The non-lighting measures are only offered for those units that have electric water heating.

The PECO SMF Solutions program has two segments: SMF Residential (SMFRES), and SMF Non-Residential (SMFNR). The non-residential segment includes projects completed in Commercial & Industrial (C&I) and government, nonprofit, and institutional (GNI) multi-family buildings. The SMF Solutions program was evaluated as a whole, including both the residential segment and the non-residential segment. The residential segment of SMF Solutions program PY5 impact evaluation activities, findings, and recommendations is discussed in this section. The non-residential segment is discussed in a separate section.

10.1 Program Updates

The SMF Solutions program is a new Phase II program. The program design and planning started on June 1, 2013. The PY5 implementation launched in September 2013 and ended in May 2014.

Despite the lack of participation in the prescriptive channel, the SMF Solutions program as a whole, exceeded the PY5 planned MWh goals. However, the program underachieved the demand reduction goals. The SMFRES segment achieved 104 percent of the planned PY5 MWh savings goal and 50 percent of the demand reduction goal. For both the program components, a majority of the participation was in the TRM Lighting category. These measures have lower peak demand coincidence factors than the non-lighting measures, which contributed to the underattainment of the program peak demand reduction.

Program staff reported the program has a good pipeline of direct install projects for PY6 and should have no problem meeting PY6 goals.

10.1.1 Definition of Participant

Every individual residential utility account ID completing energy efficiency upgrades either in the direct install channel or in the prescriptive channel is counted as a participant in the SMFRES segment.

10.2 Impact Evaluation Gross Savings

In PY5, the SMFRES segment of the SMF Solutions program did not see any participation in the prescriptive channel and 100 percent of the verified savings were from direct install measures. Sixty-eight percent of these direct install measure savings were from TRM-lighting measures. In PY5, the SMF Solutions program completed 6,445 residential direct install projects. The program had no prescriptive measure participation and therefore did not incur any incentive payments.

Table 10-1 shows the SMFRES segment-level energy and demand reported savings estimates and gross impact results.

Table 10-1: Phase II SMF Solutions - Residential Segment Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	6,445	2,374	0.2	-
Phase II Total	**6,445**	**2,374**	**0.2**	-

Source: Evaluation Team Analysis

10.2.1 M&V Methodology

In PY5, the evaluation team calculated the SMF Solutions program gross impacts. Net impacts are scheduled to be evaluated in PY6 and PY7.

The PY5 evaluation methods consisted of in-depth phone interviews with program management and implementation staff, tracking data analysis, and project application file reviews. The evaluation approach for deemed measures was to verify both the reported quantity and that the measure matched the TRM-required specifications. The evaluation team conducted a record-by-record review of the projects listed in the tracking database by recalculating the savings estimates using the 2013 TRM guidance.

To support the impact evaluation, project documentation in electronic format was obtained from the implementer for each of the 30 sampled SMFRES projects. Documentation included project direct installation forms and summary sheets, which included premise-level ex ante savings, measure type, and

measure count information. The evaluation team verified all measures installed at a sampled facility and verified the counts and that the ex ante savings adhered to the 2013 TRM.

10.2.2 Sampling

The sample design for the PY5 SMF Solution program used stratified ratio estimation. The evaluation team designed the final program sample to achieve the required 85/15 confidence and precision level with a 0.5 CV. Within the SMFRES segment, the evaluation team stratified the sample by ex ante kWh savings recorded in the program tracking database. The evaluation team grouped projects into three strata: *Large, Medium,* and *Small.* The evaluation team designed the initial kWh cutoffs for the strata such that one-third of overall energy savings falls into each stratum. This resulted in the *Large* stratum containing very few projects and the *Small* stratum containing a large portion of the projects. The evaluation team then adjusted the kWh cutoffs to account for natural breakpoints in the project sizes and to create an efficient sample design. However, the size stratum was considered strictly to capture a large portion of the program kWh savings while still sampling a variety of differently sized projects.

In accordance with the Evaluation Plan, the evaluation team targeted a sample of 30 participants for the SMFRES segment for PY5. Table 10-2 summarizes the SMFRES segment sampling efforts.

Table 10-2: SMF Solutions - Residential Segment Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
SMFRES - Large	962	85/15	10	10	Impact: File Reviews
SMFRES - Medium	1,632	85/15	10	10	Impact: File Reviews
SMFRES - Small	3,851	85/15	10	10	Impact: File Reviews
Program Total	**6,445**	**85/15**	**30**	**30**	

Source: Evaluation Team Analysis

10.2.3 Gross Impact Evaluation Findings

The evaluation team developed ex post gross impacts, informed via file reviews and tracking database verification, for each sampled project within the SMFRES program segment and analyzed these results to determine the ex post gross impacts. The final impact analysis for the SMFRES segment resulted in an

energy and demand realization rate of 1.00. Table 10-3 presents the strata-level level relative precision levels for verified gross energy savings for the SMFRES segment.

Table 10-3: PY5 SMF Solutions - Residential Segment Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
SMFRES - Large	791	1.00	791	0.0	0%
SMFRES - Medium	781	1.00	781	0.0	0%
SMFRES - Small	802	1.00	802	0.0	0%
Program Total	**2,374**	**1.00**	**2,374**	**0.0**	**0.0%**

Source: Evaluation Team Analysis

Table 10-4 presents the strata-level level relative precision levels for verified gross demand savings for the SMFRES segment.

Table 10-4: PY5 SMF Solutions - Residential Segment Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
SMFRES - Large	0.07	1.00	0.07	0.0	0%
SMFRES - Medium	0.06	1.00	0.06	0.0	0%
SMFRES - Small	0.05	1.00	0.05	0.0	0%
Program Total	**0.18**	**1.00**	**0.18**	**0.0**	**0.0%**

Source: Evaluation Team Analysis

10.3 Impact Evaluation Net Savings

Net impacts were not measured in PY5.

10.4 Process Evaluation

The PY5 process evaluation is informed mainly by in-depth interviews of the PECO program management staff and Franklin Energy staff. The process evaluation was also supported by the program materials review, program tracking data review, and verification and due diligence review. Each of these data collection activities provided qualitative and quantitative information on the program's structure, design, and performance in comparison with intentions, or a combination of these factors.

10.4.1 PECO Program Management Staff and Franklin Energy Staff Interviews

The evaluation team conducted three in-depth interviews. Two of these in-depth interviews were with PECO staff and one with Franklin Energy staff, during the months of June and July 2014. The interviews were designed to enable the evaluation team to ask questions about the program's design, development, administration, and delivery during PY5 and also to obtain "real-time" information about current program activity through asking open-ended questions that created a "free-flowing" conversation.

During the in-depth interviews, the program staff reported that a lot of the MF property owners or managers perceive their participation in PECO's SMF Solutions program as an opportunity to market their properties as "green and energy-efficient". This is a resounding validation of PECO's objective to strengthen customer trust in PECO as their partner in saving energy.

Despite the lack of prescriptive channel participation, program staff all agrees that the SMF Solutions program is working well to meet the planned MWh goals as it was designed. The program staff reported having good communication and coordination between PECO and Franklin Energy, and indicated that they have worked together to identify and work on program improvements. In the past year they have worked together to update the website, create a tri-fold brochure, create a stand-alone mail marketing piece, and complete a case study. Currently, they are looking for the next possible case study candidate and working to update the site-specific audit report template to incorporate better/more useful information such as payback and return on investment.

The program staff is working with trade allies to find prescriptive projects, putting a strong focus on benchmarking to figure out where building owners are spending their money, simplifying the application, and increasing participation in smaller buildings. Currently, Franklin Energy has the primary responsibility for program marketing.

Program staff reported that attendance of the Greater Philadelphia Apartment Association conference was "the single best event for marketing". The program staff reported that the SMF Solutions team went from struggling to find leads to being swamped with leads in the following week. The program staff reported that interest in the program during this meeting has made the pipeline very strong and has built up a healthy backlog of direct install participants for PY6.

Program staff also noted that feedback from customers comment cards and the call center has been overwhelmingly positive. Customers emphasized that they are especially happy with the water heating measures and 9-watt CFL bulbs in bathrooms and that residents are impressed with how quickly the direct install team does their job. But most importantly, program staff reports the program has a good pipeline of projects for PY6 and should have no problem meeting PY6 goals. This pipeline is mainly a result of the Greater Philadelphia Apartment Association conference, which the program staff attended.

All program staff reported the main concern with the current program is getting customers to participate in the prescriptive portion of the program. The prescriptive channel is a specialized portion of the

program, as it only applies to the common areas within commercial MF buildings. One program staff mentioned a desire to see custom measures included in the program offerings as well as prescriptive measures offered to in-unit residents, such as programmable thermostats, and PTACs. The evaluation team looks forward to discussing the barriers for prescriptive participation with the customers as part of the PY6 evaluation work.

Due to the healthy backlog of direct install projects, the program staff has been able to focus their energy less on recruitment and more on prescriptive participation. One barrier to prescriptive participation noted by program staff is access to the decision maker. Generally, the site manager can make decisions about direct install measures, but the decision to install prescriptive measures is made by the property management firm or the building owners. Program staff noted that they have been working on making good relationships at the site level to break down this barrier.

Another concern of the program staff is problems with scheduling. For example, maintenance staff has canceled the direct-install appointment to attend to more pressing issues. The program is trying to overcome this problem by putting more effort upfront. One example given was they are now placing reminder calls leading up to the scheduled appointment.

Program staff noted that the only real cross-program coordination is for refrigerator measures for the low-income program. If the implementation staff determine a refrigerator qualifies, the information gets passed onto the LEEP team via PECO staff. The program staff reported that the implementation staff is doing a good job in sending along any leads they encounter and encouraging participation in other programs.

The program staff reported that the benchmarking feature has been slow to get started. Benchmarking is a marketing feature provided by Franklin Energy, which compares the participating building's performance against other similar buildings in PECO's territory. This value-added feature, provided by Franklin Energy, compares the participating building's performance data against similar buildings in PECO territory and identifies potential EE improvement measures. The benchmarking feature is offered to SMFCI and SMF government, nonprofit, and institutional (SMFGNI) customers with >50,000 sq. ft. of common space and for MF sites with >40 dwelling units. This feature provides the property managers and owners with a report detailing the potential EE measures feasible at the facility, in addition to the comparison of building performance. Program staff reported that there was one pilot property that agreed to participate during PY5, but due to staff turnover, the property was no longer interested in participating.

10.5 Recommendations for Program

The recommendations from the PY5 evaluation are summarized in Table 10-5 below. The evaluation team looks forward to researching SMFRES segment specific findings to make actionable recommendations as part of the PY6 evaluation work.

Table 10-5: SMF Solutions – Residential Segment Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should consider the following cross-cutting recommendation: PECO's program managers need to track the program goals and attainment targets against the plan while holding the CSP accountable for program performance. This will ensure that PECO is on track to meet the sector- and segment-specific EE&C plan targets.	Implemented. PECO continuously monitors program performance relative to Plan and makes adjustments as warranted.

Source: Navigant analysis and PECO

During the course of the interviews, program staff indicated that there is no tracking of the success of the coordination with other PECO programs. The evaluation team suggests that PECO consider the following ideas to enhance cross-program coordination:

- PECO program managers should work with the CSP staff to look for opportunities to promote participation in other programs. PECO program managers for similar program sectors (e.g., SHR and SMF) should be communicating regularly to know what is going on in each other's programs and how they can support each other. PECO program managers should leverage the on-site scoping audits conducted as part of the pre-installation visit to identify the potential for installation of cross-program measures.
- PECO program managers should track the conversion rate of SMF Solutions program generated leads into installed projects under other programs. This will help PECO measure and control cross-program coordination.

10.6 Financial Reporting

The PY5 TRC ratio for the residential component of the SMF Solutions program was 1.83, showing that the program was cost effective. A summary of program finances, including the breakout of costs and benefits for the residential segment, is shown in Table 10-6.

Table 10-6: Summary of SMFRES Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	0	0
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	958	958
Marketing[2]	*18*	*18*
Subtotal EDC Implementation Costs	**976**	**976**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	976	976
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**976**	**976**
Total NPV Lifetime Energy Benefits	**1,595**	**1,595**
Total NPV Lifetime Capacity Benefits	**69**	**69**
Total NPV TRC Benefits[6]	**1,786**	**1,786**
TRC Benefit-Cost Ratio[7]	**1.83**	**1.83**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Evaluation Team Analysis

11 Smart Equipment Incentives - Commercial and Industrial

PECO launched the SEI program in Phase I and has continued the program into Phase II. PECO filed the SEI program with the Pennsylvania PUC as two programs targeting different nonresidential customer segments. The SEI C&I program targets the commercial and industrial segment while the SEI GNI program targets the government, nonprofit, and institutional segment. The program offers incentives for projects with prescriptive measures (e.g., lighting and variable frequency drives) and custom projects. A main goal of the SEI program in Phase II is to encourage the installation of efficient non-lighting equipment. This section focuses primarily on the SEI C&I program.

SEI implementer DNV GL completed 329 C&I retrofit projects in PY5. In addition, C&I customers completed 43 projects through the SAR program. Eighty-two percent of total SEI PY5 energy savings came from lighting measures, including lighting controls. Navigant's impact evaluation, which included file reviews, phone verification, pre-installation site visits, and post-installation site visits, resulted in a realization rate on the energy savings of 1.12 for the SEI C&I program. Total verified gross savings were 31,546 MWh for the SEI C&I program, 56 percent of the PY5 SEI C&I target of 55,941 MWh. The program did not meet the goals primarily due to a slow start to the Phase II marketing and outreach efforts. Navigant's analysis of free ridership and spillover determined a NTG ratio of 0.7 for the C&I sector using the SWE methodology.

Program expenditures for SEI C&I in PY5 totaled $6.4 million, approximately 63 percent of the PY5 budget of $10.2 million. The PY5 TRC benefit-cost ratio achieved for SEI C&I was 2.11.

11.1 Program Updates

The SEI program changed the program requirements in PY5 to require a pre-application for all projects. PECO is now staffing specific managers and engineers on projects based on their project type or industry, which aims to create longer term relationships with customers.

11.1.1 Definition of Participant

Each participant of the SEI C&I programs is defined by a completed project. Each project may include the installation of one or more measures, and each can be of different measure types.

11.2 Impact Evaluation Gross Savings

Overall, the program achieved gross realization rates of 1.12 for energy and 1.05 for demand. The program-level relative precision was just slightly over the 15 percent target (15.7 percent relative precision at 85 percent confidence interval) for the energy and slightly over for the demand estimate (15.1

percent relative precision at 85 percent confidence interval). Table 11-1 shows the reported results for the C&I program.

Table 11-1: Phase II SEI – C&I Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	N/A	N/A	N/A	N/A
Low-Income	N/A	N/A	N/A	N/A
Small Commercial and Industrial	N/A	N/A	N/A	N/A
Large Commercial and Industrial	372	28,268	4.99	$2,178
Government, Non-Profit, and Institutional	N/A	N/A	N/A	N/A
Phase II Total	**372**	**28,268**	**4.99**	**$2,178**

Source: Navigant analysis and program data

The sample design for PY5 SEI retrofit projects used stratified ratio estimation similar to the method used in PY1–PY4. Based on a combined paid annual population of 329 C&I retrofit projects, the final verified sample size was 29 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 exceed the required 85/15 confidence and precision at the program level with coefficients of variation chosen to reflect the PY4 achieved relative precision targets.[49]

Navigant also added extra sites as a buffer to the minimum sample size to meet the 85/15 confidence and precision level. The evaluation team determined the number of buffer sites per stratum by calculating the necessary sample size to achieve 85 percent confidence and 15 percent precision as well as 90 percent confidence and 10 percent precision. Navigant chose the number of buffer sites to be roughly 2/3rds - 3/4ths of the difference between the counts needed under these two scenarios. Three additional projects that received pre-installation site visits are also included in the program-level realization rate, two in the Medium stratum and one in the large stratum.

The strata boundaries were defined with Q1 data and Q2 data, and later revised to include Q3 data. The boundaries were defined to include approximately the top 33 percent of reported kWh savings in the

[49] Navigant designed the SEI C&I sample with an assumed CV of 0.5 for all strata based on the PY4 CVs of 0.23 for the large stratum, 0.31 for the medium stratum, and 0.38 for the small stratum. However, the calculated PY5 CVs based on the evaluation were much higher than in PY4 or in the design for the small stratum. The CVs based on the PY5 evaluation were 0.11 for the large stratum, 0.30 for the medium stratum, and 0.98 for the small stratum.

large stratum, the middle 33 percent of reported kWh savings in Medium stratum, and the lower 33 percent of reported kWh savings in the Small stratum. The sampling strategy used in PY5 is presented in Table 11-2.

Table 11-2: SEI – C&I Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Stratum 1 – Large projects	8	85/15	7	7	On-site Verification
Stratum 2 – Medium projects	38	85/15	12	14	On-site Verification
Stratum 3 – Small projects	283	85/15	10	11	On-site Verification and phone verification
Program Total	**329**	**85/15**	**29**	**32**	

Source: Navigant analysis and program data

The sample was pulled in three stages: after Q2 using both Q1 and Q2 data, after Q3, and after Q4. During each stage, the sample design was reviewed and adjustments 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 PY5. The percentage of total samples 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 98 percent of aggregate program savings. The team determined that sampling from the smallest projects representing the bottom 2 percent of aggregate program savings would be of limited value to the program evaluation.

The team also worked to mitigate systematic uncertainty in the PY5 evaluation. The sources, examples, and strategies to mitigate systematic uncertainty are listed below.

- **Source**: On-site metering
  Examples: Uncertainty in the metering device itself, equipment placement, poor calibration
  Strategies to Mitigate: Systematic uncertainty could have been found in the placement of lighting loggers for lighting logger studies. If the lighting loggers were not correctly placed they may have been influenced by alternative lighting sources including none-program incentivized lighting or natural sunlight. To mitigate against this uncertainty, Navigant reviewed all logger data to ensure that it was reasonable. Navigant also decided to not use certain logger data for PECO-13-05365 because the information was not reasonable with normal lighting use. Navigant ensured against systematic uncertainty in equipment by utilize experienced field staff to deploy and ensure metering equipment was installed correctly.

- **Source**: Survey design
  Examples: Incomplete information collected on-site, leading survey questions
  Strategies to Mitigate: Systematic uncertainty could have been found in the collection of information while on-site. To prevent against any potential information lost, Navigant followed up with the customer on any uncertain items such as HOU, baseline questions, etc.
- **Source**: Human error during site visits
  Examples: Forgetting to complete a key field on the field form
  Strategies to Mitigate: Systematic uncertainty could have been found in the information gathered while on-site. To prevent against this, Navigant trained their field staff before completing on-site visits as well as reviewed field forms to ensure that all proper information was collected from the field staff.
- **Source:** Sample design
  Examples: Non-coverage errors, non-response bias, self-selection bias
  Strategies to Mitigate: Navigant solicited the help of PECO on contacting a few of the sampled sites including PECO-13-04786, PECO-14-05495, and PECO-13-05262. Navigant reviewed the sampled sites to ensure that it was representative of the entire population. Only one of the 61 sampled sites was not verified due to an inability to contact the customer. This particular site did respond to Navigant's contacts at first but indicated that the person responsible for the retrofit was no longer with the company and the new contact was not comfortable answer the questions because they were not employed until after the retrofit was completed.

The evaluation team verified gross impacts for demand and energy 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 and IMPs approved by the Pennsylvania PUC through the SWE team. The impacts for deemed measures 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.

The TRM or approved IMP provided the algorithms and default assumptions for calculating the impacts and the variables to be verified for partially deemed measures. 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. The evaluation team conducted an application and file review and developed a site-specific M&V 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 an SSMVP, and conducted a

site visit. The primary difference was that there were no deemed variables and all custom measures followed an enhanced rigor level of effort.

Navigant used the following three main approaches for evaluating the sampled projects: desk reviews, phone verifications, and on-site M&V. For all projects, Navigant completed a desk review. The team carefully reviewed all project documentation and the SIDs tracking database for each sampled project.

Desk Review

All projects underwent a desk review. In addition, the project documentation had to be complete and could be used to verify the measures installed. The desk review made use of project applications, associated calculations, and submitted invoices and specification sheets. Measures included lighting, HVAC, motors, variable frequency drives, and custom projects.

PECO provided project-specific analysis files, invoices, specification sheets, and other retrofit documents for the sampled projects so the evaluation team could conduct the reviews. Documentation included scanned files of hard-copy application forms and supporting documentation from the applicant (e.g., ex ante impact calculations, invoices, and measure specification sheets), CSP inspection reports, photos of installed measures, and important email and memoranda.

Phone Verification

Navigant conducted a phone verification for projects that met the following requirements to supplement the desk reviews: 1) the project was a small, partially deemed project where the TRM or an IMP applied; 2) the project had relatively small savings (i.e., those in small stratum); and 3) the project documentation was complete and could be used to verify that the measures were installed. Navigant completed a phone verification for two projects in the sample to verify measure installation. For these sites, the primary objective of the phone verification was to collect the data identified in the SSMVP, including verification of installed quantities and type, equipment nameplate data, operating schedules, and a careful description of site conditions. Navigant achieved the verification through verbal inspection of the measures and by interviewing the customers.

On-Site M&V

Navigant conducted an on-site verification for projects in the large and medium stratums as well as small stratum that did not meet certain requirements to supplement the desk reviews. Navigant visited 30 of the 32 projects in the sample (nine of the 11 small projects, 14 of the 14 medium projects and seven of the seven large projects) to verify measure installation. For the majority of the sites, the primary objective of the visits was to collect the data identified in the SSMVP, including verification of installed quantities and type, equipment nameplate data, operating schedules, and a careful description of site conditions. Navigant achieved the verification through visual inspection of the measures and by interviewing the customers. For six projects, Navigant also installed data loggers to measure run-time hours and energy

consumption. Warren Energy Engineering, Mondre Energy, and Navigant completed on-site verifications. Navigant found various discrepancies while on-site. These discrepancies are detailed in the Table 11-3 below.

Table 11-3: SEI – C&I On-Site Discrepancies

Category of Change	C&I - Small	C&I - Medium	C&I - Large
Baseline Equipment Quantities	3	1	0
Post-Retrofit Equipment Quantities	3	2	1
Building Type	0	0	0
Space Cooling	3	1	1
Hours of Use	6	13	6
Coincidence Factor	4	6	2
Space Cooling HVAC Interaction Factor	1	1	1
Baseline Equipment Specifications	3	2	0
Post-Retrofit Equipment Specifications	4	8	4
Claimed Heating Savings	0	0	0
Measure Type Change (e.g., TRM vs. custom)	1	0	0
Other	0	0	1
Program Total	**28**	**34**	**16**

Note: Values in tables are number of sites.

Source: Navigant analysis

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 the SWE's requirements for each project.[50] These requirements align with the PJM peak demand period defined as 2:00-6:00 p.m. on non-holiday weekdays during June, July, and August. The evaluation of PY5 projects included a review of program-tracking data and supporting documentation (e.g., invoices, spec sheets) before developing an 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

[50] The SWE requirements were detailed in a February 11, 2014, memo titled *GM-022 Peak Demand Savings for PY5*.

measurements, run-time hour data logging, and post-installation interval metering depending on the needs of the project. The evaluation team utilized customer-supplied data from an emergency management system (EMS) or supervisory control and data acquisition systems when available. In addition, the team requested billing data for some projects from PECO on a monthly or 15-minute interval basis, depending on the site.

The summaries of evaluation results for energy and demand are presented in Table 11-4 and Table 11-5, respectively.

Table 11-4: Program Year 5 SEI – C&I Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
C&I - Large	8,307	0.98	8,168	0.11	2%
C&I - Medium	9,748	1.24	12,077	0.30	10%
C&I - Small	10,170	1.11	11,258	0.98	45%
Smart App Rec Commercial	43	1.00	43	N/A	N/A
Program Total	**28,267**	**1.12**	**31,546**	**N/A**	**15.7%**

Source: Navigant analysis and program data

Table 11-5: Program Year 5 SEI – C&I Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
C&I - Large	1.13	0.99	1.11	0.21	5%
C&I - Medium	1.81	1.20	2.17	0.29	10%
C&I - Small	2.04	0.96	1.97	0.89	44%
Smart App Rec Commercial	0.01	1.00	0.01	N/A	N/A
Program Total	**4.99**	**1.05**	**5.26**	**N/A**	**15.1%**

Source: Navigant analysis and program data

The key recommendations from this section are listed below.

- **Recommendation #1: DNV GL should review the TRM and train staff on the use of the TRM.** Staff should be more careful when selecting the reported HOU and CF as roughly half of the sampled projects had adjustments to both HOU and CF. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but

TRM-deemed HOU were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.

- **Recommendation #2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations.** DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus QC on the HOU and CF for lighting projects and the motor nominal efficiency for variable frequency drive (VFD) projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings.

11.3 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 Navigant calculated gross program impacts, the team derived net program impacts by estimating a NTG ratio that quantifies the percentage of the gross program impacts that can reliably be attributed to the program. Once the evaluation team estimated free ridership and spillover, Navigant calculated the NTG ratios as 1 – Free Ridership Rate + Spillover Rate. Table 11-6 shows the sample design for the PY5 NTG research.

Table 11-6: SEI – C&I Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries (kWh)	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[51] to Achieve Sample
Large	>2,000,000	2	0.5	85/15	1	1	100%
Medium	275,000 to 2,000,000	19	0.5	85/15	5	5	89%
Small	<275,000	145	0.5	85/15	13	13	85%
Program Total		**166**	**0.5**	**85/15**	**19**	**19**	**86%**

Source: Navigant analysis

[51] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

During Phase II, the evaluation team used a different approach to estimate free ridership than the Phase I approach due to SWE requirements. For comparisons purposes, Navigant estimated free ridership in PY5 using both the Phase I and Phase II approaches. The Phase I approach uses three scores to estimate free ridership: (1) timing and selection, (2) program influence and (3) no program. The Phase I approach does not assign a value to "don't know" answers whereas the Phase II approach uses two scores to estimate free ridership: (1) intention and (2) influence. The Phase II approach does account for "don't know" answers. Navigant explains both methodologies below.

Free-Ridership Assessment – Phase II Approach

The team assessed free ridership using a customer self-report approach following the Research Into Action and ETO framework.[52] This approach uses a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the ETO methodology, the free- ridership analysis included the following two elements of free ridership: 1) *intention* to carry out the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient project.

The total free ridership score illustrated in Equation 11-1 is the sum of the intention and the program influence scores, resulting in a score ranging from 0 to 100. This score is divided by 100 to convert it into a proportion for application to gross savings values.

Equation 11-1. Total Free Ridership

$$Free\ Ridership\ (FR) = \frac{Intention\ Score + Program\ Influence\ Score}{100}$$

Intention Score

The intention score was assessed through several brief questions used to determine how the upgrade or equipment replacement likely would have differed if the respondent had not received the program assistance. The initial question asked the respondent to identify, out of a limited set of options, the option that best described what most likely would have occurred without the program assistance. Note that "program assistance" often includes more than just the incentive – it may also include audits, technical assistance, and the like. The offered response options (typically four or five, and preferably no more than six) captured the following four general outcomes:

1. Would have canceled or postponed the project, upgrade, or purchase
2. Would have done something that would have produced savings, but not as much as those achieved through the upgrade or equipment replacement as implemented

[52] Jane Peters and Ryan Bliss, Research Into Action Team, *Common Approach for Measuring Free Riders for Downstream Programs*, October 4, 2013.

3. Would have completed the upgrade or equipment replacement as implemented
4. Don't know

The algorithm does consider respondents who said they would have canceled or postponed the project as free riders in terms of intention (a score of 0 for the intention score). The approach did consider respondents who indicated they would have done something that would have resulted in less energy savings as partial free riders in terms of intention (free ridership ranging from 12.5 to 37.5 for the intention component in the case of nonresidential programs). The respondents that indicated they would have undertaken the project as implemented without the program received a score based on how they would have paid for the upgrade. "Don't know" responses were assigned the midpoint score of 25 for the intention component.

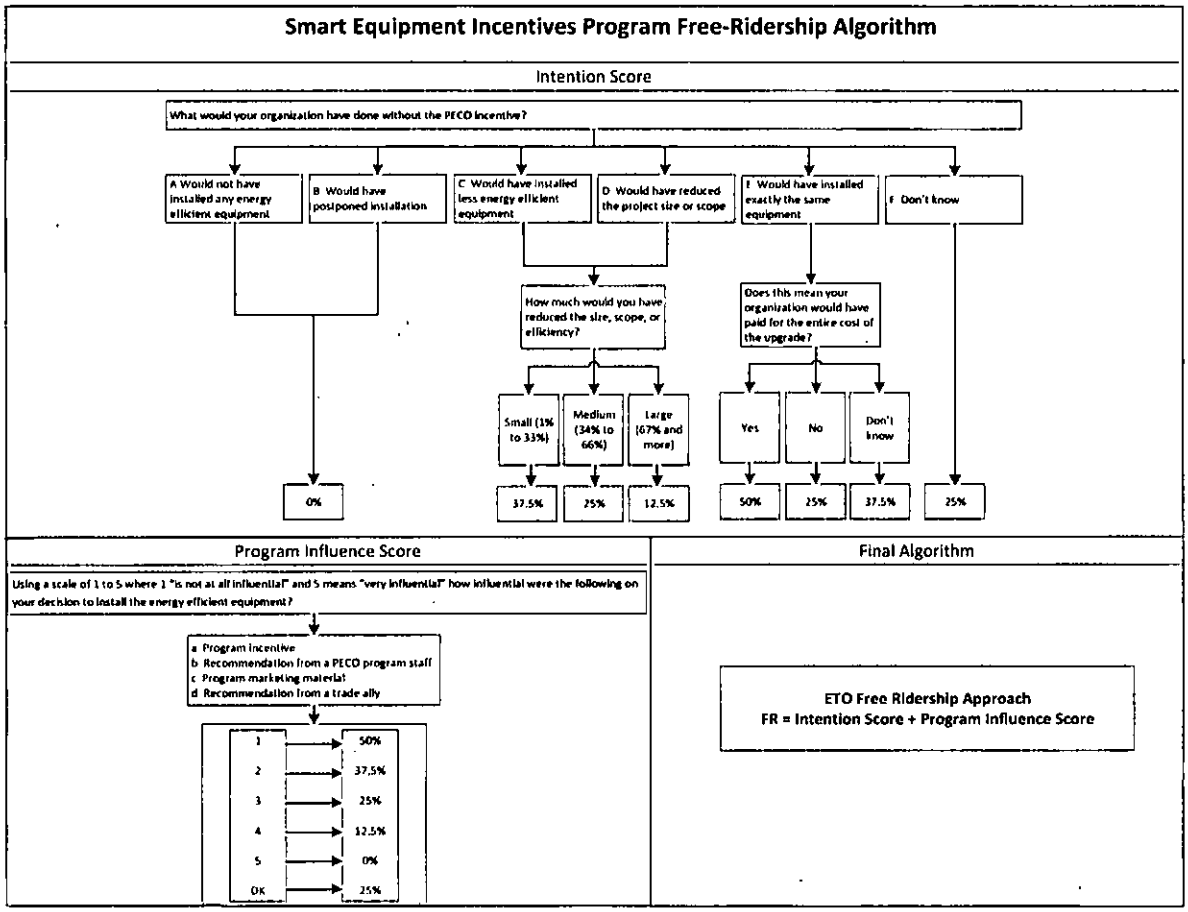
Program Influence Score

To assess the program influence score on the participant's decision to implement energy efficiency improvements, Navigant asked respondents how much influence – on a scale of 1 (no influence) to 5 (great influence) – various program elements had on the decision to implement the project. The elements used to influence customer decision making included program information, program incentives, interaction with program staff (technical assistance), and interaction with program proxies, such as members of a trade ally network.

A participant's program influence score was then set to the participant's maximum influence rating for any program element. The rationale was that if any given program element had a great influence score on the respondent's decision, then the program itself had that level of influence, even if other elements had less influence. The program influence score and free ridership have an inverse relationship: the greater the program influence, the lower the free ridership and vice versa.

Figure 11-1 summarizes both the intention score and program influence score calculations for the SEI program. The figure shows the possible response combinations to the questions described in the intention score section and the value assigned to each unique combination. In addition, it shows the program influence score and possible answers to the five-point scale along with the "don't know" answers.

Figure 11-1: Phase II Free-Ridership Algorithm



Source: Navigant analysis

Free-Ridership Assessment – Phase I Approach

Navigant also assessed free ridership 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 surveys concerning the following three items:

A **Timing and Selection** score that reflects the influence of the most important various program and program-related elements on the customer's decision to implement the specific program measure at this time.

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 customer's

decision to implement the specific program measure. This approach cuts the score in half if the customer learned about the program after they decided to implement the measures.

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 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 PY5 projects, if applicable.

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

Spillover Approach

Spillover occurs when there are reductions in energy consumption or demand caused by the presence of the energy efficiency program, but which the program does not directly influence. The evaluation team asked program participants a battery of questions to quantitatively assess spillover. This approach applies to both free-ridership methodologies - Phase I and Phase II. 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. To the best of your knowledge, do you know when you installed the additional energy-efficient equipment?
3. Could you describe the energy efficiency measure installed?

4. 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.)
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?

The battery of questions attempted to quantify all the savings from additional non-incented equipment installed after the respondent's participation in the program. Additionally, the evaluation team included a question about the level of influence the program had on the respondent's decision to install the additional measures. An example of the question is below.

1. On a 0 to 5 scale, with 0 meaning "not at all influential" and 5 meaning "extremely influential," how influential was your experience with PECO's program in your decision to install the additional energy-efficient equipment?

The team assigned the influence rating a value, which determined what proportion of the measure's energy savings were attributed to the program:

- A rating of 4 or 5 = 1.0 (full savings attributed to the program).
- A rating of 2 or 3 = 0.5 (half of the savings attributed to the program).
- A rating of 0 or 1 = 0 (no savings attributed to the program).

Where applicable, Navigant calculated the savings for each additional measure installed per the TRM. For measures not included in the TRM, the evaluator may conduct a brief engineering analysis to assess savings or to identify an alternative source and methodology for assessing savings.

Navigant calculated spillover for measures reported as the product of the measure savings, number of units, and influence score, as illustrated in Equation 11-2. Navigant calculated all spillover estimates using customer self-reported data and did not conduct follow-up interviews or site visits.

Equation 11-2. Spillover Savings from Installed Measures

$$Measure\ SO = Measure\ Savings * Number\ of\ Units * Program\ Influence$$

For each of the above categories, the evaluators then totaled the savings associated with each program participant, to give the overall participant spillover savings reflected in Equation 11-3.

Equation 11-3. Overall Participant Spillover

$$Participant\ SO = \Sigma Measure\ SO$$

The team then multiplied the mean participant spillover savings for the participant sample by the total number of participants to yield an estimated total participant spillover savings for the program. Equation 11-4 shows the algorithm used to calculate spillover for the program.

Equation 11-4. Spillover Savings for the Program

$$\Sigma Participant\ SO\ (population) = \frac{\sum Participant\ SO\ (sample)}{Sample\ n} * \text{Population } N$$

Finally, the team divided the total savings by the total program savings to yield a participant spillover percentage, as shown in Equation 11-5.

Equation 11-5. Participant Spillover Percentage

$$\%\ Participant\ SO\ = \frac{\sum Participant\ SO\ (population)}{Program\ Savings} * 100$$

NTG Findings

The results from the NTG research using the Phase I free-ridership approach and the spillover approach are shown in Table 11-7. The PY5 SEI C&I NTG ratio is 0.7.

Table 11-7: Program Year 5 SEI – C&I Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Large	0.3	0.03	0.8	0.5	0%
Medium	0.3	0.03	0.7	0.5	17%
Small	0.4	0.03	0.6	0.5	21%
Program Total[53]	0.3	0.03	0.7	0.5	8%

Source: Navigant analysis

In PY5, the Navigant team analyzed the responses of the online survey where spillover was identified based on participant responses to a battery of spillover questions. Navigant designed these questions to identify those cases where spillover was possible and to quantify the self-reported energy and demand savings from the spillover equipment installation.

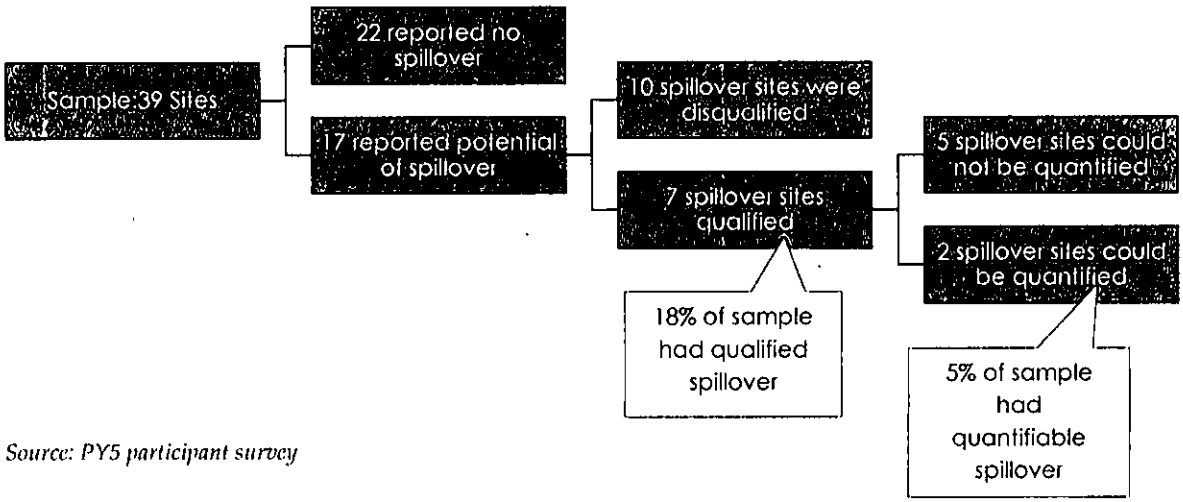
As shown in Figure 11-2, the Navigant team determined that of the 39 participants surveyed, 17 reported installing additional energy-efficient equipment. Out of the 17 participants, 6 either were not sure about

[53] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

whether they were going to receive an incentive for the additional equipment installed or did receive a PECO incentive. One participant said the project is still under development. Three participants said the program was not influential in their decision to install the additional energy-efficient equipment. Five participants did not give enough information to estimate energy savings.

While the spillover evaluation revealed a high percentage of self-reported activity, only two participants provided enough information to quantify spillover; the spillover calculated was 0.03.

Figure 11-2: PY5 Spillover



Source: PY5 participant survey

Based on the net-to-gross research findings in PY5, the evaluation team will plan to use the SWE framework (Phase II approach) to calculate NTG in future program years. The Navigant team observed significant differences in NTG ratios between the Phase I and Phase II approaches. The Phase II ETO approach is a simpler method with less opportunity for inconsistent answers to key questions. Navigant recommends that PECO utilize the ETO approach in future program years. However, the team recommends adding a control question to summarize answers to the intention and influence questions, which would allow the team to correct inconsistent answers.

11.4 Process Evaluation

The evaluation team conducted multiple research activities in support of the process evaluation. The evaluation team evaluated the C&I and GNI participant groups together; thus, the results of the process evaluation are presented identically in both annual report sections. The research activities included the following:

1. Program materials review
2. Program theory and logic model development

3. Tracking system review
4. Verification and due diligence review
5. Primary data collection
    a. Interviews with the PECO program management staff and implementation contractor staff
    b. Online and telephone surveys with 19 participating C&I customers and 20 participating GNI customers
    c. Web-based online focus groups with 15 participating and non-participating contractors
    d. Attendance of a PECO-sponsored Trade Ally Advisory Council Dinner

Program Materials Review

The evaluation team reviewed marketing and outreach materials available on the program's website,[54] as well as PECO-developed program sell sheets and quick reference guides for both the C&I and GNI sectors and the Strategic Marketing and Outreach Plan developed by DNV GL. The team also completed a detailed review of the online program application and program and trade ally materials. Finally, the evaluation team reviewed the Program Operations Manual, the DNV GL Database transformation manual, and QC Checks documents.

The PECO website redirects the user to an easy-to-navigate page that allows the customer to select from a number of residential and commercial programs and rebates. Information on the SEI web page includes FAQs, brief explanations of the types of equipment eligible for rebates, a program library containing presentations and additional program resources, links to program Trade Allies, and electronic/online versions of program applications. The website also features additional customer support resources, including a toll-free phone number (1-888-5-PECO-SAVE or 1-888-573-2672) and an email hotlink (PECOSmartIdeas@kema.com).

Program Theory and Logic Model

The main goal of the SEI program is to achieve energy savings that will contribute to achieving the company's demand-side management goals by installing energy efficiency measures at nonresidential sites. This could include businesses as well as nonprofits and government and municipal facilities.

This section provides a summary of the barriers, activities, and outcomes for the PECO SEI program. Navigant's complete program theory and a logic model memo for the SEI program as it currently operates were provided to PECO.

[54] www.peco.com/smartideas.

Barriers

Target participants face a significant first-cost barrier when attempting to implement energy efficiency measures. Many target customers do not have available budget to spend on energy efficiency upgrades. Lack of awareness of the SEI program and their financial and technical support is another related barrier. Lastly, many customers lack awareness of energy efficiency opportunities in their facilities. Target customers, especially small to medium-size customers who do not have a facilities engineer or staff, do not know of all of their options to reduce energy use and cost, nor which options are the most cost effective.

Activities

The purpose of the SEI program is to educate and assist eligible target customers with making their facilities more energy efficient. The program reaches eligible customers through activities designed to influence them to take actions that ultimately generate energy savings. A summary of these activities is as follows:

- Conduct outreach to program participants
- Develop information and program collateral
- Conduct outreach to contractors and suppliers
- Provide rebates for qualifying measures

Outputs and Outcomes

It is important to distinguish between outputs and outcomes. For the purposes of the logic model, Navigant defines outputs as the immediate results from specific program activities. These results are typically easily identified and can often be counted by reviewing program records. An example for the PECO SEI program would be the rebates paid for energy-efficient measures installed through the program. Outcomes are distinguished from outputs by their less direct (and often harder to quantify) results from specific program activities.

Outcomes represent anticipated impacts associated with PECO's program activities and will vary depending on the time period being assessed. An example would be energy and demand savings. On a continuum, program activities will lead to immediate outputs that, if successful, will collectively work toward achievement of anticipated short-, intermediate-, and long-term program outcomes. A summary of these outcomes follows:

- Increase awareness of energy savings opportunities/assist customers in acting on those opportunities
- Increase consumers' awareness and understanding of the breadth of energy efficiency opportunities in their facilities
- Support the development of a robust market of energy efficiency service providers

- Overcome financial barriers
- Strengthen customer trust in PECO
- Promote customer successes
- Develop a robust network of trade allies to promote energy-efficient measures to their customers
- Target customers who install energy-efficient measures and receive rebates
- Encourage customers to pursue a comprehensive set of energy efficiency measures
- Make significant contributions to attainment of PECO's energy savings goals

Tracking System Review

PECO uses the SIDS to track their portfolio of programs. The evaluation team received tracking data, an extraction from the PECO online database, electronically on a quarterly basis. The evaluation team used the tracking system to complete both the impact and process evaluations. The team used the tracking system for designing the impact and process samples and the inputs for the cost-effectiveness test. The tracking data used to develop the final impact evaluation results was a combination of all quarterly extracts.

This year's tracking system included a new naming convention for easier use. Descriptive names replaced numerical identifiers as the naming convention for the spreadsheet's tabs. The new naming convention more clearly identified the type of information contained in each tab. As an example, the tab previously labeled "100" in Phase I was updated to "Customer" in PY5 and, as the name suggests, it contains customer information. In the same way, the tabs previously labeled "200" and "300" now read "Projects" and "Measures", respectively, and contained project- and measure-level data.

The evaluation team verified that the tracking system was consistent with the PY5 TRM. The evaluation team also verified that all data necessary for the evaluation was included in the tracking system. This included verifying that all columns that were relevant to the program and to the measures incented were filled in with data. Not all columns in the tracking system were relevant for all measures so some blank fields were expected; therefore, this step focused on verifying if any of the relevant data fields were blank.

The team also verified the accuracy of participation data entered into the tracking system. Navigant verified this with a review of the applications for the impact evaluation sample projects. Accuracy of data entry for projects that had been updated since the initial application was also verified by ensuring that new data included in supplemental project files were accurately entered into the tracking system. Finally, the team performed an engineering review of the inputs and outputs of the energy and demand impacts of the sample of projects to verify that the database was providing correct information.

The evaluation team identified several tracking system issues that PECO should consider addressing in order to improve the usability of the tracking system as the portfolio of programs continues into PY6 of Phase II. The findings, and some recommended steps for improvement, are listed below.

The evaluation team discovered various discrepancies between the project application files and the SIDS tracking data. In total, 21 of the 61[55] (34 percent) sample projects had discrepancies between the application files and the SIDS tracking data.

- Fifteen projects had discrepancies due to the different CFs in the application files and the SIDS tracking data.
- Four projects were determined to have discrepancies between the nominal efficiency in the application files and those in the SIDS tracking data.
- One of these projects had a discrepancy in the HOU used in the different data sources.
- One project was determined to have changed the fixture type and was updated in the application files but not in the SIDS tracking database.

The tracking system contained blank columns and inconsistent values. On many occasions, columns titled "Measure Quantity" and "Measure Size" were blank. This meant that the evaluation team was unable to verify the quantity of measures installed for a given project. There were other occasions where some information was populated, but it referred the user (the evaluation team, in this case) to specific project files instead of listing the data in the tracking system itself. This again meant that the evaluation team was unable to verify the quantity of measures unless we had specifically requested the project file referenced.

Additionally, columns titled "Measure Quantity Unit" and "Measure Size Unit" were filled in inconsistently, even for the same measure types. For example, sometimes the same lighting measures listed the measure quantity unit as "per fixture" and other times "per kWh saved". Knowing both data points is useful to the evaluation team, but many times only one or the other was provided. These inconsistencies made it difficult to compare quantities and savings among projects and customers.

The tracking system algorithm nomenclature did not always match that of the PY5 TRM. The inconsistent nomenclature made mapping the algorithms in the tracking system to the PY5 TRM more difficult. For example, if the algorithm nomenclature "kWbase" matched the tracking system "baseline kW", QC against the TRM would be made easier.

The tracking system had inconsistent measure type units. Descriptions of quantities for all measures that fall under the same measure types were not consistent. For example, the team reviewed data for occupancy sensors and found that the units used were "watts controlled," "watts reduced," "W," or "Watts." The tracking system used all four terms to describe the unit of measure.

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[55] During the impact evaluation, one of the sampled GNI Small projects could not be verified due to customer non-responsiveness. The final GNI evaluation sample did not include this site. Therefore, the team requested and reviewed documentation for a total of 61 projects, but completed the full evaluation on 60 projects.

There are significant discrepancies in customer names in the tracking system. While designing the samples, the evaluation team found significant discrepancies in the way a customer name was entered in the system multiple times. These discrepancies also happened with the contact person name and the contact information. For example, the same address was entered in different ways. These discrepancies made it difficult to identify unique customers. The team spent a significant amount of time developing new unique identifiers and matching similar names in order to design the sample.

IMP is not an option in the tracking system. The tracking system does not include "IMP" as an option to identify whether the measure is a TRM, IMP, or custom measure. The tracking system only includes the options TRM and custom.

The tracking system does not have fields that list details for the incremental cost including the source or the units used. In many cases, the incremental cost data are different than third-party sources. For instance, when reviewing an HVAC measure the tracking system had a value for incremental cost of "X"; however, it did not list the source of the value or the unit (e.g., per ton, per British thermal unit (BTU)). The team was able to deduce the cost per unit but it was not consistent with other sources.

The recommendations from the findings in this section include the following:

- **Recommendation #3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system.** This includes:
    - Ensuring that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings.
    - Developing a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct.
    - Ensuring that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.

Verification and Due Diligence

The evaluation team performed a verification and due diligence review for the SEI program, including a review of the program's quality assurance and savings verification procedures. The team conducted interviews with key PECO and DNV GL staff during December of 2013 and February of 2014. In three of these interviews, the evaluation team focused on the tracking systems and QA/QC procedures and scored

the program based on the metric definitions contained in the American Council for an Energy Efficient Economy Energy Efficiency Best Practices tool,[56] the results of which are shown in Table 11-8.

Table 11-8: QA/QC Best Practices Scorecard

ID	Best Practice	Score
1	Design program tracking system to support the requirements of evaluators as well as program staff	BP
2	Use Internet to facilitate data entry and reporting; build in real-time data validation systems that perform routine data quality functions	MA
3	Automate, as much as is practical, routine functions (e.g., monthly program reports)	MA
4	Develop electronic application processes	BP
5	Develop accurate algorithms and assumptions on which to base savings estimates	BP
6	Conduct regular checks of tracking reports to assess program performance	BP
7	Document tracking system and provide manuals for all users	BP
8	Base quality control on program's relationship with vendors, number of vendors involved, types of measures, project volume, and variability of project size	MA
9	Verify accuracy of rebates, coupons, and invoices to ensure the reporting system is recording actual product installations by target market	BP
10	Require pre-inspections for large or uncertain impact projects	BP
11	Conduct in-program measurement/impact evaluation for the very largest projects or those with uncertain impacts	BP
12	Assess customer satisfaction with the product through evaluation	BP
13	Build in statistical features to the sampling protocol to allow a reduction in the number of required inspections based on observed performance and demonstrated quality of work. Use a "good" random sample	BP
14	Use inspections and the verification function as a training tool for the market, especially for market transformation programs	MA

Note: Scores are Best Practice (BP), Meets Average (MA) or Below Average (BA).

Source: ACEEE tool. (http://www.eebestpractices.com/benchmarking.asp)

The evaluation found that PECO and DNV GL continue to refine their quality control procedures and incorporate recommendations into the QA/QC process. PECO and DNV GL have also continued to work to align their QA/QC, program tracking, and verification procedures with Pennsylvania requirements and guidance from the SWE.

The evaluation team's findings drawn from the verification and due diligence effort are listed below.

DNV GL and PECO have not fully automated data transfers between databases. Currently DNV GL transfers data monthly using a batch process. The evaluation team found discrepancies in the data transfer process (e.g., formatting issues, missing fields).

[56] http://www.eebestpractices.com/benchmarking.asp.

The Operations Manual is meeting quality assurance safeguards. The program's Operations Manual includes guidelines that generally meet expected quality assurance safeguards. The program is complying with the policies and procedures set forth in the Operations Manual, including criteria for project eligibility and collecting supporting documentation for projects.

PECO restructured implementer contracts based on verified gross savings and performance. For Phase II, PECO restructured the DNV GL contract to reflect performance towards goals. Under the new terms, PECO will pay DNV GL 80 percent of their administrative fees upfront but hold back the remaining 20 percent based on performance towards program goals, with 10 percent being paid on gross goals and another 10 percent on realized goals. There are also several penalties regarding such measures as call center performance and safety, which could carry a penalty of 1 percent each. Navigant suggests that PECO continue to monitor whether DNV GL is meeting their new contractual goals and determine whether these goals align with the actual goals of the program and of the entire portfolio.

PECO implemented an online application form in PY5. In Phase II, PECO and DNV GL rolled out a new web-based application where program participants and contractors can apply for incentives, view the status of applications, create company profiles, and apply to become a trade ally if desired. The web-based application site also contains a message center and live chat capability to encourage continued communication during the application process.

PECO and DNV GL added a section to the project summary invoice, which shows whether there are any variances in the imported DNV GL project data as compared to the invoice accompanying it (i.e., discrepancies in savings calculations). SIDS automatically alerts program managers via a hotlink on the summary invoice to variances in the project such as differences in savings estimates, incentive amounts, project application dates, and approvals, and allows them to click on the hotlink and go to the section of the project file where the discrepancy is and to investigate the issue. PECO does this by performing calculations on the monthly data import from DNV GL and comparing those calculations to the invoice submitted for the project. This allows for more transparency in the QA/QC process and program managers are able to see all the information about a particular project in one place. This practice ensures the program manager is more involved in the QA/QC process and has better information about the project he/she is approving.

The recommendation from the findings in this section is listed below.

- **Recommendation #4:** PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.

Primary Data Collection

Program Management and Staff Interviews

The evaluation team conducted three in-depth interviews with PECO staff and three in-depth interviews with key members of the SEI program implementation contractor team, DNV GL, during the months of December 2013 and February 2014. Navigant designed the interview guides to enable the evaluation team to ask questions about the program's administration and delivery during the program year (PY5) and also to obtain real-time information about current program activity through asking open-ended questions that created a free-flowing conversation. To aid in making these interviews informative, the evaluation team reviewed current program reporting documents, marketing plans and materials, and QC documents such as the KSIM Manual and DNV GL QC Checks documents.

Participant Survey

The evaluation team conducted an online survey of participating customers for both the SEI C&I and SEI GNI PY5 retrofit programs. The evaluation team supplemented the online survey with telephone surveys of four C&I and seven GNI customers who had not responded to the online survey. In total, the evaluation team completed 39 participating customer surveys: 28 online surveys, and 11 telephone surveys. Out of the 39 surveys, 19[57] surveys were with participating C&I customers and 20 surveys were with participating GNI customers. The team emailed all participants the survey and ensured the number of responses needed to meet a precision of ±15 at the 85 percent confidence level for the NTG results. The survey assessed all of the parameters necessary to calculate NTG ratios. Additional data was collected to support the process evaluation such as program design and implementation, program marketing and awareness, and customer satisfaction. Table 11-9 shows the sampling strategy for the participant survey effort.

[57] Two of the C&I participants did not fully complete the survey. One respondent completed only the net-to-gross battery and therefore is not included in the process analysis. The other respondent dropped out of the survey prior to completing the firmographics battery and is included in the process analysis and net-to-gross analysis.

Table 11-9: SEI – C&I Sampling Strategy for PY5 Process Evaluation

Target Group or Stratum (if appropriate)	Stratum Boundaries (kWh)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
Large	>2,000,000	2	0.5	85/15	1	1	100%	Online and phone survey
Medium	275,000 to 2,000,000	19	0.5	85/15	5	5	89%	Online and phone survey
Small	<275,000	145	0.5	85/15	13	13	85%	Online and phone survey
Program Total	N/A	166	0.5	85/15	19	19	86%	N/A

Source: Navigant analysis

Contractor Focus Groups

Navigant conducted focus groups with contractors participating in the SEI programs. The evaluation team held four groups with 15 participants across two evenings in July and August 2014. Navigant's goals for these events were to explore ways to motivate customer participation, gain insight into market forces influencing customer participation, elicit trade ally interests and needs, and discuss market effects associated with the program.

As seen in Table 11-10, each group highlighted specific segments of contractors participating in the SEI programs. Groups focused on ultra-savings generating contractors (i.e., those achieving savings over 500,000 kWh), large savings generating contractors (i.e., those achieving savings between 100,000 kWh and 500,000 kWh), small savings generating contractors (i.e., those achieving savings below 100,000 kWh), and non-participant contractors (i.e., those who completed projects in PY4, but did not complete any projects in PY5).

The evaluation team did not differentiate between contractors and trade allies when fielding the focus groups. PECO Smart Ideas trade allies are contractors, suppliers, energy service companies (ESCOs) or design professionals who have been educated on the program and have agreed to follow the program's rules and processes. Both trade allies and those who have not registered as trade allies are eligible to participate in the program. Of the 15 contractors participating in the focus groups, 6 (40 percent) were PECO Smart Ideas trade allies.

Table 11-10: Focus Group Participants by Group Type

Group Type	Number of Participants
Ultra savings (Over 500,000 kWh)	3
Large savings (100,000-500,000 kWh)	4
Small savings (Below 100,000 kWh)	4
Non-participants	4

Source: Navigant

Primary Data Collection Findings

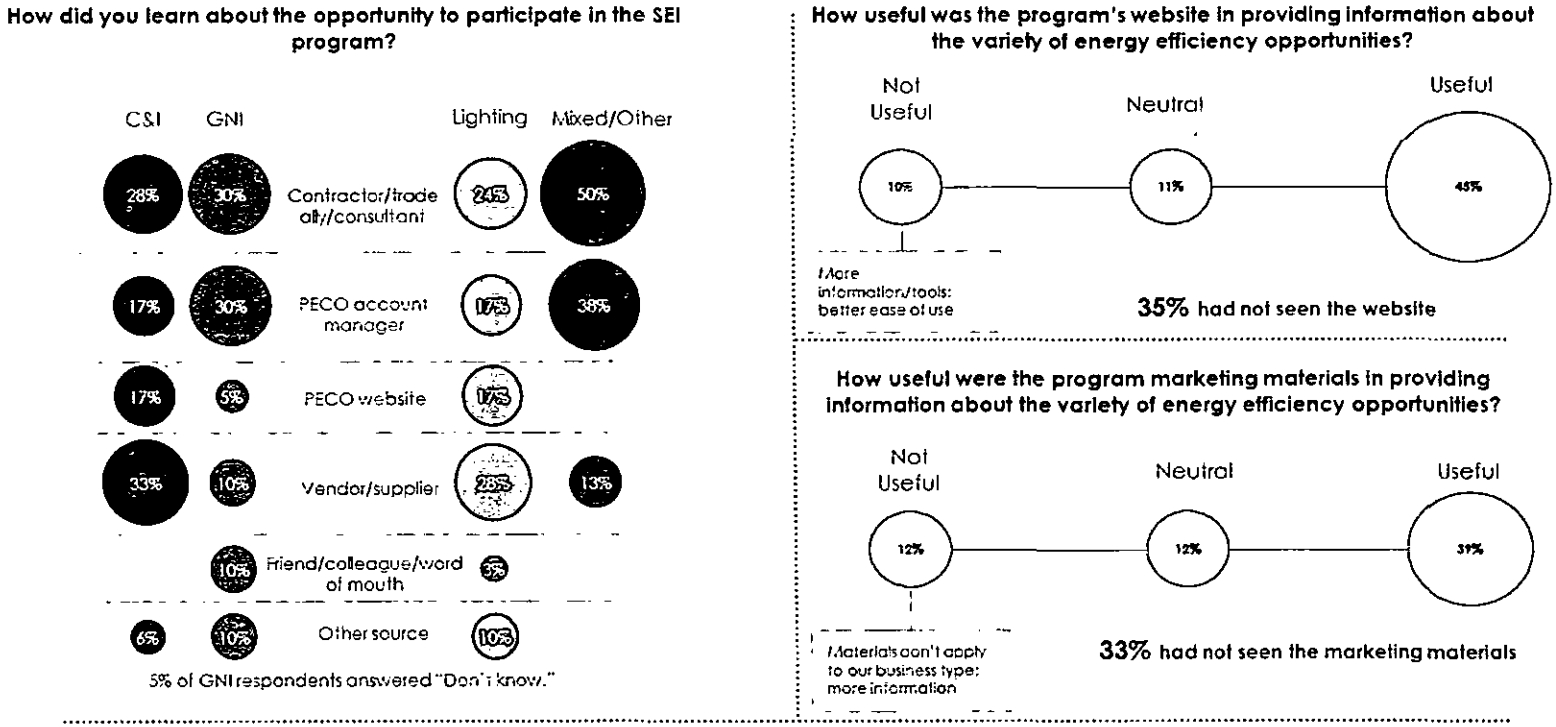
The process evaluation focused on program awareness and marketing, influence of payback on program participation, project development and influence opportunities, purchasing decisions and the influence of incentives on program participation, and market effects. Data sources for the process evaluation included a review of program materials, an online survey with 39 program participants (19 C&I participants and 20 GNI participants), four focus groups with 15 participating contractors, and six in-depth interviews, three with PECO program staff and three with the DNV GL program implementation team.

Percentages based on the online survey data illustrated in figures and tables as well as discussed in the text of this section are typically based on 38 responses (18 C&I respondents and 20 GNI respondents, which includes four C&I and seven GNI telephone responses), because one participant did not complete the process section of the survey. Some questions were asked only of some respondents and the percentages were calculated using these different bases. "Don't know" responses that are less than 4 percent are not included in our analysis. For all other cases, valid percentages are presented. The team noted differences among subgroups (i.e., C&I and GNI participants) when significant; the comparisons are not statistically significant if not noted. Figure 11-3 contains the answers to all survey questions. The sections below provide findings from the process evaluation.

Program Awareness and Marketing

Customer satisfaction with the SEI program continues to be high with 83 percent of C&I participants and 90 percent of GNI participants "very satisfied" with the program and 17 percent of C&I participants and 10 percent of GNI participants "somewhat satisfied" with the program. When asked for any additional comments or ways to improve the program, most respondents, regardless of type, were unable to offer any comments or suggestions; however, those with suggestions asked for greater responsiveness from the program citing long wait times for responses or inadequate responses. Figure 11-3 shows the responses from the participant survey on program awareness and marketing.

Figure 11-3: SEI Program Awareness and Marketing



Source: Participant survey

Customers reported hearing about the program from a variety of sources. Although statistically insignificant, C&I and GNI participants tended to cite alternative sources for first hearing about the SEI program. C&I participants tended to be made aware of the program by their vendors and suppliers (33 percent) and also their trade allies or contractors (28 percent), whereas GNI participants most often reported first hearing about the program from their PECO account manager (30 percent) and from trade allies or contractors (30 percent).

Program marketing is important to customers and contractors; however, those who have seen the website feel that it is being under-utilized. Thirty-five percent of participants claimed to have never seen the PECO website. In focus group discussions, a few contractors noted having difficulty in finding information on the website and particularly, finding information for PECO trade allies.[58]

Forty-five percent of participants reported that the website was useful in providing information about the variety of energy efficiency opportunities in their facility. Several focus group participants offered suggestions for ways to improve the website for both trade ally and customer use. Specifically, trade allies argued that PECO should expand the search options provided to customers looking for a contractor or consultant to allow users to search by trade ally specialty and by geographic area to make it easier for customers to connect with trade allies.

In terms of program marketing materials, 39 percent of participants felt that program marketing materials were useful in providing information about the variety of energy efficiency opportunities in their facilities. When asked for ways to make program marketing materials more useful, program participants generally asked for more descriptive materials as well as materials, like case studies, that appeal to uniquely positioned firms (e.g., heavy industrial or engineering firms).

Influence of Payback on Program Participation

Participants and contractors alike expressed concern over the payback period for projects. Required payback periods varied by customer type. Overall, about 72 percent of C&I participants preferred a payback period of three years or less compared to 65 percent of GNI participants who could complete a project with a payback period of five years or less.

Among contractors there were also differences related to expected payback periods. Most indicated preference for shorter payback periods (i.e., three years or less); although a few contractors claimed that payback periods under five years were within the range they try to target for their customers. One contractor summed it up this way:

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[58] PECO Smart Ideas trade allies are contractors, suppliers, energy service companies (ESCOs) or design professionals who have been educated on the program and have agreed to follow the program's rules and processes. Both trade allies and those who have not registered as trade allies are eligible to participate in the program.

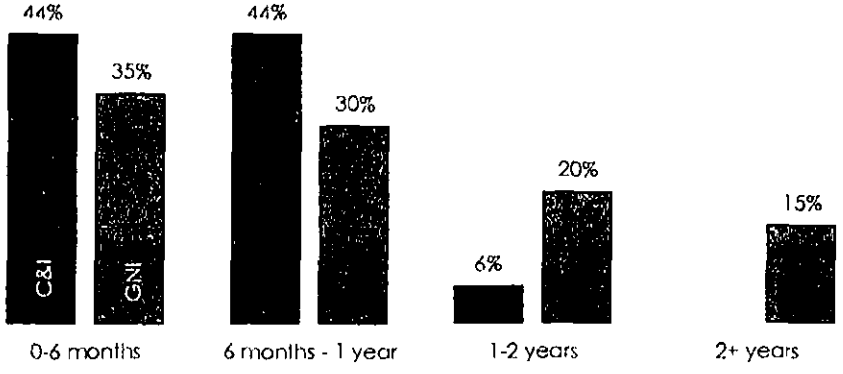
"I think three years is probably it for industrial customers or sometimes you can get maybe a bit higher, maybe five years, for a commercial customer, but they like to see something fairly quick."

Project Development and Influence Opportunities

Figure 11-4 shows the results from the surveys for the project development process and the point at which PECO could have influenced project design decisions. For both participant types, the time from project development to completion was typically less than a year. Nearly half (44 percent) of C&I participants cited a time period under six months compared to 35 percent of GNI participants. In terms of when PECO could intervene and influence design decisions, participants indicated the planning and the budgeting segments of the process would be preferred.

Figure 11-4: Project Development Process and PECO Influence

How long does it take to develop a project?



6% of C&I respondents answered "Don't know"

At what point could PECO have influenced project design decisions?

C&I
0 - 6 months: 44%
6 months - 1 year: 6%
Involvement by PECO would not influence our decision: 17%
Don't know: 33%

GNI
0 - 6 months: 20%
6 months - 1 year: 20%
1 - 2 years: 5%
Involvement by PECO would not influence our decision: 40%
Don't know: 15%

PECO's influence is greatest during planning and budgeting.

Source: Participant survey

When asked about the timing of potential intervention, C&I participants claimed that PECO could influence design decisions within the first six months of the projects (44 percent); however, a third (33

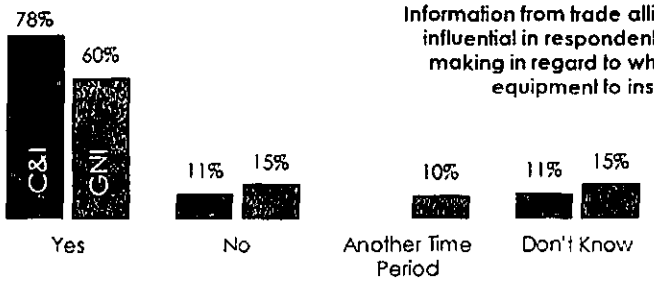
percent) indicated that they did not know when would be the best time to provide guidance. Interestingly, for GNI participants, 40 percent said that involvement by PECO would not influence their design decisions, which could result from more budget constraints, in terms of timing and availability of funds. Given that nearly all C&I participants claim that the time to develop a project from planning to completion is less than a year (88 percent), the opportunity to influence C&I participants is somewhat limited and certainly contingent on the timing of intervention. For GNI participants, the timeline for project completion was more varied with 65 percent citing less than a year and a third (35 percent) indicating that the projects could take a year or more to complete.

Purchasing Decisions and the Influence of Incentives on Program Participation

According to program participants, opportunities exist for PECO to impact subsequent equipment purchasing decisions with over three-quarters (78 percent) of C&I participants and 60 percent of GNI participants considering installation of additional equipment within the next year as shown in Figure 11-5. Likewise, the majority of respondents (67 percent of C&I participants and 75 percent of GNI participants) stated that the SEI program influenced their decisions to buy energy-efficient equipment. There is no correlation to the NTG results because program influence only accounts for up to 50 percent of the NTG score.

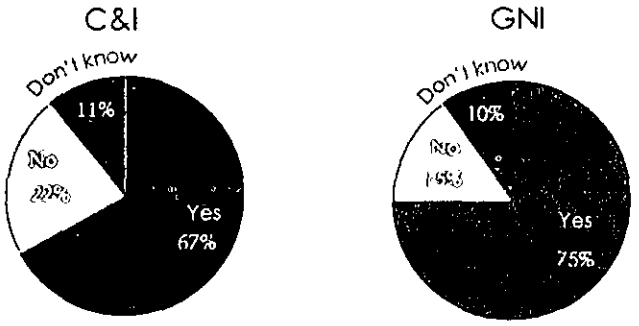
Figure 11-5: Purchasing Decisions

Is your organization considering installing additional equipment in the next 12 months?



Information from trade allies was most influential in respondent decision-making in regard to what type of equipment to install.

Did the SEI program affect the energy efficient equipment your organization decides to purchase?



Does your organization have a sustainability program?

48% of respondents reported having a sustainability program

Of those, almost half have a capital budget in place for purchasing energy efficient equipment

Source: Participant survey

Nearly half (48 percent) of participants reported having sustainability programs in place. The team found that C&I participants with sustainability programs in place were more likely to be thinking about installing additional energy-efficient equipment in the next year. Of C&I participants, 57 percent of those with a sustainability program were considering installing equipment in the next year, whereas only 43 percent without sustainability programs were considering doing so.[59] GNI participants with sustainability

[59] Results statistically significant at the 0.001 level.

programs in place were not different statistically than those without sustainability programs in place when thinking about installing additional energy-efficient equipment in the next year.

Of those participants with a sustainability program in place, 50 percent of C&I participants and 36 percent of GNI participants also had capital budgets for purchasing energy-efficient equipment. Yet, several contractors argued that sustainability programs and practices are more common at businesses now, but tangible longer-term financial savings are still the most important determinant of action.

Participants indicated that the best channels through which PECO could influence decisions about the types of energy-efficient equipment varied between participant types. Nearly all C&I participants (93 percent) stated that recommendations from trade allies were most influential followed by advertising information about PECO (64 percent), whereas GNI participants reported being most influenced by recommendations from PECO staff (58 percent).[60]

Increasing the level of efficiency for equipment selected for projects is a key issue for the PECO SEI program. Figure 11-6 shows that nearly three-quarters (71 percent) of C&I participants and 45 percent of GNI participants reported that they would choose standard equipment over energy-efficient equipment based on the cost of the equipment.[61] Even with a notable amount of respondents citing cost, many respondents, regardless of type (25 percent of GNI participants and 18 percent of C&I participants, respectively) were unable to cite a reason for selecting standard equipment over energy-efficient equipment.

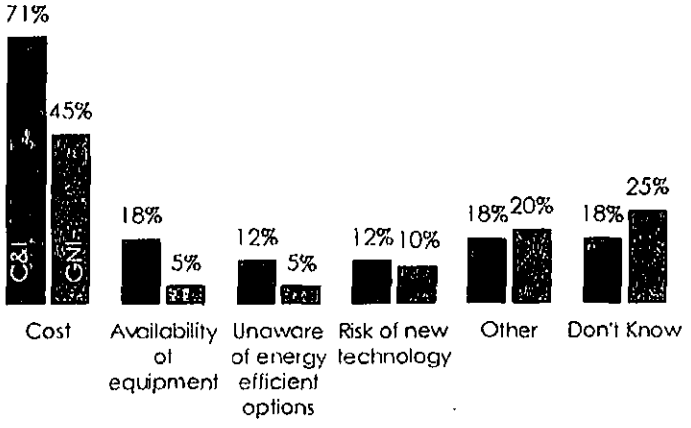
For contractors, improving the efficiency level of equipment is based on generating customer buy-in to the value of the equipment. One contractor working with ultra-savings projects argued that customers will listen often to recommendations, but disregard them because the suggestion is viewed as "an expense rather than as an investment." Other small savings contractors claimed that often the decision is already out of their hands by the time the project reaches their business because the customer has already settled on specific equipment purchases.

[60] This question was asked of participants who stated that they plan to install additional energy-efficient equipment in the next 12 months.

[61] This question allowed participants to provide multiple responses.

Figure 11-6: Influence of Incentives

Why would you chose standard equipment over energy efficient equipment?



Respondents could select more than one option.

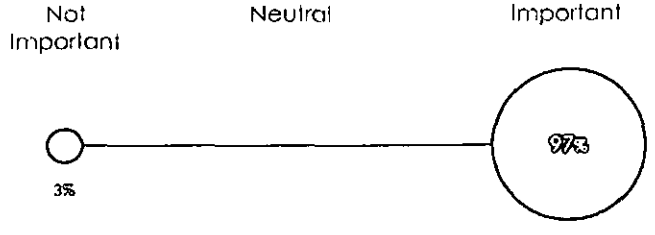
What would the impact be of lowering the incentive in the middle of your planning cycle?

***C&I - 50%** of respondents said they would either postpone or accelerate the project timeline to try and capture the higher incentive*

39% of respondents said "Don't Know"

***GNI - 55%** of respondents said that the lower incentive would have no impact on their project planning*

How important is it to you that the incentive doesn't change?



Source: Participant survey

Not surprisingly, changes to incentive levels were met with strong disapproval from both participants and contractors. Ninety-seven percent of participants said that it was "important" that incentive levels did not change.[62]

When asked how lowering incentive levels would have impacted the planning cycle, reactions from participants varied. For C&I participants, over a third (39 percent) were unable to say how the change would have affected their decisions; however, over a quarter (28 percent) would have postponed their project and 22 percent would have attempted to accelerate the project to capture the larger incentive. Interestingly, C&I participants who reported being influenced by PECO were significantly more likely to report either postponing their project or speeding up the project's timeline.[63]

The majority of GNI participants (55 percent) claimed that the lowering of incentive amounts would have no effect on their project decisions. Very few respondents indicated that they would attempt to accelerate their projects (20 percent) or postpone their project (10 percent).

> "The current incentives are nice, and I'd rather have them then have no incentives at all. They serve to sweeten the deal. But they are just not rich enough to really drive projects. I don't see the current incentive levels attracting the capital and manpower needed.

A key finding of the focus groups was that contractors do not think incentives are pushing the market to act. Universally, contractors asked for increases in incentive levels; however, many also noted that there are barriers in place that keep customers from realizing the benefits of the program. One trade ally suggested that a lack of awareness keeps customers from taking advantage of incentives until after major decisions about the project are already in place. Several others argued that incentives levels are not currently driving customers to take action. Navigant recognizes that PECO may be in the process of implementing some of the suggestions brought forth by contractors, which include the following:

- **More descriptive program materials.** When asked for ways to make program marketing materials more useful, program participants generally asked for more descriptive materials as well as materials, like case studies, that appeal to uniquely positioned firms (e.g., heavy industrial or engineering firms).
- **Alternative incentive offerings.** A few contractors argued that PECO could generate larger projects and non-lighting projects through the allowance of either multiple measure incentives or combo measure incentives, where, in addition to lighting work, the contractor would be required

[62] Results statistically significant at the 0.001 level.

[63] Results statistically significant at the 0.005 level.

to complete another measure type, such as an HVAC or VFD project, to receive an incentive. One contractor explained how this process could work:

"So it can't be just lighting, it can't be just HVAC, it has to be a combination. It can be HVAC and compressed air, or you know, motors and HVAC or motors and lighting, but it can't be just lighting. And then you can also say that of the total savings, lighting can't be more than a certain percentage of the project... You get better penetration into the non-lighting consumption and you also do bigger projects and if you marry HVAC and lighting, you know, the overall economics look pretty good."

- **Tiered incentives.** Some contractors also discussed allowing tiered incentives for projects that save a larger percentage of annual energy consumption or peak demand.
- **Funding for audits.** One contractor suggested that PECO provide funding for audits and on-site energy project managers. The contractor, who was unaware that PECO does have a program in place for cost-free audits, felt this could help customers identify energy efficiency opportunities and more easily channel projects into PECO programs and incentives.
- **Marketing of the program to customers.** Contractors asked for more direct marketing of the program to customers. Here, they argued that PECO could leverage customer data to identify energy efficiency opportunities and then use bill inserts and website advertisements, to make customers aware of available incentives to support completing the work. One contractor noted:

  "As a businessman, unless you're driving customers to my door and I'm responding to them, there's just no incentive for us to work in Pennsylvania. And I'm born and raised in Philadelphia and the surrounding area; it breaks my heart but I have to go where the business is and right now the business is in New Jersey."

Market Effects

The evaluation team questioned trade allies about general market effects during the focus groups. Navigant asked contractors who participated in the program in PY5 the following questions:

- How has the rebate program and/or being a trade ally (if applicable) affected your business?
- How has it changed the way you approach marketing or sales?
- How has it changed your staffing?
- How has it affected your inventory or ordering process?

While most contractors stated that they use the program and utilize the rebates for their customers, the results of the questions designed to understand market effects were inconclusive. Several contractors noted that being a trade ally had not really changed their business; for instance, they reported utilizing PECO's marketing materials but explained it was not enough to make a difference in their business. Others reported that PECO's marketing had made a difference in sales; driving large customers to do projects they would not have otherwise considered but these contractors did not report changing their own marketing of program-qualified equipment due to the program being available. Based on these findings, the team suggests exploring this issue further in PY6 based on PECO's interest in market effects research.

The evaluation team has one key recommendation based on the process findings:

- **Recommendation #5: PECO should work on building relationships with contractors and the trade ally network.** Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the EE space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.[64] Navigant recommends implementing these plans[65] in PY6.

11.5 Recommendations for Program

The evaluation team used various analytical methods to complete the evaluation including performing a gross impact evaluation, program materials review, tracking system review, a verification and due diligence review, interviews with program managers and implementation contractor staff, participant surveys, and contractor focus groups. This subsection details recommendations from the evaluation and Table 11-11 lists each recommendation along with the PECO status.

Recommendation #1: DNV GL should review the TRM and train staff on the use of the TRM. Staff should be more careful when selecting the reported hours of use and coincidence factor as roughly half of the sampled projects had adjustments to both hours of use and coincidence factor. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours

[64] DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016."

[65] "In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."

but TRM-deemed hours of use were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.

Recommendation #2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus quality control on the hours of use and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings.

Recommendation #3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system. DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.

Recommendation #4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.

Recommendation #5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the energy efficiency space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to

strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.[66] Navigant recommends implementing these plans[67] in PY6.

Table 11-11: SEI – C&I Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: DNV GL should review the TRM and train staff on the use of the TRM. Staff should be more careful when selecting the reported hours of use and coincidence factor as roughly half of the sampled projects had adjustments to both hours of use and coincidence factor. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but TRM-deemed hours of use were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.

[66] DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016."

[67] "In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex - ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus quality control on the hours of use and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings. For example DNV GL could potentially appoint one individual to review all projects for consistency with the TRM or appoint technology specific teams that focus on particular projects types as to gain expertise in evaluating the project savings associated with that technology type.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.
Recommendation 3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system. DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.
Recommendation 4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Currently DNV GL transfers data monthly using a batch process. The evaluation team found discrepancies in the data transfer process (e.g., formatting issues, missing fields). PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited. IN addition PECO will work with DNVGL to consider automating the data transfer process as recommended.
Recommendation 5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the energy efficiency space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a	Being considered. PECO will work on developing better relationships with contractors and the trade ally network. PECO will collaborate with DNVGL to implement the strategies outlined in the Marketing plan and outreach tactics for DNVGL.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.85 Navigant recommends implementing these plans86 in PY6. 85 DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016." 86 "In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."	

Source: Navigant analysis

11.6 Financial Reporting

The SEI program continued to operate cost-effectively in PY5. The TRC benefit-cost ratio achieved for SEI C&I was 2.11. A breakdown of the SEI C&I program finances is presented in Table 11-12.

Table 11-12: Summary of SEI C&I Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	2,178	2,178
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	2,178	2,178
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	4,247	4,247
Marketing[2]	3	3
Subtotal EDC Implementation Costs	4,250	4,250
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	6,428	6,428
Participant Costs[4]	6,598	6,598
Total NPV TRC Costs[5]	**10,848**	**10,848**
Total NPV Lifetime Energy Benefits	20,344	20,344
Total NPV Lifetime Capacity Benefits	2,569	2,569
Total NPV TRC Benefits[6]	**22,914**	**22,914**
TRC Benefit-Cost Ratio[7]	**2.11**	**2.11**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

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

[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.

[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.

[5] Total TRC Costs includes Total EDC Costs and Participant Costs.

[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.

[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

12 Smart Equipment Incentives – Government, Nonprofit, and Institutional

PECO launched the SEI program in Phase I and has continued the program into Phase II. PECO filed the SEI program with the Pennsylvania PUC as two programs targeting different nonresidential customer segments. The SEI C&I program targets the commercial and industrial segment while the SEI GNI program targets the government, nonprofit, and institutional segment. The program offers incentives for projects with prescriptive measures (e.g., lighting and variable frequency drives) and custom projects. A main goal of the SEI program in Phase II is to encourage the installation of efficient non-lighting equipment. This section focuses primarily on the SEI GNI program.

SEI implementer DNV GL completed 101 GNI retrofit projects in PY5. Eighty-two percent of total SEI PY5 energy savings came from lighting measures, including lighting controls. Navigant's impact evaluation, which included file reviews, phone verification, pre-installation site visits, and post-installation site visits, resulted in a realization rate on the energy savings of 0.90 for the SEI GNI program. Total verified gross savings were 9,174 MWh for the SEI GNI program, 38 percent of the PY5 SEI GNI target of 24,158 MWh. The program did not meet the goals, primarily due to a slow start to the Phase II marketing and outreach efforts. Navigant's analysis of free ridership and spillover determined a NTG ratio of 0.4 for the GNI sector using the SWE methodology.

Program expenditures for SEI GNI in PY5 totaled 3.6 million, approximately 57 percent of the PY5 budget of $6.3 million. The TRC benefit-cost ratio achieved for SEI GNI was 1.26.

12.1 Program Updates

The SEI program changed the program requirements in PY5 to require a pre-application for all projects. PECO is now staffing specific managers and engineers on projects based on their project type or industry, which aims to create longer term relationships with customers.

12.1.1 Definition of Participant

Each participant of the SEI GNI programs is defined by a completed project. Each project may include the installation of one or more measures, and each can be of different measure types.

12.2 Impact Evaluation Gross Savings

Overall, the program achieved gross realization rates of 0.9 for energy and 0.7 for demand. The program-level relative precision was under the 15 percent target (6 percent relative precision at 85 percent

confidence interval) for the energy and over for the demand estimate (38 percent relative precision at 85 percent confidence interval). Table 12-1 shows the reported results for the C&I program.

Table 12-1: Phase II SEI-GNI Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	N/A	N/A	N/A	N/A
Low-Income	N/A	N/A	N/A	N/A
Small Commercial and Industrial	N/A	N/A	N/A	N/A
Large Commercial and Industrial	N/A	N/A	N/A	N/A
Government, Non-Profit, and Institutional	101	10,173	2	$1,031
Phase II Total	**101**	**10,173**	**2**	**$1,031**

Source: Navigant analysis

The sample design for PY5 SEI retrofit projects used stratified ratio estimation similar to the method used in PY1–PY4. Based on a combined paid annual population of 101 GNI retrofit projects, the final evaluated sample size was 29 GNI projects for the program year, with samples allocated by participation from each quarter and by stratum. The evaluation team designed the final GNI sample to exceed the required 85/15 confidence and precision at the program level with coefficients of variation chosen to reflect the PY4 achieved relative precision targets.[68]

Navigant also added extra sites as a buffer to the minimum sample size to meet the 85/15 confidence and precision level. The evaluation team determined the number of buffer sites per stratum by calculating the necessary sample size to achieve 85 percent confidence and 15 percent precision as well as 90 percent confidence and 10 percent precision. Navigant chose the number of buffer sites to be roughly 2/3rds - 3/4ths of the difference between the counts needed under these two scenarios. One of the sampled GNI Small stratum projects was not able to be verified and was therefore dropped from the program-level realization rate calculation.

The strata boundaries were defined with Q1 data and Q2 data, and later revised to include Q3 data. The boundaries were defined to include approximately the top 33 percent of reported kWh savings in the Large stratum, the middle 33 percent of reported kWh savings in Medium stratum, and the lower 33

[68] Navigant designed the SEI GNI sample with an assumed CV based on the PY4 CV: 0.5 for the large stratum, 0.6 for the medium stratum, 0.8 for the small stratum, and 0.5 for the municipal lighting stratum. The calculated PY5 CVs were 0.16 for the large stratum, 0.10 for the medium stratum, 0.69 for the small stratum, and 0.00 for the municipal lighting stratum.

percent of reported kWh savings in the Small stratum. The sampling strategy used in PY5 is presented in Table 12-2.

Table 12-2: SEI - GNI Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Stratum 1 – Large projects	4	85/15	4 (census)	4 (census)	On-site Verification
Stratum 2 – Medium projects	12	85/15	9	9	On-site Verification
Stratum 3 – Small projects	83	85/15	14	13	On-site Verification and phone verification
Stratum 4 – Municipal Lighting projects	2	85/15	2	2	Phone Verification
Program Total	**101**	**85/15**	**29**	**28**	N/A

Source: Navigant analysis

The sample was pulled in three stages: after Q2 using both Q1 and Q2 data, after Q3, and after Q4. During each stage, the sample design was reviewed and adjustments 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 PY5. The percentage of total samples 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 98 percent of aggregate program savings. The team determined that sampling from the smallest projects representing the bottom 2 percent of aggregate program savings would be of limited value to the program evaluation.

The team also worked to mitigate systematic uncertainty in the PY5 evaluation. The sources, examples, and strategies to mitigate systematic uncertainty are listed below.

- **Source**: On-site metering
  Examples: Uncertainty in the metering device itself, equipment placement, poor calibration
  Strategies to Mitigate: Systematic uncertainty could have been found in the placement of lighting loggers for lighting logger studies. If the lighting loggers were not correctly placed they may have been influenced by alternative lighting sources including none-program incentivized lighting or natural sunlight. To mitigate against this uncertainty, Navigant reviewed all logger data to ensure that it was reasonable. Navigant also decided to not use certain logger data for PECO-13-05365 because the information was not reasonable with normal lighting use. Navigant ensured against systematic uncertainty in equipment by utilize experienced field staff to deploy and ensure metering equipment was installed correctly.
- **Source**: Survey design

Examples: Incomplete information collected on-site, leading survey questions
Strategies to Mitigate: Systematic uncertainty could have been found in the collection of information while on-site. To prevent against any potential information lost, Navigant followed up with the customer on any uncertain items such as HOU, baseline questions, etc.

- **Source**: Human error during site visits
  Examples: Forgetting to complete a key field on the field form
  Strategies to Mitigate: *Systematic uncertainty could have been found in the information gathered* while on-site. To prevent against this, Navigant trained their field staff before completing on-site visits as well as reviewed field forms to ensure that all proper information was collected from the field staff.
- **Source:** Sample design
  Examples: Non-coverage errors, non-response bias, self-selection bias
  Strategies to Mitigate: Navigant solicited the help of PECO on contacting a few of the sampled sites including PECO-13-04786, PECO-14-05495, and PECO-13-05262. Navigant reviewed the sampled sites to ensure that it was representative of the entire population. Only one of the 61 sampled sites was not verified due to an inability to contact the customer. This particular site did respond to Navigant's contacts at first but indicated that the person responsible for the retrofit was no longer with the company and the new contact was not comfortable answer the questions because they were not employed until after the retrofit was completed.

The evaluation team verified gross impacts for demand and energy 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 and IMPs approved by the Pennsylvania PUC through the SWE team. The impacts for deemed measures 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.

The TRM or approved IMP provided the algorithms and default assumptions for calculating the impacts and the variables to be verified for partially deemed measures. 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. The evaluation team conducted an application and file review and developed a 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 an SSMVP, and conducted a

site visit. The primary difference was that there were no deemed variables and all custom measures followed an enhanced rigor level of effort.

Navigant used the following three main approaches for evaluating the sampled projects: desk reviews, phone verifications, and on-site M&V. For all projects, Navigant completed a desk review. The team carefully reviewed all project documentation and the SIDs tracking database for each sampled project.

Navigant used the following three main approaches for evaluating the sampled projects: desk reviews, phone verifications, and on-site M&V. For all projects, Navigant completed a desk review. The team carefully reviewed all project documentation and the SIDs tracking database for each sampled project.

Desk Review

All projects underwent a desk review. In addition, the project documentation had to be complete and could be used to verify the measures installed. The desk review made use of project applications, associated calculations, and submitted invoices and specification sheets. Measures included lighting, HVAC, motors, variable frequency drives, and custom projects.

PECO provided project-specific analysis files, invoices, specification sheets, and other retrofit documents for the sampled projects so the evaluation team could conduct the reviews. Documentation included scanned files of hard-copy application forms and supporting documentation from the applicant (e.g., ex ante impact calculations, invoices, and measure specification sheets), CSP inspection reports, photos of installed measures, and important email and memoranda.

Phone Verification

Navigant conducted a phone verification for projects that met the following requirements to supplement the desk reviews: 1) the project was a small, partially deemed project where the TRM or an IMP applied; 2) the project had relatively small savings (i.e., those in small stratum); and 3) the project documentation was complete and could be used to verify that the measures were installed. Navigant completed a phone verification for five projects in the sample to verify measure installation. For these sites, the primary objective of the phone verification was to collect the data identified in the SSMVP, including verification of installed quantities and type, equipment nameplate data, operating schedules, and a careful description of site conditions. Navigant achieved the verification through verbal inspection of the measures and by interviewing the customers.

On-Site M&V

Navigant conducted an on-site verification for projects in the large and medium stratums as well as small stratum that did not meet certain requirements to supplement the desk reviews. Navigant visited 23 of the 28 projects in the sample (none of the two municipal lighting projects, 10 of the 13 small projects, 9 of the 9 medium projects, and 4 of the 4 large projects) to verify measure installation. For the majority of

the sites, the primary objective of the visits was to collect the data identified in the SSMVP, including verification of installed quantities and type, equipment nameplate data, operating schedules, and a careful description of site conditions. Navigant achieved the verification through visual inspection of the measures and by interviewing the customers. For four projects, Navigant also installed data loggers to measure run-time hours and energy consumption. Warren Energy Engineering, Mondre Energy, and Navigant completed on-site verifications. Navigant found various discrepancies while on-site. These discrepancies are detailed in Table 12-3.

Table 12-3: SEI – GNI On-Site Discrepancies

Category of Change	GNI - Small	GNI - Medium	GNI - Large	GNI – Muni Lighting
Baseline Equipment Quantities	1	1	0	1
Post-Retrofit Equipment Quantities	1	1	0	1
Building Type	1	0	0	0
Space Cooling	0	1	0	0
Hours of Use	6	2	1	0
Coincidence Factor	3	6	0	0
Space Cooling HVAC Interaction Factor	0	0	0	0
Baseline Equipment Specifications	3	1	0	1
Post-Retrofit Equipment Specifications	8	3	0	0
Claimed Heating Savings	0	1	0	0
Measure Type Change (e.g., TRM vs. custom)	0	0	0	0
Other	3	3	2	0
Program Total	**26**	**19**	**3**	**3**

Note: Values in tables are number of sites.

Source: Navigant analysis

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 the SWE's requirements for each project.[69] These requirements align with the PJM peak demand period defined as 2:00-6:00 p.m. on non-holiday weekdays during June, July, and August. The evaluation of PY5 projects included a review of program-tracking data and supporting documentation (e.g., invoices, spec sheets) before developing an 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

[69] The SWE requirements were detailed in a February 11, 2014, memo titled *GM-022 Peak Demand Savings for PY5*.

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. The evaluation team utilized customer-supplied data from an EMS or supervisory control and data acquisition systems when available. In addition, the team requested billing data for some projects from PECO on a monthly or 15-minute interval basis, depending on the site.

The summaries of evaluation results for energy and demand are presented in Table 12-4 and Table 12-5, respectively.

Table 12-4: SEI - GNI Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
GNI - Large	3,418	1.11	3,780	0.16	0%
GNI - Medium	3,186	0.99	3,146	0.10	3%
GNI - Small	3,516	0.62	2,197	0.69	27%
GNI - Muni Lighting	53	0.96	51	0.08	0%
Program Total	**10,173**	**0.90**	**9,174**	N/A	**6%**

Source: Navigant analysis

Table 12-5: SEI - GNI Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
GNI - Large	0.54	0.98	0.53	1.95	1.29
GNI - Medium	0.66	0.69	0.45	0.69	0.18
GNI - Small	0.68	0.50	0.34	1.82	0.71
GNI - Muni Lighting	0.0	0.00	0.0	N/A	0.00
Program Total	**1.87**	**0.70**	**1.32**	N/A	**38%**

Source: Navigant analysis

The key recommendations from this section are listed below.

- **Recommendation #1: DNV GL should review the TRM and train staff on the use of the TRM.** Staff should be more careful when selecting the reported HOU and CF as roughly half of the sampled projects had adjustments to both HOU and CF. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but TRM-deemed HOU were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.
- **Recommendation #2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations.** DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus QC on the HOU and CF for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings.

12.3 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 Navigant calculated gross program impacts, the team derived net program impacts by estimating a NTG ratio that quantifies the percentage of the gross program impacts that can reliably be attributed to the program. Once the evaluation team estimated free ridership and spillover, Navigant calculated the NTG ratios as 1 – Free Ridership Rate + Spillover Rate.

Table 12-6 shows the sample design for the PY5 NTG research.

Table 12-6: SEI-GNI Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries (kWh)	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[70] to Achieve Sample
Large	>1,000,000	2	0.5	85/15	1	1	100%
Medium	200,000 to 1,000,000	8	0.5	85/15	7	7	100%
Small	< 200,000	62	0.5	85/15	12	12	95%
Program Total	N/A	72	0.5	85/15	20	20	96%

Source: Navigant analysis

During Phase II, the evaluation team used a different approach to estimate free ridership than the Phase I approach due to SWE requirements. For comparisons purposes, Navigant estimated free ridership in PY5 using both the Phase I and Phase II approaches. The Phase I approach uses three scores to estimate free ridership: (1) timing and selection, (2) program influence and (3) no program. The Phase I approach does not assign a value to "don't know" answers whereas the Phase II approach uses two scores to estimate free ridership: (1) intention and (2) influence. The Phase II approach does account for "don't know" answers. Navigant explains both methodologies below.

Free-Ridership Assessment – Phase II Approach

The team assessed free ridership using a customer self-report approach following the Research Into Action and ETO framework.[71] This approach uses a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the ETO methodology, the free- ridership analysis included the following two elements of free ridership: 1) *intention* to carry out the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient project.

[70] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

[71] Jane Peters and Ryan Bliss, Research Into Action Team, *Common Approach for Measuring Free Riders for Downstream Programs*, October 4, 2013.

The total free ridership score illustrated in Equation 12-1is the sum of the intention and the program influence scores, resulting in a score ranging from 0 to 100. This score is divided by 100 to convert it into a proportion for application to gross savings values.

Equation 12-1. Total Free Ridership

$$Free\ Ridership\ (FR) = \frac{Intention\ Score + Program\ Influence\ Score}{100}$$

Intention Score

The intention score was assessed through several brief questions used to determine how the upgrade or equipment replacement likely would have differed if the respondent had not received the program assistance. The initial question asked the respondent to identify, out of a limited set of options, the option that best described what most likely would have occurred without the program assistance. Note that "program assistance" often includes more than just the incentive – it may also include audits, technical assistance, and the like. The offered response options (typically four or five, and preferably no more than six) captured the following four general outcomes:

1. Would have canceled or postponed the project, upgrade, or purchase
2. Would have done something that would have produced savings, but not as much as those achieved through the upgrade or equipment replacement as implemented
3. Would have completed the upgrade or equipment replacement as implemented
4. Don't know

The algorithm does consider respondents who said they would have canceled or postponed the project as free riders in terms of intention (a score of 0 for the intention score). The approach did consider respondents who indicated they would have done something that would have resulted in less energy savings as partial free riders in terms of intention (free ridership ranging from 12.5 to 37.5 for the intention component in the case of nonresidential programs). The respondents that indicated they would have undertaken the project as implemented without the program received a score based on how they would have paid for the upgrade. "Don't know" responses were assigned the midpoint score of 25 for the intention component.

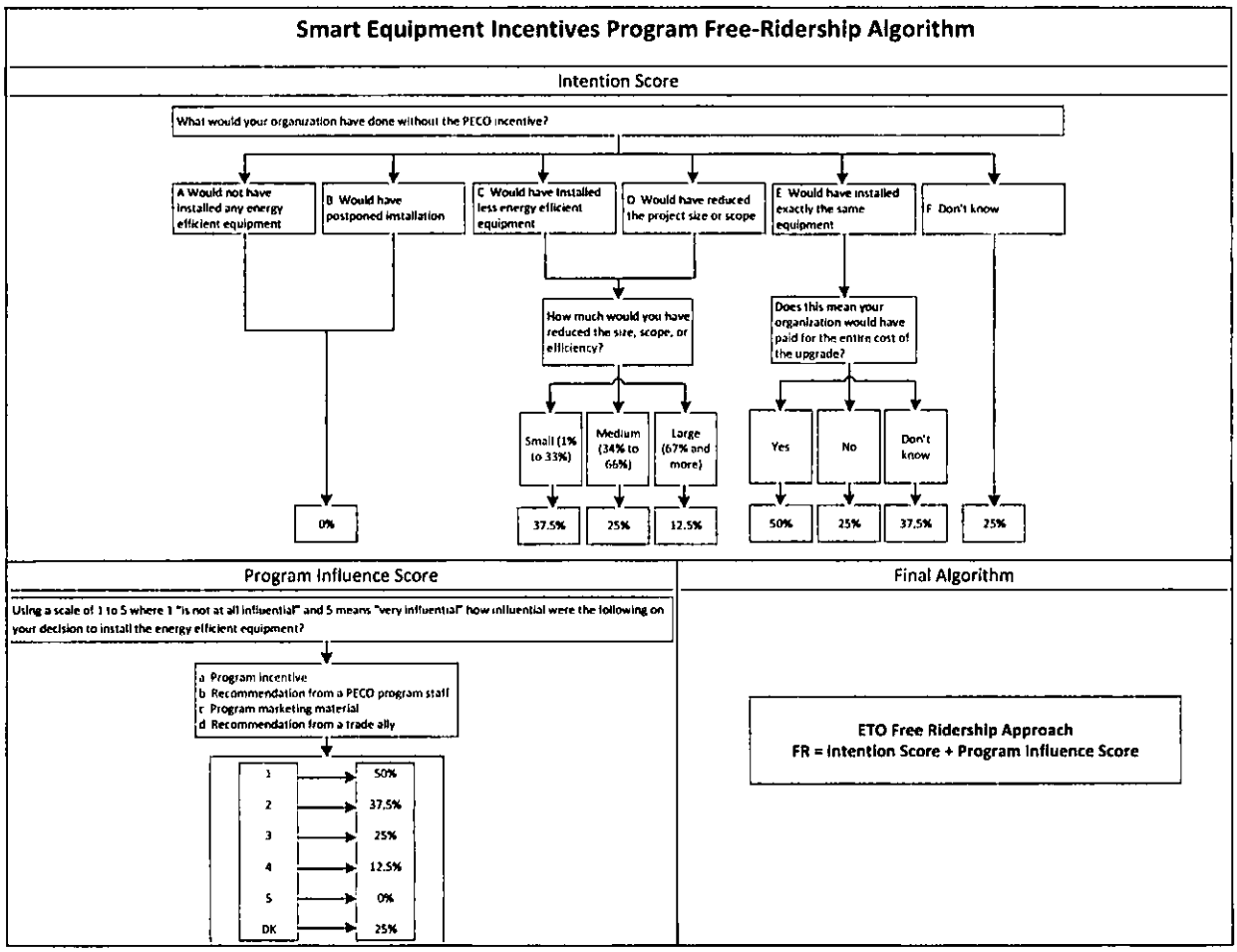
Program Influence Score

To assess the program influence score on the participant's decision to implement energy efficiency improvements, Navigant asked respondents how much influence – on a scale of 1 (no influence) to 5 (great influence) – various program elements had on the decision to implement the project. The elements used to influence customer decision making included program information, program incentives, interaction with program staff (technical assistance), and interaction with program proxies, such as members of a trade ally network.

A participant's program influence score was then set to the participant's maximum influence rating for any program element. The rationale was that if any given program element had a great influence score on the respondent's decision, then the program itself had that level of influence, even if other elements had less influence. The program influence score and free ridership have an inverse relationship: the greater the program influence, the lower the free ridership and vice versa.

Figure 12-1 summarizes both the intention score and program influence score calculations for the SEI program. The figure shows the possible response combinations to the questions described in the intention score section and the value assigned to each unique combination. In addition, it shows the program influence score and possible answers to the five-point scale along with the "don't know" answers.

Figure 12-1: Phase II Free-Ridership Algorithm



Source: Navigant

Free-Ridership Assessment – Phase I Approach

Navigant also assessed free ridership 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 surveys concerning the following three items:

A **Timing and Selection** score that reflects the influence of the most important various program and program-related elements on the customer's decision to implement the specific program measure at this time.

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 customer's decision to implement the specific program measure. This approach cuts the score in half if the customer learned about the program after they decided to implement the measures.

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 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 PY5 projects, if applicable.

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

Spillover Approach

Spillover occurs when there are reductions in energy consumption or demand caused by the presence of the energy efficiency program, but which the program does not directly influence. The evaluation team asked program participants a battery of questions to quantitatively assess spillover. This approach applies to both free-ridership methodologies - Phase I and Phase II. 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. To the best of your knowledge, do you know when you installed the additional energy-efficient equipment?
3. Could you describe the energy efficiency measure installed?
4. 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.)
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?

The battery of questions attempted to quantify all the savings from additional non-incented equipment installed after the respondent's participation in the program. Additionally, the evaluation team included a question about the level of influence the program had on the respondent's decision to install the additional measures. An example of the question is below.

1. On a 0 to 5 scale, with 0 meaning "not at all influential" and 5 meaning "extremely influential," how influential was your experience with PECO's program in your decision to install the additional energy-efficient equipment?

The team assigned the influence rating a value, which determined what proportion of the measure's energy savings were attributed to the program:

- A rating of 4 or 5 = 1.0 (full savings attributed to the program).
- A rating of 2 or 3 = 0.5 (half of the savings attributed to the program).
- A rating of 0 or 1 = 0 (no savings attributed to the program).

Where applicable, Navigant calculated the savings for each additional measure installed per the TRM. For measures not included in the TRM, the evaluator may conduct a brief engineering analysis to assess savings or to identify an alternative source and methodology for assessing savings.

Navigant calculated spillover for measures reported as the product of the measure savings, number of units, and influence score, as illustrated in Equation 12-2. Navigant calculated all spillover estimates using customer self-reported data and did not conduct follow-up interviews or site visits.

Equation 12-2. Spillover Savings from Installed Measures

$$Measure\ SO = Measure\ Savings * Number\ of\ Units * Program\ Influence$$

For each of the above categories, the evaluators then totaled the savings associated with each program participant, to give the overall participant spillover savings reflected in Equation 12-3.

Equation 12-3. Overall Participant Spillover

$$Participant\ SO = \Sigma Measure\ SO$$

The team then multiplied the mean participant spillover savings for the participant sample by the total number of participants to yield an estimated total participant spillover savings for the program. Equation 12-4 shows the algorithm used to calculate spillover for the program.

Equation 12-4. Spillover Savings for the Program

$$\Sigma Participant\ SO\ (population) = \frac{\sum Participant\ SO\ (sample)}{Sample\ n} * \text{Population } N$$

Finally, the team divided the total savings by the total program savings to yield a participant spillover percentage, as shown in Equation 12-5.

Equation 12-5. Participant Spillover Percentage

$$\%\ Participant\ SO = \frac{\sum Participant\ SO\ (population)}{Program\ Savings} * 100$$

NTG Findings

The results from the NTG research using the Phase I free-ridership approach and the spillover approach is shown in Table 12-7. The PY5 SEI GNI NTG ratio is 0.4.

Table 12-7: Program Year 5 SEI-GNI Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Large	0.8	0.03	0.3	0.5	0%
Medium	0.8	0.03	0.3	0.5	27%
Small	0.5	0.03	0.6	0.5	19%
Program Total[72]	0.7	0.03	0.4	0.5	11%

Source: Navigant analysis

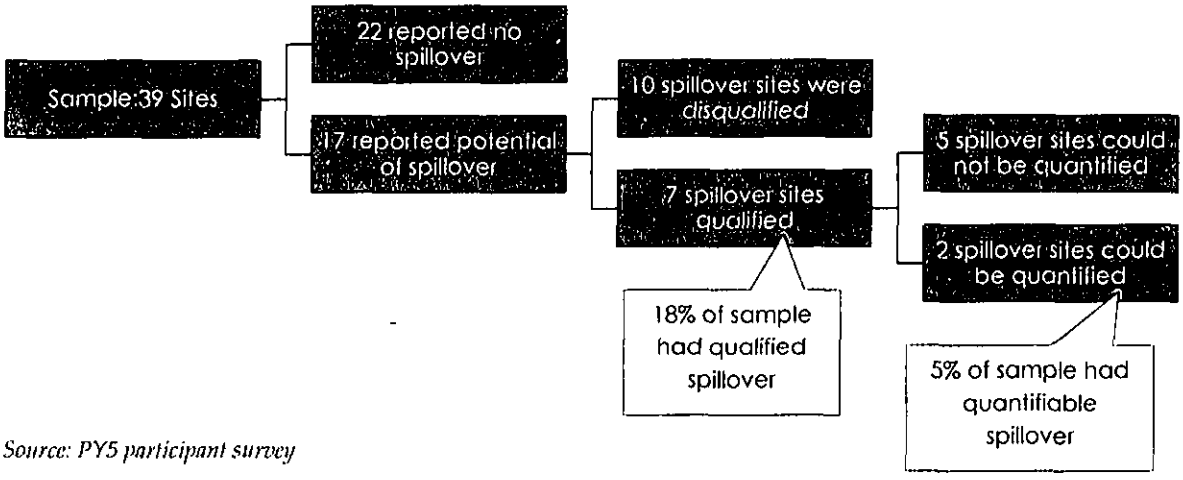
In PY5, the Navigant team analyzed the responses of the online survey where spillover was identified based on participant responses to a battery of spillover questions. Navigant designed these questions to identify those cases where spillover was possible and to quantify the self-reported energy and demand savings from the spillover equipment installation.

As shown in Figure 12-2, the Navigant team determined that of the 39 participants surveyed, 17 reported installing additional energy-efficient equipment. Out of the 17 participants, 6 either were not sure about whether they were going to receive an incentive for the additional equipment installed or did receive a PECO incentive. One participant said the project is still under development. Three participants said the program was not influential in their decision to install the additional energy- efficient equipment. Five participants did not give enough information to estimate energy savings.

While the spillover evaluation revealed a high percentage of self-reported activity, only two participants provided enough information to quantify spillover; the spillover calculated was 0.03.

[72] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Figure 12-2: PY5 Spillover



Source: PY5 participant survey

Based on the net-to-gross research findings in PY5, the evaluation team will plan to use the SWE framework (Phase II approach) to calculate NTG in future program years. The Navigant team observed significant differences in NTG ratios between the Phase I and Phase II approaches. The Phase II ETO approach is a simpler method with less opportunity for inconsistent answers to key questions. Navigant recommends that PECO utilize the ETO approach in future program years. However, the team recommends adding a control question to summarize answers to the intention and influence questions, which would allow the team to correct inconsistent answers.

12.4 Process Evaluation

The evaluation team conducted multiple research activities in support of the process evaluation. The evaluation team evaluated the C&I and GNI participant groups together; thus, the results of the process evaluation are presented identically in both annual report sections. The research activities included the following:

1. Program materials review
2. Program theory and logic model development
3. Tracking system review
4. Verification and due diligence review
5. Primary data collection
    a. Interviews with the PECO program management staff and implementation contractor staff
    b. Online and telephone surveys with 19 participating C&I customers and 20 participating GNI customers
    c. Web-based online focus groups with 15 participating and non-participating contractors
    d. Attendance of a PECO-sponsored Trade Ally Advisory Council Dinner

Program Materials Review

The evaluation team reviewed marketing and outreach materials available on the program's website,[73] as well as PECO-developed program sell sheets and quick reference guides for both the C&I and GNI sectors and the Strategic Marketing and Outreach Plan developed by DNV GL. The team also completed a detailed review of the online program application and program and trade ally materials. Finally, the evaluation team reviewed the Program Operations Manual, the DNV GL Database transformation manual, and Quality Control (QC) Checks documents.

The PECO website redirects the user to an easy-to-navigate page that allows the customer to select from a number of residential and commercial programs and rebates. Information on the SEI web page includes FAQs, brief explanations of the types of equipment eligible for rebates, a program library containing presentations and additional program resources, links to program Trade Allies, and electronic/online versions of program applications. The website also features additional customer support resources, including a toll-free phone number (1-888-5-PECO-SAVE or 1-888-573-2672) and an email hotlink (PECOSmartIdeas@kema.com).

Program Theory and Logic Model

The main goal of the SEI program is to achieve energy savings that will contribute to achieving the company's demand-side management goals by installing energy efficiency measures at nonresidential sites. This could include businesses as well as nonprofits and government and municipal facilities.

This section provides a summary of the barriers, activities, and outcomes for the PECO SEI program. Navigant's complete program theory and a logic model memo for the SEI program as it currently operates were provided to PECO.

Barriers

Target participants face a significant first-cost barrier when attempting to implement energy efficiency measures. Many target customers do not have available budget to spend on energy efficiency upgrades. Lack of awareness of the SEI program and their financial and technical support is another related barrier. Lastly, many customers lack awareness of energy efficiency opportunities in their facilities. Target customers, especially small to medium-size customers who do not have a facilities engineer or staff, do not know of all of their options to reduce energy use and cost, nor which options are the most cost effective.

[73] www.peco.com/smartideas.

Activities

The purpose of the SEI program is to educate and assist eligible target customers with making their facilities more energy efficient. The program reaches eligible customers through activities designed to influence them to take actions that ultimately generate energy savings. A summary of these activities is as follows:

- Conduct outreach to program participants
- Develop information and program collateral
- Conduct outreach to contractors and suppliers
- Provide rebates for qualifying measures

Outputs and Outcomes

It is important to distinguish between outputs and outcomes. For the purposes of the logic model, Navigant defines outputs as the immediate results from specific program activities. These results are typically easily identified and can often be counted by reviewing program records. An example for the PECO SEI program would be the rebates paid for energy-efficient measures installed through the program. Outcomes are distinguished from outputs by their less direct (and often harder to quantify) results from specific program activities.

Outcomes represent anticipated impacts associated with PECO's program activities and will vary depending on the time period being assessed. An example would be energy and demand savings. On a continuum, program activities will lead to immediate outputs that, if successful, will collectively work toward achievement of anticipated short-, intermediate-, and long-term program outcomes. A summary of these outcomes follows:

- Increase awareness of energy savings opportunities/assist customers in acting on those opportunities
- Increase consumers' awareness and understanding of the breadth of energy efficiency opportunities in their facilities
- Support the development of a robust market of energy efficiency service providers
- Overcome financial barriers
- Strengthen customer trust in PECO
- Promote customer successes
- Develop a robust network of trade allies to promote energy-efficient measures to their customers
- Target customers who install energy-efficient measures and receive rebates
- Encourage customers to pursue a comprehensive set of energy efficiency measures
- Make significant contributions to attainment of PECO's energy savings goals

Tracking System Review

PECO uses the SIDS to track their portfolio of programs. The evaluation team received tracking data, an extraction from the PECO online database, electronically on a quarterly basis. The evaluation team used the tracking system to complete both the impact and process evaluations. The team used the tracking system for designing the impact and process samples and the inputs for the cost-effectiveness test. The tracking data used to develop the final impact evaluation results was a combination of all quarterly extracts.

This year's tracking system included a new naming convention for easier use. Descriptive names replaced numerical identifiers as the naming convention for the spreadsheet's tabs. The new naming convention more clearly identified the type of information contained in each tab. As an example, the tab previously labeled "100" in Phase I was updated to "Customer" in PY5 and, as the name suggests, it contains customer information. In the same way, the tabs previously labeled "200" and "300" now read "Projects" and "Measures", respectively, and contained project- and measure-level data.

The evaluation team verified that the tracking system was consistent with the PY5 TRM. The evaluation team also verified that all data necessary for the evaluation was included in the tracking system. This included verifying that all columns that were relevant to the program and to the measures incented were filled in with data. Not all columns in the tracking system were relevant for all measures so some blank fields were expected; therefore, this step focused on verifying if any of the relevant data fields were blank.

The team also verified the accuracy of participation data entered into the tracking system. Navigant verified this with a review of the applications for the impact evaluation sample projects. Accuracy of data entry for projects that had been updated since the initial application was also verified by ensuring that new data included in supplemental project files were accurately entered into the tracking system. Finally, the team performed an engineering review of the inputs and outputs of the energy and demand impacts of the sample of projects to verify that the database was providing correct information.

The evaluation team identified several tracking system issues that PECO should consider addressing in order to improve the usability of the tracking system as the portfolio of programs continues into PY6 of Phase II. The findings, and some recommended steps for improvement, are listed below.

The evaluation team discovered various discrepancies between the project application files and the SIDS tracking data. In total, 21 of the 61[74] (34 percent) sample projects had discrepancies between the application files and the SIDS tracking data.

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[74] During the impact evaluation, one of the sampled GNI Small projects could not be verified due to customer non-responsiveness. The final GNI evaluation sample did not include this site. Therefore, the team requested and reviewed documentation for a total of 61 projects, but completed the full evaluation on 60 projects.

- Fifteen projects had discrepancies due to the different CFs in the application files and the SIDS tracking data.
- Four projects were determined to have discrepancies between the nominal efficiency in the application files and those in the SIDS tracking data.
- One of these projects had a discrepancy in the HOU used in the different data sources.
- One project was determined to have changed the fixture type and was updated in the application files but not in the SIDS tracking database.

The tracking system contained blank columns and inconsistent values. On many occasions, columns titled "Measure Quantity" and "Measure Size" were blank. This meant that the evaluation team was unable to verify the quantity of measures installed for a given project. There were other occasions where some information was populated, but it referred the user (the evaluation team, in this case) to specific project files instead of listing the data in the tracking system itself. This again meant that the evaluation team was unable to verify the quantity of measures unless we had specifically requested the project file referenced.

Additionally, columns titled "Measure Quantity Unit" and "Measure Size Unit" were filled in inconsistently, even for the same measure types. For example, sometimes the same lighting measures listed the measure quantity unit as "per fixture" and other times "per kWh saved". Knowing both data points is useful to the evaluation team, but many times only one or the other was provided. These inconsistencies made it difficult to compare quantities and savings among projects and customers.

The tracking system algorithm nomenclature did not always match that of the PY5 TRM. The inconsistent nomenclature made mapping the algorithms in the tracking system to the PY5 TRM more difficult. For example, if the algorithm nomenclature "kWbase" matched the tracking system "baseline kW", QC against the TRM would be made easier.

The tracking system had inconsistent measure type units. Descriptions of quantities for all measures that fall under the same measure types were not consistent. For example, the team reviewed data for occupancy sensors and found that the units used were "watts controlled," "watts reduced," "W," or "Watts." The tracking system used all four terms to describe the unit of measure.

There are significant discrepancies in customer names in the tracking system. While designing the samples, the evaluation team found significant discrepancies in the way a customer name was entered in the system multiple times. These discrepancies also happened with the contact person name and the contact information. For example, the same address was entered in different ways. These discrepancies made it difficult to identify unique customers. The team spent a significant amount of time developing new unique identifiers and matching similar names in order to design the sample.

IMP is not an option in the tracking system. The tracking system does not include "IMP" as an option to identify whether the measure is a TRM, IMP, or custom measure. The tracking system only includes the options TRM and custom.

The tracking system does not have fields that list details for the incremental cost including the source or the units used. In many cases, the incremental cost data are different than third-party sources. For instance, when reviewing an HVAC measure the tracking system had a value for incremental cost of "X"; however, it did not list the source of the value or the unit (e.g., per ton, per British thermal unit (BTU)). The team was able to deduce the cost per unit but it was not consistent with other sources.

The recommendations from the findings in this section include the following:

- **Recommendation #3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system.** This includes:
    - Ensuring that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings.
    - Developing a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct.
    - Ensuring that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.

Verification and Due Diligence

The evaluation team performed a verification and due diligence review for the SEI program, including a review of the program's quality assurance and savings verification procedures. The team conducted interviews with key PECO and DNV GL staff during December of 2013 and February of 2014. In three of these interviews, the evaluation team focused on the tracking systems and QA/QC procedures and scored the program based on the metric definitions contained in the ACEEE Energy Efficiency Best Practices tool,[75] the results of which are shown in Table 12-8.

[75] http://www.eebestpractices.com/benchmarking.asp.

Table 12-8: QA/QC Best Practices Scorecard

ID	Best Practice	Score
1	Design program tracking system to support the requirements of evaluators as well as program staff	BP
2	Use Internet to facilitate data entry and reporting; build in real-time data validation systems that perform routine data quality functions	MA
3	Automate, as much as is practical, routine functions (e.g., monthly program reports)	MA
4	Develop electronic application processes	BP
5	Develop accurate algorithms and assumptions on which to base savings estimates	BP
6	Conduct regular checks of tracking reports to assess program performance	BP
7	Document tracking system and provide manuals for all users	BP
8	Base quality control on program's relationship with vendors, number of vendors involved, types of measures, project volume, and variability of project size	MA
9	Verify accuracy of rebates, coupons, and invoices to ensure the reporting system is recording actual product installations by target market	BP
10	Require pre-inspections for large or uncertain impact projects	BP
11	Conduct in-program measurement/impact evaluation for the very largest projects or those with uncertain impacts	BP
12	Assess customer satisfaction with the product through evaluation	BP
13	Build in statistical features to the sampling protocol to allow a reduction in the number of required inspections based on observed performance and demonstrated quality of work. Use a "good" random sample	BP
14	Use inspections and the verification function as a training tool for the market, especially for market transformation programs	MA

Note: Scores are Best Practice (BP), Meets Average (MA) or Below Average (BA).

Source: ACEEE tool. (http://www.eebestpractices.com/benchmarking.asp)

The evaluation found that PECO and DNV GL continue to refine their quality control procedures and incorporate recommendations into the QA/QC process. PECO and DNV GL have also continued to work to align their QA/QC, program tracking, and verification procedures with Pennsylvania requirements and guidance from the SWE.

The evaluation team's findings drawn from the verification and due diligence effort are listed below.

DNV GL and PECO have not fully automated data transfers between databases. Currently DNV GL transfers data monthly using a batch process. The evaluation team found discrepancies in the data transfer process (e.g., formatting issues, missing fields)

The Operations Manual is meeting quality assurance safeguards. *The program's Operations Manual* includes guidelines that generally meet expected quality assurance safeguards. The program is complying with the policies and procedures set forth in the Operations Manual, including criteria for project eligibility and collecting supporting documentation for projects.

PECO restructured implementer contracts based on verified gross savings and performance. For Phase II, PECO restructured the DNV GL contract to reflect performance towards goals. Under the new terms, PECO will pay DNV GL 80 percent of their administrative fees upfront but hold back the remaining 20 percent based on performance towards program goals, with 10 percent being paid on gross goals and another 10 percent on realized goals. There are also several penalties regarding such measures as call center performance and safety, which could carry a penalty of 1 percent each. Navigant suggests that PECO continue to monitor whether DNV GL is meeting their new contractual goals and determine whether these goals align with the actual goals of the program and of the entire portfolio.

PECO implemented an online application form in PY5. In Phase II, PECO and DNV GL rolled out a new web-based application where program participants and contractors can apply for incentives, view the status of applications, create company profiles, and apply to become a trade ally if desired. The web-based application site also contains a message center and live chat capability to encourage continued communication during the application process.

PECO and DNV GL added a section to the project summary invoice, which shows whether there are any variances in the imported DNV GL project data as compared to the invoice accompanying it (i.e., discrepancies in savings calculations). SIDS automatically alerts program managers via a hotlink on the summary invoice to variances in the project such as differences in savings estimates, incentive amounts, project application dates, and approvals, and allows them to click on the hotlink and go to the section of the project file where the discrepancy is and to investigate the issue. PECO does this by performing calculations on the monthly data import from DNV GL and comparing those calculations to the invoice submitted for the project. This allows for more transparency in the QA/QC process and program managers are able to see all the information about a particular project in one place. This practice ensures the program manager is more involved in the QA/QC process and has better information about the project he/she is approving.

The recommendation from the findings in this section is listed below.

- **Recommendation #4:** PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.

Primary Data Collection

Program Management and Staff Interviews

The evaluation team conducted three in-depth interviews with PECO staff and three in-depth interviews with key members of the SEI program implementation contractor team, DNV GL, during the months of December 2013 and February 2014. Navigant designed the interview guides to enable the evaluation team to ask questions about the program's administration and delivery during the program year (PY5) and also to obtain real-time information about current program activity through asking open-ended questions that

created a free-flowing conversation. To aid in making these interviews informative, the evaluation team reviewed current program reporting documents, marketing plans and materials, and QC documents such as the KSIM Manual and DNV GL QC Checks documents.

Participant Survey

The evaluation team conducted an online survey of participating customers for both the SEI C&I and SEI GNI PY5 retrofit programs. The evaluation team supplemented the online survey with telephone surveys of four C&I and seven GNI customers who had not responded to the online survey. In total, the evaluation team completed 39 participating customer surveys: 28 online surveys, and 11 telephone surveys. Out of the 39 surveys, 19[76] surveys were with participating C&I customers and 20 surveys were with participating GNI customers. The team emailed all participants the survey and ensured the number of responses needed to meet a precision of ±15 at the 85 percent confidence level for the NTG results. The survey assessed all of the parameters necessary to calculate NTG ratios. Additional data was collected to support the process evaluation such as program design and implementation, program marketing and awareness, and customer satisfaction. Table 12-9 shows the sampling strategy for the participant survey effort.

Table 12-9: SEI-GNI Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (kWh)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	*Percent of* Population Frame Contacted to Achieve Sample	Evaluation Activity
Large	>1,000,000	2	0.5	85/15	1	1	100%	Online and phone survey
Medium	200,000 to 1,000,000	8	0.5	85/15	7	7	100%	Online and phone survey
Small	< 200,000	62	0.5	85/15	12	12	95%	Online and phone survey
Program Total	N/A	72	0.5	85/15	20	20	96%	N/A

Source: Navigant analysis

[76] Two of the C&I participants did not fully complete the survey. One respondent completed only the net-to-gross battery and therefore is not included in the process analysis. The other respondent dropped out of the survey prior to completing the firmographics battery and is included in the process analysis and net-to-gross analysis.

Contractor Focus Groups

Navigant conducted focus groups with contractors participating in the SEI programs. The evaluation team held four groups with 15 participants across two evenings in July and August 2014. Navigant's goals for these events were to explore ways to motivate customer participation, gain insight into market forces influencing customer participation, elicit trade ally interests and needs, and discuss market effects associated with the program.

As seen in Table 12-10, each group highlighted specific segments of contractors participating in the SEI programs. Groups focused on ultra-savings generating contractors (i.e., those achieving savings over 500,000 kWh), large savings generating contractors (i.e., those achieving savings between 100,000 kWh and 500,000 kWh), small savings generating contractors (i.e., those achieving savings below 100,000 kWh), and non-participant contractors (i.e., those who completed projects in PY4, but did not complete any projects in PY5).

The evaluation team did not differentiate between contractors and trade allies when fielding the focus groups. PECO Smart Ideas trade allies are contractors, suppliers, ESCOs or design professionals who have been educated on the program and have agreed to follow the program's rules and processes. Both trade allies and those who have not registered as trade allies are eligible to participate in the program. Of the 15 contractors participating in the focus groups, 6 (40 percent) were PECO Smart Ideas trade allies.

Table 12-10: Focus Group Participants by Group Type

Group Type	Number of Participants
Ultra savings (Over 500,000 kWh)	3
Large savings (100,000-500,000 kWh)	4
Small savings (Below 100,000 kWh)	4
Non-participants	4

Source: Navigant

Primary Data Collection Findings

The process evaluation focused on program awareness and marketing, influence of payback on program participation, project development and influence opportunities, purchasing decisions and the influence of incentives on program participation, and market effects. Data sources for the process evaluation included a review of program materials, an online survey with 39 program participants (19 C&I participants and 20 GNI participants), four focus groups with 15 participating contractors, and six in-depth interviews, three with PECO program staff and three with the DNV GL program implementation team.

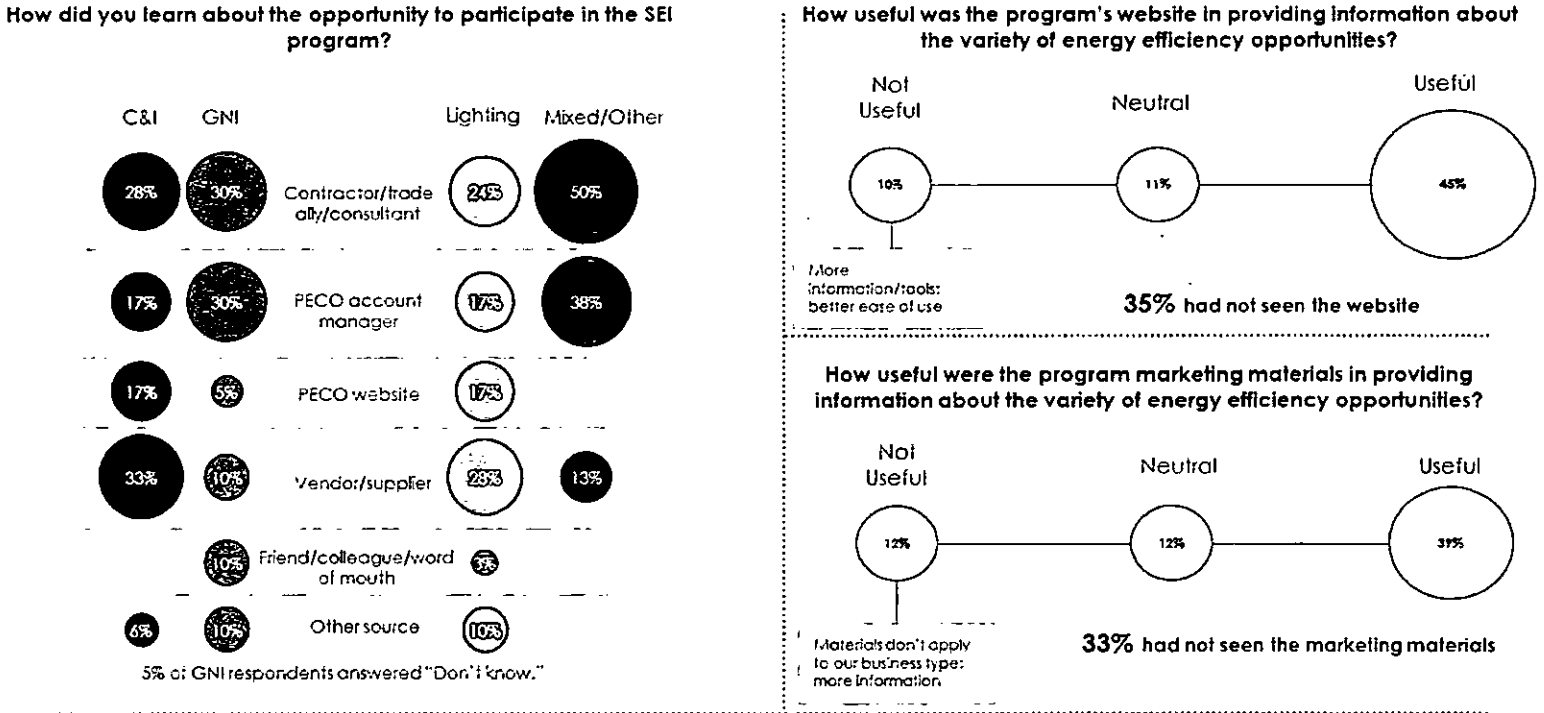
Percentages based on the online survey data illustrated in figures and tables as well as discussed in the text of this section are typically based on 38 responses (18 C&I respondents and 20 GNI respondents, which includes four C&I and seven GNI telephone responses), because one participant did not complete

the process section of the survey. Some questions were asked only of some respondents and the percentages were calculated using these different bases. "Don't know" responses that are less than 4 percent are not included in our analysis. For all other cases, valid percentages are presented. The team noted differences among subgroups (i.e., C&I and GNI participants) when significant; the comparisons are not statistically significant if not noted. Figure 12-3 contains the answers to all survey questions. The sections below provide findings from the process evaluation.

Program Awareness and Marketing

Customer satisfaction with the SEI program continues to be high with 83 percent of C&I participants and 90 percent of GNI participants "very satisfied" with the program and 17 percent of C&I participants and 10 percent of GNI participants "somewhat satisfied" with the program. When asked for any additional comments or ways to improve the program, most respondents, regardless of type, were unable to offer any comments or suggestions; however, those with suggestions asked for greater responsiveness from the program citing long wait times for responses or inadequate responses. Figure 12-3 shows the responses from the participant survey on program awareness and marketing.

Figure 12-3: SEI Program Awareness and Marketing



Source: Participant survey

Customers reported hearing about the program from a variety of sources. Although statistically insignificant, C&I and GNI participants tended to cite alternative sources for first hearing about the SEI program. C&I participants tended to be made aware of the program by their vendors and suppliers (33 percent) and also their trade allies or contractors (28 percent), whereas GNI participants most often reported first hearing about the program from their PECO account manager (30 percent) and from trade allies or contractors (30 percent).

Program marketing is important to customers and contractors; however, those who have seen the website feel that it is being under-utilized. Thirty-five percent of participants claimed to have never seen the PECO website. In focus group discussions, a few contractors noted having difficulty in finding information on the website and particularly, finding information for PECO trade allies.[77]

Forty-five percent of participants reported that the website was useful in providing information about the variety of energy efficiency opportunities in their facility. Several focus group participants offered suggestions for ways to improve the website for both trade ally and customer use. Specifically, trade allies argued that PECO should expand the search options provided to customers looking for a contractor or consultant to allow users to search by trade ally specialty and by geographic area to make it easier for customers to connect with trade allies.

In terms of program marketing materials, 39 percent of participants felt that program marketing materials were useful in providing information about the variety of energy efficiency opportunities in their facilities. When asked for ways to make program marketing materials more useful, program participants generally asked for more descriptive materials as well as materials, like case studies, that appeal to uniquely positioned firms (e.g., heavy industrial or engineering firms).

Influence of Payback on Program Participation

Participants and contractors alike expressed concern over the payback period for projects. Required payback periods varied by customer type. Overall, about 72 percent of C&I participants preferred a payback period of three years or less compared to 65 percent of GNI participants who could complete a project with a payback period of five years or less.

Among contractors there were also differences related to expected payback periods. Most indicated preference for shorter payback periods (i.e., three years or less), although a few contractors claimed that payback periods under five years were within the range they try to target for their customers. One contractor summed it up this way:

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[77] PECO Smart Ideas trade allies are contractors, suppliers, energy service companies (ESCOs) or design professionals who have been educated on the program and have agreed to follow the program's rules and processes. Both trade allies and those who have not registered as trade allies are eligible to participate in the program.

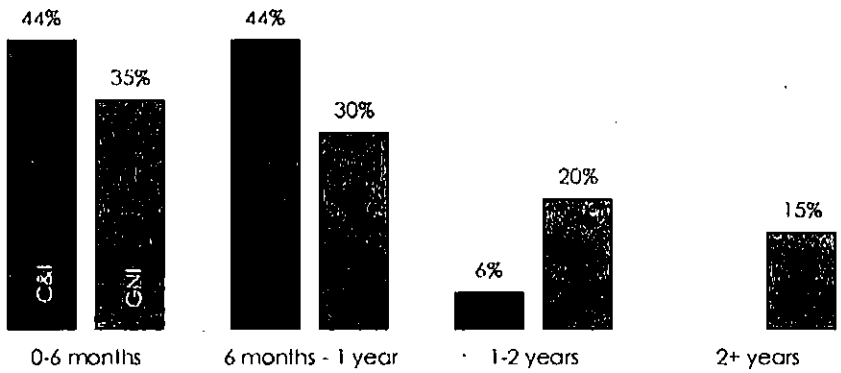
"I think three years is probably it for industrial customers or sometimes you can get maybe a bit higher, maybe five years, for a commercial customer, but they like to see something fairly quick."

Project Development and Influence Opportunities

Figure 12-4 shows the results from the surveys for the project development process and the point at which PECO could have influenced project design decisions. For both participant types, the time from project development to completion was typically less than a year. Nearly half (44 percent) of C&I participants cited a time period under six months compared to 35 percent of GNI participants. In terms of when PECO could intervene and influence design decisions, participants indicated the planning and the budgeting segments of the process would be preferred.

Figure 12-4: Project Development Process and PECO Influence

How long does it take to develop a project?



6% of C&I respondents answered "Don't know"

At what point could PECO have influenced project design decisions?

C&I
0 - 6 months: 44%
6 months - 1 year: 6%
Involvement by PECO would not influence our decision: 17%
Don't know: 33%

GNI
0 - 6 months: 20%
6 months - 1 year: 20%
1 - 2 years: 5%
Involvement by PECO would not influence our decision: 40%
Don't know: 15%

PECO's influence is greatest during planning and budgeting.

Source: Participant survey

When asked about the timing of potential intervention, C&I participants claimed that PECO could influence design decisions within the first six months of the projects (44 percent); however, a third (33

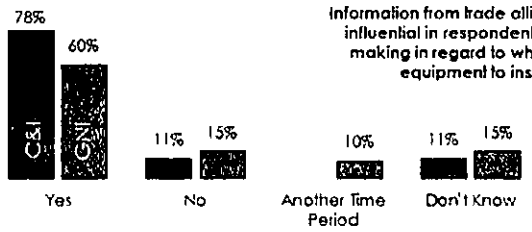
percent) indicated that they did not know when would be the best time to provide guidance. Interestingly, for GNI participants, 40 percent said that involvement by PECO would not influence their design decisions, which could result from more budget constraints, in terms of timing and availability of funds. Given that nearly all C&I participants claim that the time to develop a project from planning to completion is less than a year (88 percent), the opportunity to influence C&I participants is somewhat limited and certainly contingent on the timing of intervention. For GNI participants, the timeline for project completion was more varied with 65 percent citing less than a year and a third (35 percent) indicating that the projects could take a year or more to complete.

Purchasing Decisions and the Influence of Incentives on Program Participation

According to program participants, opportunities exist for PECO to impact subsequent equipment purchasing decisions with over three-quarters (78 percent) of C&I participants and 60 percent of GNI participants considering installation of additional equipment within the next year as shown in Figure 12-5. Likewise, the majority of respondents (67 percent of C&I participants and 75 percent of GNI participants) stated that the SEI program influenced their decisions to buy energy-efficient equipment. There is no correlation to the NTG results because program influence only accounts for up to 50 percent of the NTG score.

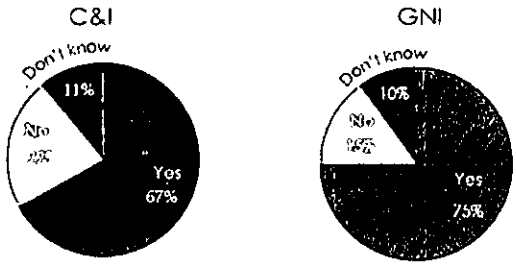
Figure 12-5: Purchasing Decisions

Is your organization considering installing additional equipment in the next 12 months?



Information from trade allies was most influential in respondent decision-making in regard to what type of equipment to install.

Did the SEI program affect the energy efficient equipment your organization decides to purchase?



Does your organization have a sustainability program?

48% of respondents reported having a sustainability program

Of those, almost half have a capital budget in place for purchasing energy efficient equipment

Source: Participant survey

Nearly half (48 percent) of participants reported having sustainability programs in place. The team found that C&I participants with sustainability programs in place were more likely to be thinking about installing additional energy-efficient equipment in the next year. Of C&I participants, 57 percent of those with a sustainability program were considering installing equipment in the next year, whereas only 43 percent without sustainability programs were considering doing so.[78] GNI participants with sustainability programs in place were not different statistically than those without sustainability programs in place when thinking about installing additional energy-efficient equipment in the next year.

Of those participants with a sustainability program in place, 50 percent of C&I participants and 36 percent of GNI participants also had capital budgets for purchasing energy-efficient equipment. Yet, several

[78] Results statistically significant at the 0.001 level.

contractors argued that sustainability programs and practices are more common at businesses now, but tangible longer-term financial savings are still the most important determinant of action.

Participants indicated that the best channels through which PECO could influence decisions about the types of energy-efficient equipment varied between participant types. Nearly all C&I participants (93 percent) stated that recommendations from trade allies were most influential followed by advertising information about PECO (64 percent), whereas GNI participants reported being most influenced by recommendations from PECO staff (58 percent).[79]

Increasing the level of efficiency for equipment selected for projects is a key issue for the PECO SEI program. Figure 12-6 shows that nearly three-quarters (71 percent) of C&I participants and 45 percent of GNI participants reported that they would choose standard equipment over energy-efficient equipment based on the cost of the equipment.[80] Even with a notable amount of respondents citing cost, many respondents, regardless of type (25 percent of GNI participants and 18 percent of C&I participants, respectively) were unable to cite a reason for selecting standard equipment over energy-efficient equipment.

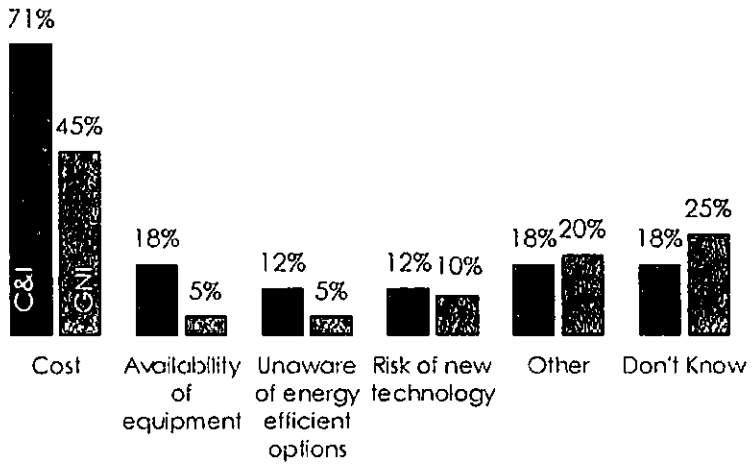
For contractors, improving the efficiency level of equipment is based on generating customer buy-in to the value of the equipment. One contractor working with ultra-savings projects argued that customers will listen often to recommendations, but disregard them because the suggestion is viewed as "an expense rather than as an investment." Other small savings contractors claimed that often the decision is already out of their hands by the time the project reaches their business because the customer has already settled on specific equipment purchases.

[79] This question was asked of participants who stated that they plan to install additional energy-efficient equipment in the next 12 months.

[80] This question allowed participants to provide multiple responses.

Figure 12-6: Influence of Incentives

Why would you chose standard equipment over energy efficient equipment?



Respondents could select more than one option.

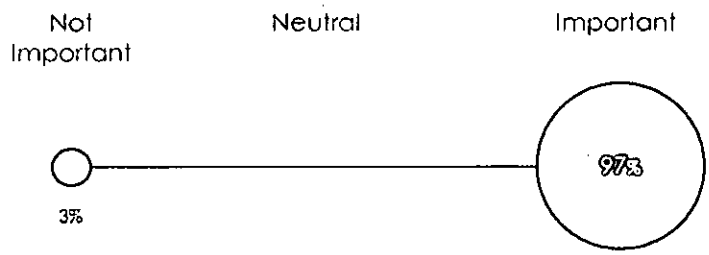
What would the impact be of lowering the incentive in the middle of your planning cycle?

C&I - 50% of respondents said they would either postpone or accelerate the project timeline to try and capture the higher incentive

39% of respondents said "Don't Know"

GNI - 55% of respondents said that the lower incentive would have no impact on their project planning

How important is it to you that the incentive doesn't change?



Source: Participant survey

Not surprisingly, changes to incentive levels were met with strong disapproval from both participants and contractors. Ninety-seven percent of participants said that it was "important" that incentive levels did not change.[81]

When asked how lowering incentive levels would have impacted the planning cycle, reactions from participants varied. For C&I participants, over a third (39 percent) were unable to say how the change would have affected their decisions; however, over a quarter (28 percent) would have postponed their project and 22 percent would have attempted to accelerate the project to capture the larger incentive. Interestingly, C&I participants who reported being influenced by PECO were significantly more likely to report either postponing their project or speeding up the project's timeline.[82]

> "The current incentives are nice, and I'd rather have them then have no incentives at all. They serve to sweeten the deal. But they are just not rich enough to really drive projects. I don't see the current incentive levels attracting the capital and manpower needed.

The majority of GNI participants (55 percent) claimed that the lowering of incentive amounts would have no effect on their project decisions. Very few respondents indicated that they would attempt to accelerate their projects (20 percent) or postpone their project (10 percent).

A key finding of the focus groups was that contractors do not think incentives are pushing the market to act. Universally, contractors asked for increases in incentive levels; however, many also noted that there are barriers in place that keep customers from realizing the benefits of the program. One trade ally suggested that a lack of awareness keeps customers from taking advantage of incentives until after major decisions about the project are already in place. Several others argued that incentives levels are not currently driving customers to take action. Navigant recognizes that PECO may be in the process of implementing some of the suggestions brought forth by contractors, which include the following:

- **More descriptive program materials.** When asked for ways to make program marketing materials more useful, program participants generally asked for more descriptive materials as well as materials, like case studies, that appeal to uniquely positioned firms (e.g., heavy industrial or engineering firms).
- ***Alternative incentive offerings.*** *A few contractors argued that PECO could generate larger* projects and non-lighting projects through the allowance of either multiple measure incentives or combo measure incentives, where, in addition to lighting work, the contractor would be required

[81] *Results statistically significant at the 0.001 level.*

[82] Results statistically significant at the 0.005 level.

to complete another measure type, such as an HVAC or VFD project, to receive an incentive. One contractor explained how this process could work:

"So it can't be just lighting, it can't be just HVAC, it has to be a combination. It can be HVAC and compressed air, or you know, motors and HVAC or motors and lighting, but it can't be just lighting. And then you can also say that of the total savings, lighting can't be more than a certain percentage of the project... You get better penetration into the non-lighting consumption and you also do bigger projects and if you marry HVAC and lighting, you know, the overall economics look pretty good."

- **Tiered incentives.** Some contractors also discussed allowing tiered incentives for projects that save a larger percentage of annual energy consumption or peak demand.
- **Funding for audits.** One contractor suggested that PECO provide funding for audits and on-site energy project managers. The contractor, who was unaware that PECO does have a program in place for cost-free audits, felt this could help customers identify energy efficiency opportunities and more easily channel projects into PECO programs and incentives.
- **Marketing of the program to customers.** Contractors asked for more direct marketing of the program to customers. Here, they argued that PECO could leverage customer data to identify energy efficiency opportunities and then use bill inserts and website advertisements, to make customers aware of available incentives to support completing the work. One contractor noted:

  "As a businessman, unless you're driving customers to my door and I'm responding to them, there's just no incentive for us to work in Pennsylvania. And I'm born and raised in Philadelphia and the surrounding area; it breaks my heart but I have to go where the business is and right now the business is in New Jersey."

Market Effects

The evaluation team questioned trade allies about general market effects during the focus groups. Navigant asked contractors who participated in the program in PY5 the following questions:

- How has the rebate program and/or being a trade ally (if applicable) affected your business?
- How has it changed the way you approach marketing or sales?
- How has it changed your staffing?
- How has it affected your inventory or ordering process?

While most contractors stated that they use the program and utilize the rebates for their customers, the results of the questions designed to understand market effects were inconclusive. Several contractors noted that being a trade ally had not really changed their business; for instance, they reported utilizing PECO's marketing materials but explained it was not enough to make a difference in their business. Others reported that PECO's marketing had made a difference in sales, driving large customers to do projects they would not have otherwise considered but these contractors did not report changing their own marketing of program-qualified equipment due to the program being available. Based on these findings, the team suggests exploring this issue further in PY6 based on PECO's interest in market effects research.

The evaluation team has one key recommendation based on the process findings:

- **Recommendation #5: PECO should work on building relationships with contractors and the trade ally network.** Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the EE space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.[83] Navigant recommends implementing these plans[84] in PY6.

12.5 Recommendations for Program

The evaluation team used various analytical methods to complete the evaluation including performing a gross impact evaluation, program materials review, tracking system review, a verification and due diligence review, interviews with program managers and implementation contractor staff, participant surveys, and contractor focus groups. This subsection details recommendations from the evaluation, and Table 12-11 lists each recommendation and the PECO status.

Recommendation #1: DNV GL should review the TRM and train staff on the use of the TRM. Staff should be more careful when selecting the reported hours of use and coincidence factor as roughly half of the sampled projects had adjustments to both hours of use and coincidence factor. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours

[83] DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016."

[84] "In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."

but TRM-deemed hours of use were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.

Recommendation #2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus quality control on the hours of use and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings.

Recommendation #3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system. DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.

Recommendation #4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.

Recommendation #5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the energy efficiency space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to

strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.[85] Navigant recommends implementing these plans[86] in PY6.

[85] DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016."

[86] "In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."

Table 12-11: SEI-GNI Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: DNV GL should review the TRM and train staff on the use of the TRMStaff should be more careful when selecting the reported hours of use and coincidence factor as roughly half of the sampled projects had adjustments to both hours of use and coincidence factor. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but TRM-deemed hours of use were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings would most likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one thus improving PECO's ability to track the portfolio's progress.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.
Recommendation 2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex-ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus quality control on the hours of use and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings. For example DNV GL could potentially appoint one individual to review all projects for consistency with the TRM or appoint technology specific teams that focus on particular projects types as to gain expertise in evaluating the project savings associated with that technology type.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.
Recommendation 3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited.
Recommendation 4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Currently DNV GL transfers data monthly using a batch process. The evaluation team	Being considered/in-process. PECO is fully engaged on this with the CSP. We are in a continuous process of

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
found discrepancies in the data transfer process (e.g., formatting issues, missing fields). PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.	improvement to resolve the system tracking and TRM related issues. We recognize this effects the realization rate and has great benefits in streamlining the process. Projects will be reviewed to ensure they follow TRM and additional CSP training solicited. In addition, PECO will work with DNVGL to consider automating the data transfer process as recommended.
Recommendation 5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the energy efficiency space despite the incentives it offers. Building relationships with a trade ally network for the SEI program is key to the program's success. Sixty-one percent of C&I respondents and 40 percent of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63 percent of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan.[85] Navigant recommends implementing these plans[86] in PY6. [85]DNV GL, "DRAFT: Strategic Marketing and Outreach Plan, PECO Smart Ideas for Business, Phase II, June 1, 2013 – May 31, 2016." [86]"In Phase II, we want to harness our Trade Ally feedback and respond to their needs. The new Trade Ally website is an exclusive tool available only to approved Trade Allies. Through this website, Trade Allies will access specialized training video modules and seminars designed to help them sharpen their sales skills. They will also be offered in-depth technology trainings to help them become more adept at selling the full suite of energy efficiency measures offered by PECO Smart Ideas programs. They will have access to proprietary marketing tools including co-branded collateral. A new Trade Ally tier program will recognize top performers and reward them accordingly, while providing proprietary access to program support for less active Trade Allies who want to elevate their performance. A Trade Ally advisory council will be established to reward top contributors and establish a forum for continual feedback. Lastly, networking events will provide opportunities to exchange information and program success stories with peers and gather insights through word-of-mouth."	Being considered. PECO will developing better PECO will collaborate with DNVGL to implement the strategies outlined in the marketing plan and outreach tactics for DNVGL.

Source: Navigant analysis

12.6 Financial Reporting

The SEI program continued to operate cost-effectively in PY5. he TRC benefit-cost ratio achieved for SEI GNI was 1.26. A breakdown of the SEI-GNI program finances is presented in Table 12-12.

Table 12-12: Summary of SEI-GNI Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	1,031	1,031
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	1,031	1,031
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	2,534	2,534
Marketing[2]	0	0
Subtotal EDC Implementation Costs	2,534	2,534
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	3,564	3,564
Participant Costs[4]	2,498	2,498
Total NPV TRC Costs[5]	**5,032**	**5,032**
Total NPV Lifetime Energy Benefits	5,658	5,658
Total NPV Lifetime Capacity Benefits	694	694
Total NPV TRC Benefits[6]	**6,363**	**6,363**
TRC Benefit-Cost Ratio[7]	**1.26**	**1.26**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

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

[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.

[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.

[5] Total TRC Costs includes Total EDC Costs and Participant Costs.

[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.

[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

13 Smart Business Solutions

The PECO Smart Business Solutions (SBS) program is designed to encourage and assist small, nonresidential customers to improve the efficiency of their existing facilities through turnkey installation and rapid project completion. The program includes lighting, refrigeration, and water heating measures that are typically low-cost with reliable, prescriptive energy savings and costs per unit.

The program is designed to assist small business owners to overcome the barriers to achieving energy efficiency that small businesses face. These include time constraints, capital constraints, lack of efficiency awareness, and lack of labor resources. The program addresses these barriers by providing incentives that are generally higher than similar measures installed through prescriptive and custom programs and by providing turnkey installation services.

13.1 Program Updates

PECO launched the SBS program in PY5, with the first participants completing projects in the second quarter of the program year. SBS is a direct-install program, designed to address informational, time, and resource barriers that PECO's small business customers face by making it easy for eligible customers to learn about the cost-effective savings opportunities in their facilities and by providing deeply discounted installation of lighting, electric water heating, and refrigeration efficiency measures. In its first year of operation, the program focused exclusively on lighting measures.

SBS implementer SmartWatt completed 417 projects in PY5, including nine projects in the GNI sector. Navigant's impact evaluation, which included file reviews and telephone surveys of sampled participants, resulted in a realization rate of 0.95. Total verified gross savings were 10,620 MWh, 86 percent of the PY5 SBS target of 12,334 MWh. Navigant's analysis of free ridership and spillover determined a NTG ratio of 0.9 using the SWE methodology. In contrast to the program design, which assumed that the program would not retrofit T12 linear fluorescent fixtures, over 80 percent of PY5 energy savings came from the replacement of T12 fixtures—measures that will have reduced lifetime savings in PY6 and PY7 due to a change in TRM baseline assumptions.

13.1.1 Definition of Participant

A participant in the SBS program is considered to be one project at one facility.

13.2 Impact Evaluation Gross Savings

Table 13-1 presents the gross reported energy and demand savings for the SBS program, distributed across customer sectors. As the table demonstrates, more than 95 percent of program activity was in the C&I sector, with the remainder in the GNI sector.

Table 13-1: Phase II SBS Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0	0
Low-Income	0	0	0	0
Small Commercial and Industrial	408	10,688	2.2	$1,421
Large Commercial and Industrial	0	0	0	0
Government, Nonprofit, and Institutional	9	439	0.1	$55
Phase II Total	417	11,127	2.3	$1,476

Source: PECO tracking data

Navigant completed file reviews of a stratified sample of 50 completed projects and telephone surveys of 20 participants nested within the file review sample. Both of these evaluation activities provided information on the types and quantities of baseline and retrofit lighting equipment and its operation both prior to and following each EE retrofit project. Navigant used the information collected through these activities to develop revised estimates of savings for each project and to develop program-level realization rates for energy and demand.

Navigant designed a single sample of projects to gather information for both gross and net impact evaluation purposes as well as for the process evaluation. Navigant presented its sampling plan to the SWE in a memo dated June 7, 2014. The SWE subsequently approved that plan.

The participant sample is a stratified random sample from the population of program participants in the PY5 tracking database at the project-level. Once the strata break points are determined and each project is assigned to one of the strata, each project is assigned a random number. The projects are sorted first by stratum and then by random number. The number of projects identified in Table 13-2 is then selected from within each stratum to form the sample. Note that the smallest projects that cumulatively account

for one percent of the aggregate population ex ante savings are excluded from the sample, due to the low value of information those projects can provide to the program evaluation as a whole.

Table 13-2: SBS Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	57	85/15	20 / 8	20 / 8	File Review / Phone Survey
Medium	114	85/15	19 / 8	19 / 8	
Small	216	85/15	11 / 4	11 / 4	
Very small	30	85/15	0 / 0	0 / 0	
Program Total	**417**	**85/15**	**50 / 20**	**50 / 20**	**File Review / Phone Survey**

Source: PECO tracking data, Navigant analysis

Estimation of sample sizes necessary for file review activities assumed a CV of 0.7 within each stratum. As SBS was a new program in PYS, there was no historical basis for selecting a CV. However, Navigant considered 0.7 to be a conservative estimate based on its experience with evaluations of similar programs in other jurisdictions. By using a conservative estimation of the CV, the sample design increases the likelihood that the estimated sample counts will ultimately achieve the confidence and precision goals for program kWh savings. Sampling was conducted using a dynamic methodology executed on a batch-wise basis. An initial sample of 25 projects was selected in May 2014 from projects that were completed during Q1 through Q3. The remaining samples were drawn following the close of the program year from projects that completed during Q4. Navigant reviewed sample distribution after Q4 to ensure that it met the program sampling design requirements.

As initially envisioned, and as described in the June sampling memo, the primary data collection activities were to be a file review of a sample of 50 participants followed by a telephone survey of the same participants. However, once the telephone survey effort began, it became clear that it would not be possible to complete the survey of all participants for whom file review had been conducted. Accordingly, Navigant developed a nested sample design, in which a phone survey of 20 projects was nested within the original sample of 50 file reviews. Nested sampling, also referred to as double ratio estimation, can lead to very efficient M&V because an initial, relatively inexpensive M&V technique (in this case file reviews) can adjust the ex ante estimates for any gross errors and bring the intermediate savings estimates into better alignment with TRM algorithms and assumptions. The second phase of M&V (in this case, phone surveys) then makes fine adjustments to the intermediate results. Because the first phase of this M&V process is designed to result in intermediate savings estimates that are close to their actual values, one can safely assume rather low values for the CV in designing the sample for the second phase. This approach allowed Navigant to achieve the target relative precision with a smaller number of phone surveys from within the population of file review projects.

Because Navigant had already completed the file review phase when it became clear that nested sampling would be needed (because it was proving difficult to complete surveys), the CV of the file review realization rates was known to be less than 0.1. Conservatively assuming a CV of 0.4 for the telephone survey results, Navigant calculated that the target sample sizes shown in Table 13-2 for each stratum would achieve the desired confidence and precision at the program level.

Once the phone survey quotas from within the original file review sample had been satisfied, the evaluation team began calling additional participants not in the original sample frame in random sort order to satisfy the sample sizes designated in the June sampling memo for purposes of verification, net savings analysis, and process evaluation. Thus, a total of 50 phone surveys were completed, but only 20 of these were used to determine gross verified savings.

As Table 13-3 presents, Navigant's analysis resulted in an energy realization rate of 0.95, resulting in verified gross energy savings for PY5 of 10,620 MWh. This is 86 percent of the PY5 SBS target of 12,334 MWh.[87] The proximity of the realization rate to 1.0 and the very low CV and achieved relative precision indicate that the implementer's practices for estimating savings from the measures installed in PY5 are well aligned with the TRM and are applied consistently.

Table 13-3: PY5 SBS Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design[1]	Relative Precision at 85% C.L.
Large	4,338	0.93	4,016	0.2	11.9%
Medium	3,810	0.98	3,291	0.2	11.5%
Small	2,865	0.99	3,204	0.2	11.2%
Very small	114	0.95	109	N/A	N/A
Program Total	**11,127**	**0.95**	**10,620**	**0.2**	**6.5%**

[1]The CV shown here is the CV for the telephone survey activity. The CV for file reviews was less than 0.1 for each stratum.

Source: PECO tracking data, Navigant analysis

Table 13-4 presents evaluation results for demand reduction. Realization rates were above 1.0 for each stratum and for the program as a whole. This is because survey respondents frequently indicated that the lighting equipment was in operation for much or all of the peak demand period, whereas the default CF for the facility type (on which ex ante demand reductions were often based) was well below 1.0. Navigant applied the participant-reported HOU and CFs only where the HOU were more than 10 percent above or below those shown for the facility type in the TRM. As was true for the energy realization rate, the low CV

[87] *PECO Energy Efficiency and Conservation Plan (EE&C)*, p.107, March 2014.

and relative precision indicate a high degree of consistency in the program implementer's savings estimation methodology.

Table 13-4: PY5 SBS Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings[1]	Demand Realization Rate	Verified Gross Demand Savings (MW)[1]	Observed Coefficient of Variation (C_v) or Proportion in Sample Design[2]	Relative Precision at 85% C.L.
Large	0.7	1.33	1.0	0.3	15.5%
Medium	0.8	1.10	0.9	0.2	11.8%
Small	0.7	1.33	0.9	0.2	9.0%
Very small	0.0	1.24	0.0	N/A	N/A
Program Total	**2.2**	**1.24**	**2.8**	**0.3**	**7.0%**

[1]All demand values have been adjusted for line losses using a factor of 1.111
[2]The CV shown here is the CV for the telephone survey activity. The CV for file reviews was less than 0.1 for each stratum.

Source: PECO tracking data, Navigant analysis

13.3 Impact Evaluation Net Savings

Navigant determined net savings by including the standard, SWE-approved free ridership and spillover question batteries in its participant survey and utilizing the approved methodology for analyzing the responses to those questions to determine NTG ratios for all sampled projects.[88] Navigant targeted 15 percent precision at 85 percent confidence for its estimate of the program-level NTG ratio. As Table 13-5 indicates, the evaluation team collected NTG information from a total of 50 participants.

[88] For more information on the net savings methodology, the reader is referred to the SWE Guidance Memo #24: *Common Approach for Measuring Free Riders for Downstream Programs* and Guidance Memo #25: *Common Approach for Measuring Spillover (SO) for Downstream Programs*.

Table 13-5: SBS Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[89] to Achieve Sample
Large	>51 MWh	57	0.7	85/15	20	15	100%
Medium	>22 MWh, <=51 MWh	114	0.7	85/15	19	19	100%
Small	>6 MWh, <= 22 MWh	216	0.7	85/15	11	11	100%
Very small	<6 MWh	30	N/A	N/A	0	5	N/A
Program Total	N/A	417	N/A	N/A	50	50	N/A

Source: PECO tracking data, Navigant analysis

Navigant's NTG analysis, which is summarized in Table 13-6, indicates low and roughly equivalent levels of free ridership across the four strata, with total program free ridership estimated at 0.1. This is not surprising, given the population of customers eligible to participate in the SBS program. PECO chose to address this population with a direct-install approach precisely to address the information and resource barriers that this population of customers faces.

Those same barriers also make spillover unlikely for this population, which is also reflected in Table 13-6. Navigant estimates program-level spillover at 0.0. The resulting NTG ratio at the program level is 0.9.

Table 13-6: Program Year 5 SBS Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Large	0.1	0.00	0.9	0.7	7.7%
Medium	0.1	0.00	0.9	0.7	3.7%
Small	0.1	0.00	0.9	0.7	7.8%
Very Small	0.1	0.06	1.0	N/A	3.6%
Program Total	**0.1**	**0.002**	**0.9**	N/A	**3.0%**

Source: Navigant analysis

[89] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

13.4 Process Evaluation

Navigant conducted two primary research activities in support of the process evaluation. These were:

- In-depth interviews with the PECO and SmartWatt program managers
- Telephone surveys of a sample of participants and partial participants

13.4.1 Program Manager Interviews

Navigant conducted in-depth interviews with the PECO program manager and the CSP (SmartWatt) program manager. This section summarizes Navigant's findings from these interviews.

Program managers are satisfied with the way the program is operating. Both the PECO and SmartWatt program managers feel that the program is operating smoothly, with few problems. Both felt that program roles are well defined and that the program is adequately staffed.

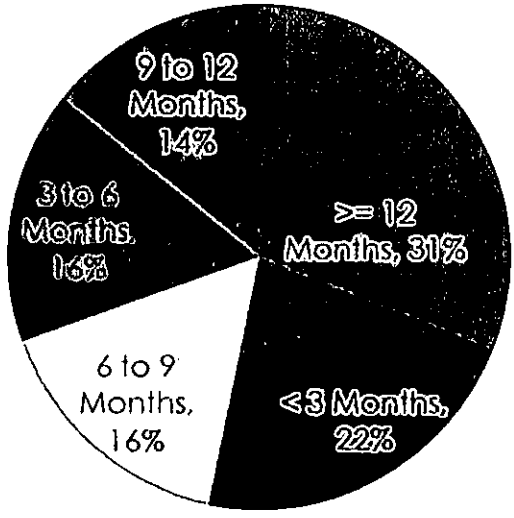
The program is able to ramp up and down quickly. Both program managers noted the program's flexibility to increase and decrease participation. The SmartWatt program manager estimated that it would take the company two to three months to add the staff necessary to increase program participation by 50 percent and about six months to double participation. He also noted that SmartWatt could ramp the program down even faster by ceasing sales representative activity. Doing so would stop new projects from being added to the pipeline, but program activity would not cease immediately due to projects already in the pipeline. The SmartWatt program manager indicated that there is typically a two-week backlog of projects for which customers have signed contracts, but which have not yet been installed. He indicated that that amounts to about 700 to 800 MWh of annual savings.

Through the end of PY5, SmartWatt was not calculating program incentives as specified in the program plan. The program description contained in the approved EE&C Plan states that "Participant discounts will be calculated so that the participant has a one-year payback on the installed equipment and will depend on usage patterns of the participant such as lighting operation hours."[90] The payback period for many projects was substantially less than one year and amounted to no more than a few months in many cases. As Figure 13-1 illustrates, less than one-third of all PY5 projects had paybacks of one year or more, and nearly half had paybacks less than 9 months. The source of this discrepancy is the fact that SmartWatt is not basing participant incentives on payback period but rather is calculating a performance incentive by multiplying estimated annual savings by approximately $0.14/kWh, capped at 90 percent of project cost. During an in-depth interview, the SmartWatt program manager indicated that this practice has not changed.

[90] *PECO Energy Efficiency and Conservation Plan (EE&C)*, p. 98, amended.

Navigant finds that in addition to being in conflict with the EE&C Plan, SmartWatt's current practice provides significantly larger incentives to participants than to which most would be entitled, were incentives calculated to provide a one-year payback. This practice reduces program cost-effectiveness and reduces the number of customers that can participate in the program. In addition, although Navigant notes that there is no evidence that this is happening (as indicated by the program's PY5 energy realization rate of 0.95), SmartWatt's current method of calculating incentives creates a perverse incentive for the implementer to inflate estimated savings, as SmartWatt's per-project administrative fee is calculated as 25 percent of the project incentive.

Figure 13-1: Payback Periods of PY5 SBS Projects



Source: Navigant analysis

13.4.2 Participant Survey

Navigant conducted a telephone survey of 50 PY5 participants to verify equipment installation, gather NTG information, and elicit information about participants' experiences with the program. Details on sampling for these surveys were previously presented in Table 13-5. The results presented in this section demonstrate that participants are largely pleased with the program, but participant responses indicate a few opportunities for improvement.

Measure Verification

The tracking data indicate that survey respondents installed a total of 3,888 measures. Their responses to survey questions inquiring into installations reveal almost perfect agreement with the tracking data, as indicated in Table 13-7.

Table 13-7: Verification Rate by Measure category

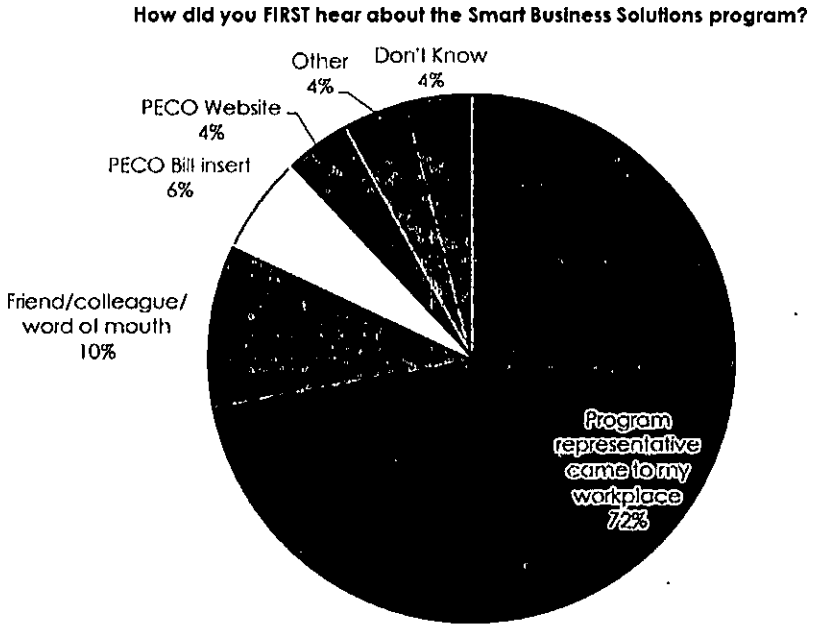
Measure Category	Verification Rate
Compact Fluorescent bulbs	0.99
Lighting controls	1.00
Exit signs	1.00
LED Fixtures	0.99
Linear fluorescent fixtures	1.00
Delamping	1.00
Total	**1.00**

Source: Participant survey

Modes of Enrollment with the SBS Program

As it is a direct-install program, with the implementer proactively engaging customers, it is not surprising that the majority of respondents learned about the program only when the sales representative arrived at their facility, as demonstrated in Figure 13-2. Word of mouth was the second most common source of information, with bill inserts and the PECO websites also mentioned by small numbers of respondents.

Figure 13-2: How Respondents Learned of the SBS Program

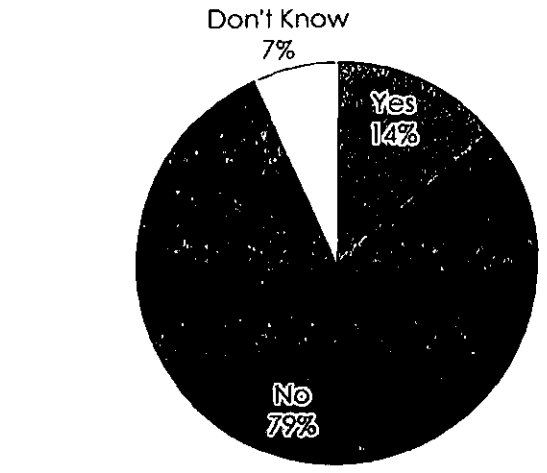


Source: Participant survey

Respondent Plans in Absence of SBS

Nearly 80 percent of respondents indicated that, without the SBS program, they would not have undertaken the EE retrofit project at their facility. The 14 percent indicating that they would have conducted the project is roughly twice the level of free ridership indicated by their responses to the NTG battery (see Section 13.3). This is not surprising, as there is often a disparity between intentions and actions to implement efficiency projects.

Figure 13-3: Respondent Plans in Absence of SBS Program



Source: Participant survey

Ease of Application Process

All respondents reported that the SmartWatt sales representative clearly explained program requirements and the participation process to them. Respondents were asked to rate the ease of application on a 5-point scale, where 1 was very difficult and 5 very easy. Eighty percent of respondents provided a rating of 5; the rest rated application ease at 4.

Disruptiveness of the Energy Audit

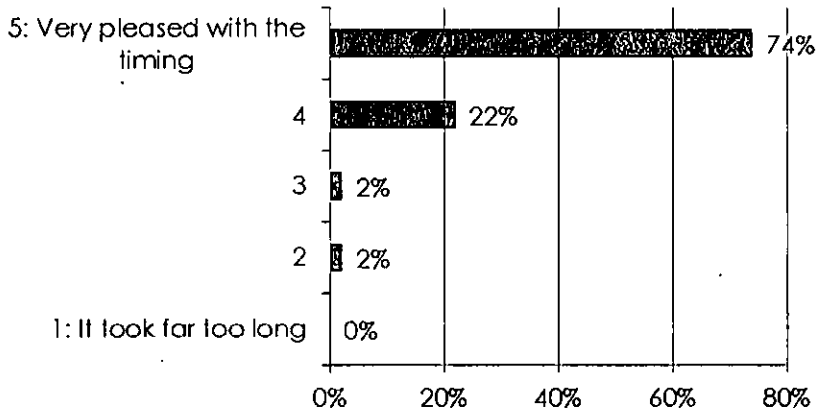
When asked to rate how disruptive the initial energy audit was, the majority of respondents, 88 percent, indicated that this was not an issue. The two respondents indicating that the audit had been disruptive to some degree were unable to provide suggestions about how the audit process could have been improved.

Interval between Audit and Installation

Navigant asked participants to use a 5-point scale to rate their satisfaction with how long it took to install the measures they agreed to, once they had signed the contract with SmartWatt. As Figure 13-4 indicates, nearly all participants found this interval to be acceptable.

Figure 13-4: Participant Satisfaction with Timing of Project Completion

How do you feel about the amount of time that passed between when you signed the contract for the project and when the electricians showed up to begin work?



Source: Participant survey

Disruptiveness of the Project

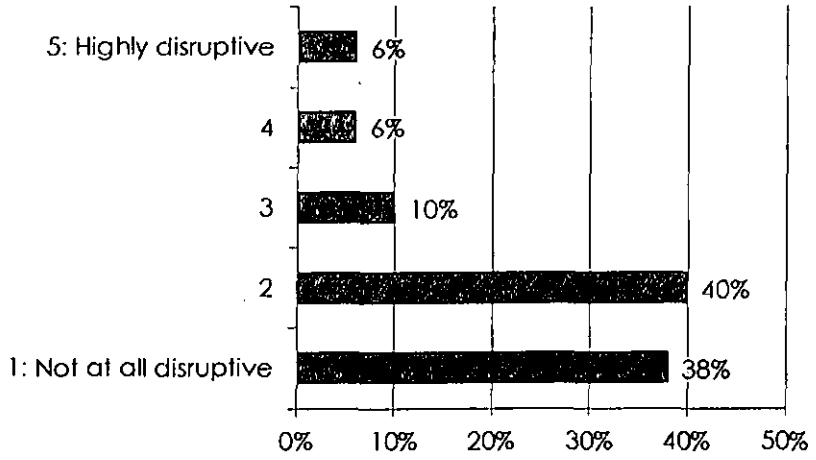
Navigant asked respondents to use a 5-point scale to rate the disruptiveness of the equipment installation, where a rating of 1 indicated not disruptive and a rating of 5 indicated that the installation was highly disruptive to business processes. The results, presented in Figure 13-5, indicate that, while most respondents found the disruption to be minimal, 22 percent indicated that the process had been somewhat to highly disruptive.

Of the eleven respondents indicating some degree of disruption (ratings from 3 to 5), ten indicated that they had received information prior to the installation about what to expect during installation and how it might disrupt normal work processes. When asked what the installation crews could have done to reduce the disruptiveness of the project, nine of these eleven respondents indicated that there was

nothing that the installers could have done. The other two respondents suggested it would have been helpful to meet with the installers in advance of the project.

Figure 13-5: Respondent Ratings of Project Disruptiveness

How disruptive would you say the installation of the efficient lighting was to your work process, using a scale where 1 means not at all disruptive and 5 is highly disruptive?



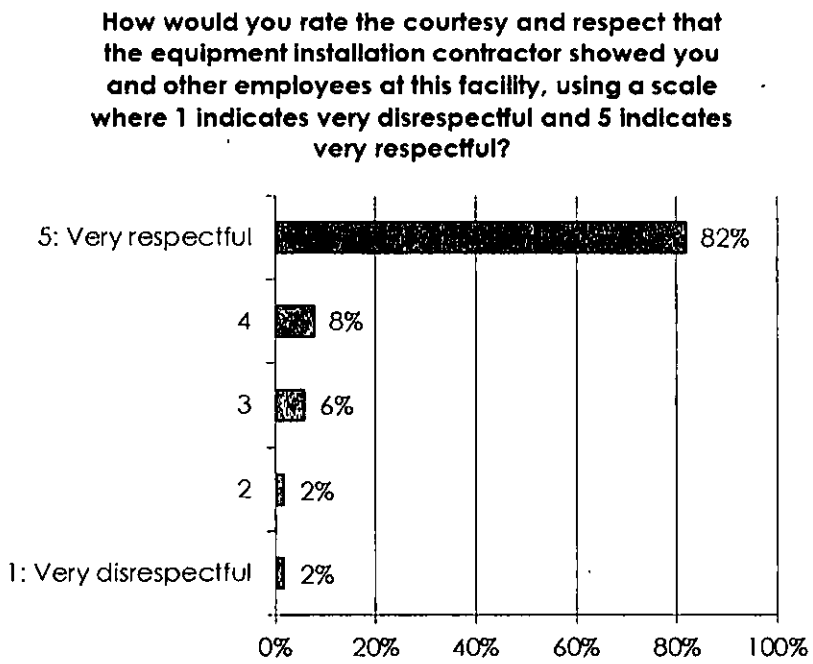
Source: Participant survey

Courtesy of Installers

Figure 13-6 demonstrates that the majority of respondents found the installation crews to be courteous and respectful. The following are some of the verbatim comments from those indicating otherwise:

- "They didn't want to do everything that was promised, they were quite lazy. They didn't want to put in motion detectors or install the dimmers properly."
- "They were more concerned about getting to the bar for happy hour."
- "They showed up whenever they felt like it. They were sloppy. They spent more time on the phone outside talking to people than inside. They never showed up on time, and they wanted to leave job uncompleted and move on to another job without finishing here."

Figure 13-6: Respondent Ratings or Installation Crew Courtesy



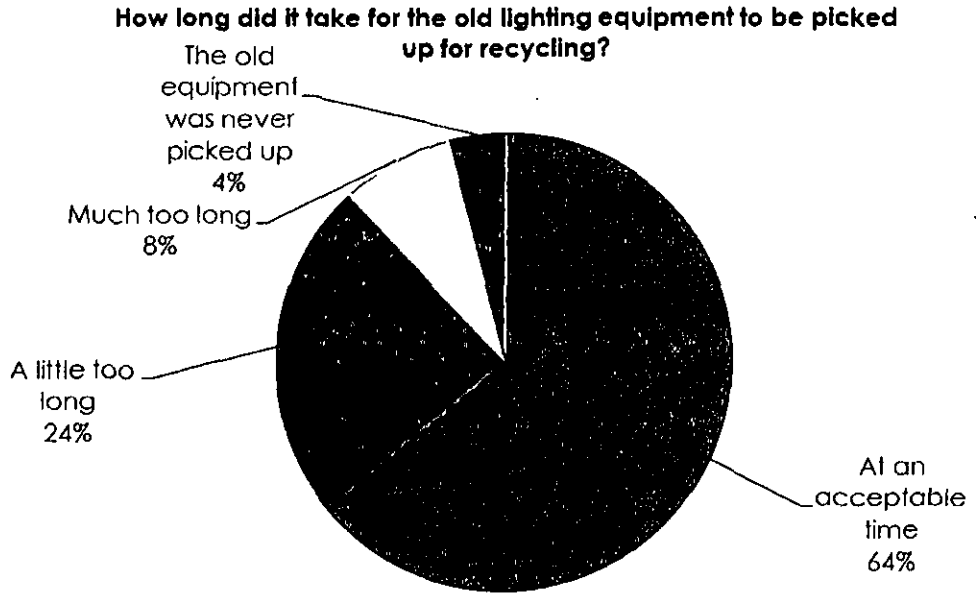
Source: Participant survey

Equipment Delivery and Removal

Navigant asked survey respondents about the timing of new equipment delivery prior to installation and removal of old equipment for disposal or recycling following the project. Nearly 90 percent indicated that the new equipment was delivered at an acceptable time, six percent felt it was "a little too far in advance", and two participants indicated that the installation crew got there first and had to wait for equipment delivery.

There was a bit more dissatisfaction following installation, with 32 percent of respondents indicating that it took "a little" or "much too long" for the old equipment to be picked up (Figure 13-7). Two respondents stated that old equipment was never picked up.

Figure 13-7: Satisfaction with Removal of Old Equipment



Source: Participant survey

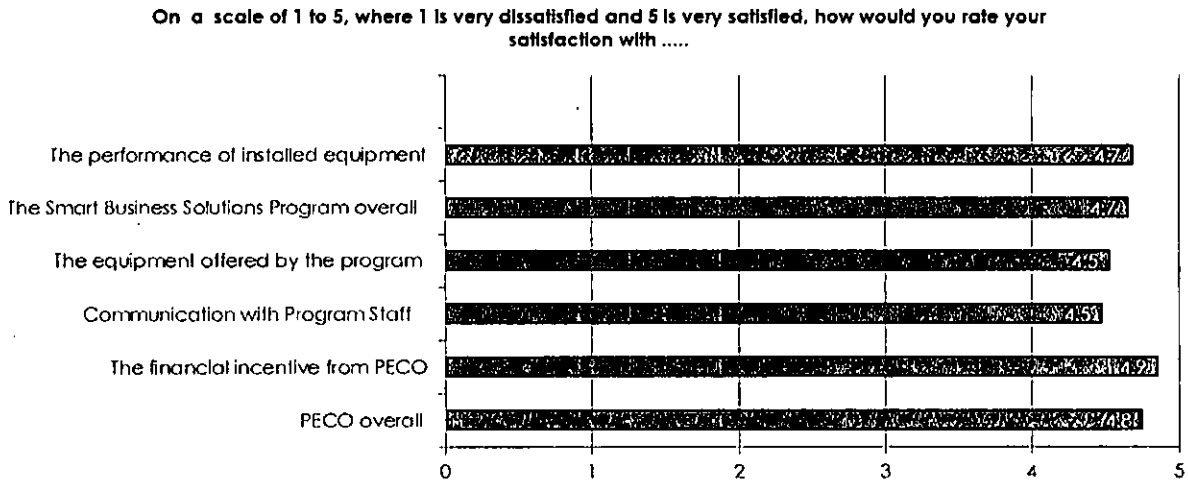
Satisfaction with Program Elements

Navigant asked survey respondents to rate their satisfaction with the five aspects of the program shown in Figure 13-8 as well as their satisfaction with PECO overall. Responses for all program elements were high, with none dropping below 4.5 on a 5-point scale. Respondents also indicated that they were pleased with PECO as well, giving PECO an average rating of 4.8.

While the overwhelming majority of participants were very pleased with the program, a small number indicated dissatisfaction with one or more program elements. In these cases, Navigant probed the reasons for their dissatisfaction. Their verbatim statements, presented below, provide anecdotal information that may be informative to program management:

- "The sales person and the installers weren't on the same page. The sales person told me I'd get motion detectors in various rooms and dimmer switches, and the people who installed them told me that wasn't possible."
- "I have made several attempts for communication and no one ever responded back."
- "I didn't save money with the program. The electric bills are the same as they were before."
- "We have one area that's not well enough lit. It's in the cooler and we will have to add more lighting in that location."

Figure 13-8: Respondent Satisfaction with Program Elements



Source: Participant survey

Navigant also gave respondents the opportunity to describe any other problems they experienced with the program. Eleven respondents described additional problems. The following verbatim comments are representative:

- "The estimator was off on his count on the lights, he missed some. And the program coordinator called and asked how happy we were. I told him about the miscount, and they sent the estimator back out. The contractor should have come back out to finish the lighting that was not finished in the first place, and that still has not happened."
- "The only problem I had is that the initial person who came out to see what we needed to replace did not factor in enough lighting in our back warehouse room. We had to call back to get more work done and that was difficult."
- "They didn't finish two of the lights, they missed them."
- "I have had a couple of lamps that have fallen down because short screws were being used. They didn't replace those lamps with wing nuts or the original setup that I had originally used. They used a cheaper way out."
- "They installed the incorrect exit signs and emergency lights. We had to buy all new fixtures and pay a contractor to correct it. We had to hire a contractor to install the correct equipment. This was in addition to the initial cost."
- "We still have lights out. We still have lights that were supposed to be changed out that were not. We have not paid for the project and I have not received a response from the program. My last contact with the program was in June."

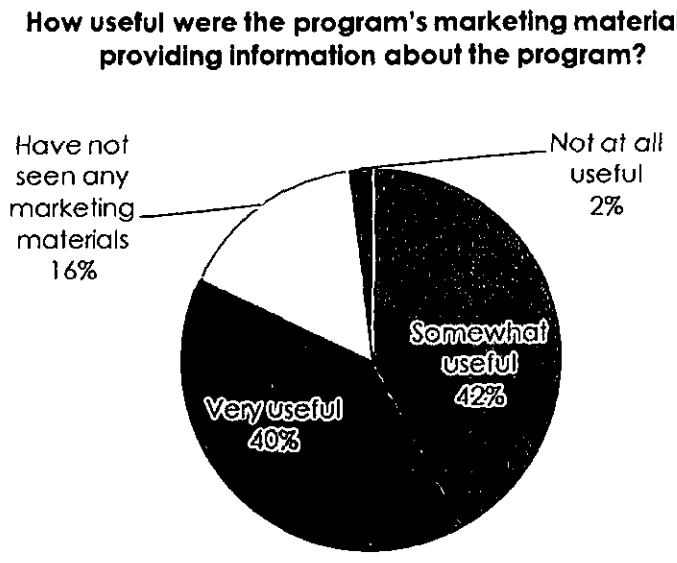
While the above quotes indicate some serious implementation issues, the satisfaction ratings shown in Figure 13-8 suggest that these issues are not systemic problems but are specific to individual projects. In

some cases, there are indications that SmartWatt was responsive when the customer raised the issue, but in other cases the respondent is still waiting for resolution of the problem.

Marketing Materials

Navigant asked participants several questions about the effectiveness of existing marketing materials and the channels that would be most effective in promoting the SBS program. Figure 13-9 indicates that most respondents found the existing materials to be helpful, though 16 percent did not remember seeing marketing materials. This is not surprising, since limited program marketing began in the latter half of the program year.

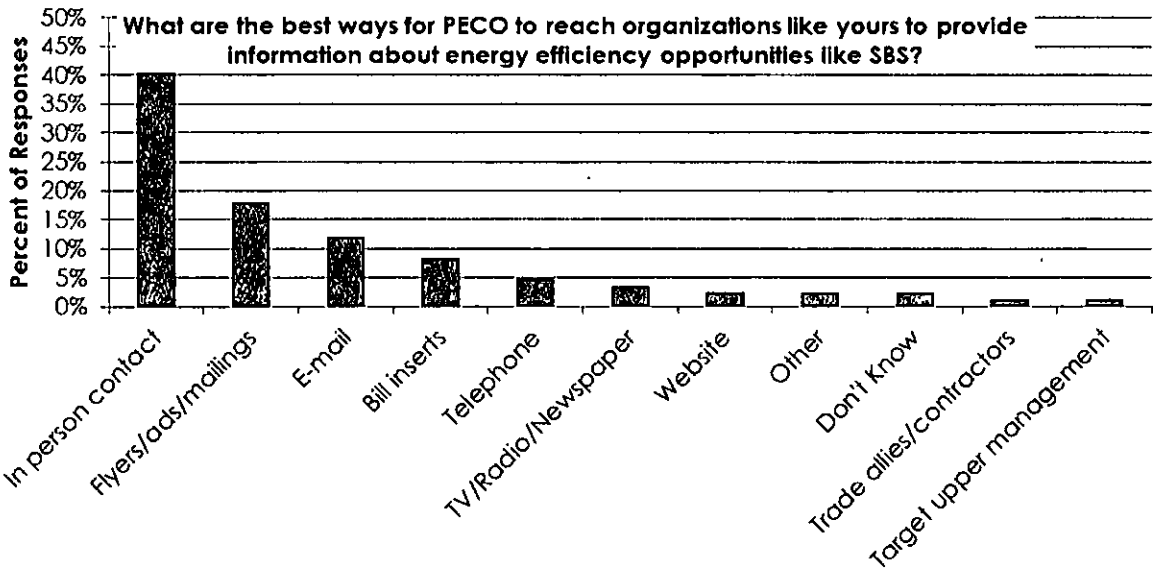
Figure 13-9: Effectiveness of Marketing Materials



Source: Participant survey

Respondents indicated that the two channels SmartWatt is already employing, namely in-person contact and direct marketing through mailings, are the most effective ways to promote the program. Figure 13-10 presents these and other channels mentioned by respondents.

Figure 13-10: Best Ways to Promote SBS

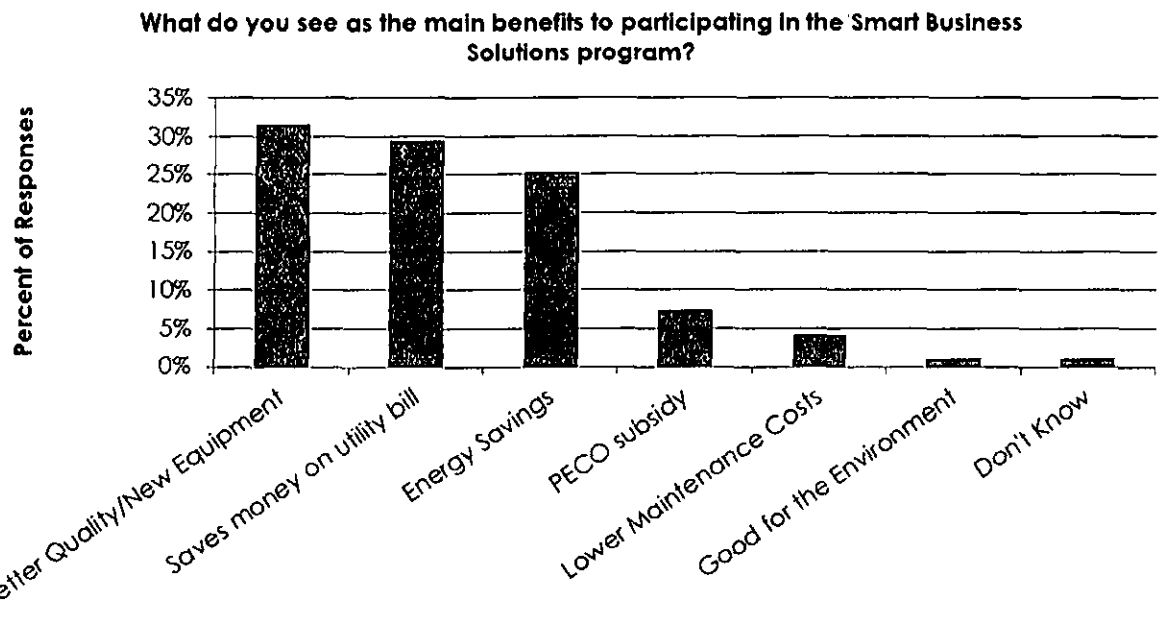


Source: Participant survey

Program Benefits

Respondents' opinions about the benefits of participation are presented in Figure 13-11. From these responses, it is clear that participants value the bill savings that their projects are providing, as well as the quality of the new lighting equipment. One rather surprising result of these responses is that the PECO incentive was mentioned as a benefit by participants only about 20 to 25 percent as often as the top three responses. This reinforces the notion that the program incentives need not be as high as they have been to drive the level of program activity needed to achieve savings goals.

Figure 13-11: Program Benefits Mentioned by Respondents



Source: Participant survey

Program Drawbacks

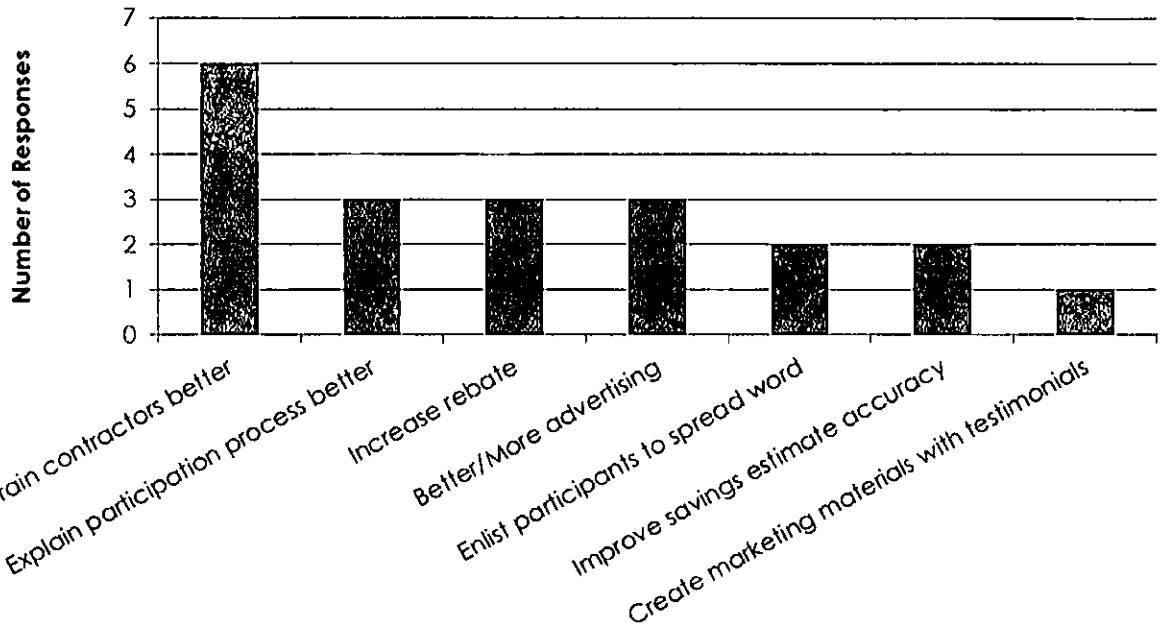
Most survey respondents were unable to think of drawbacks to participating in the SBS program. Of the nine that did articulate drawbacks, three cited disappointment that savings hadn't matched their expectations, three mentioned the projects' costs, two noted that the installations can be disruptive, and one referred to disappointment with the competence of the installation crew.

Opportunities for Improvement

Twenty-three of the respondents offered comments on how to improve the program. These comments are categorized in Figure 13-12. Given the small numbers of comments in each category, Navigant does not believe these comments indicate widespread implementation problems; however, they do suggest possible program improvements.

Figure 13-12: Participant Suggestions for Program Improvement

In your opinion, how could the Smart Business Solutions program be improved?



Source: Participant survey

Training for program employees. The most common category of comments, provided by five of the respondents, suggest better training for the installation crews and in one case the sales representative. These comments came from respondents who had previously described problems with their installation or with fixtures being missed in the initial audit.

Communication about the participation process. Three respondents suggested better communication about the participation process, indicating that they would have appreciated more information about the status of their project and when installation would begin. Although this does not appear to be a widespread problem, Navigant recommends that SmartWatt review its processes for keeping participants informed about the schedule for and status of their projects. Navigant also recommends that SmartWatt ensure that its sales representatives explain to participants what they should expect during the retrofit project, particularly if it is likely to be highly disruptive to normal work processes.

Rebate levels. Three respondents suggested higher rebates.

Savings estimate accuracy. Two respondents recommended improving the accuracy of savings estimates and indicated that their actual savings were far below the estimate they had been given.

Program marketing. Six participants made recommendations regarding marketing the program, shown in the figure as the categories "Better/More advertising", "Enlist participants to spread word", and "Create

marketing materials with testimonials". The common thread in all of these comments is that more could be done to raise awareness about the existence of this program, reflecting the fact that marketing efforts thus far have been strategic and limited. An implied message in these comments is that the participants who made them appreciate the program and want more of their peers to benefit from it. Some would clearly like to help in this effort and suggested leaving contact information behind that they could provide *to other interested business owners.*

13.5 Recommendations for Program

This section discusses the recommendations for the program, and Table 13-8 lists each recommendation and the PECO status.

Recommendation #1: The program began installations of refrigeration measures in PY6, and by doing so has begun to diversify the source of program savings. Navigant recommends that PECO work with SmartWatt to further reduce the program's dependence on savings from T12 retrofit projects. To assist with this transition, Navigant proposes to re-evaluate the cost-effectiveness of LED replacements for linear fluorescents as the cost and performance of this rapidly changing technology continue to evolve. If and when this analysis indicates cost-effective niches for this type of project, Navigant will recommend that PECO file an EE&C plan amendment to include it. Additionally, since HVAC represents a large and ubiquitous electrical load for the eligible SBS population, Navigant proposes to investigate and, if cost-effective, present a set of HVAC maintenance measures to PECO for possible inclusion in the program. Such measures would be limited to those that could be implemented quickly with relatively low cost, such as:

- Programmable thermostats
- Air filter replacement
- Refrigerant charge optimization
- Replacement of fan belts with cogged v-belts
- Check and replacement of roof-top unit (RTU) panel gaskets
- Evaporator and condenser coil cleaning
- Repair/replace refrigerant line insulation
- *Economizer repair or decommissioning*
- Time of day schedule adjustments (start/stop later/earlier)
- Discharge air temperature (DAT) set point check/program DAT reset if available in the controller but not programmed
- Outside air percentage adjustment

Should any of the above prove to be cost-effective, it would be beneficial to develop an IMP for use until the measure can be added to the TRM (with the exception of refrigerant charge optimization, which is already in the TRM). PECO would also need to file a program amendment prior to any SBS installations.

Recommendation #2: PECO should require SmartWatt to calculate project incentives to provide the participant with a one-year payback for all new projects, effective immediately. Doing so will provide the following benefits:

- It will bring the program into alignment with the EE&C plan
- It will allow limited program funds to assist a greater number of customers and result in greater savings
- It will allow the program to provide deeper savings

Recommendation #3: In future contracts with the CSP for this program, PECO should consider alternate structures for the administrative fee, such as a fixed fee per quarter or year, or a fee that varies with the number of projects completed, rather than the magnitude of energy savings.

Recommendation #4: SmartWatt should discuss participant comments regarding material pickup with its recycling contractor to determine whether any changes can be implemented to speed up the process of collecting the old equipment and to investigate what happened with the customers who claim that their old equipment has not been picked up.

Recommendation #5: Several survey respondents indicated problems with their installations that remain unresolved. Navigant will identify the specific participants who made these comments for follow-up by SmartWatt. To prevent similar unresolved issues in the future, SmartWatt should review its dispute resolution procedures to identify any gaps that may have resulted in the lack of satisfactory resolution of project issues identified by the survey participants.

Recommendation #6: Contact information for both the PECO and SmartWatt program managers should be left with each participant at the conclusion of each project, so that participants know whom to contact with problems and so that these problems can be resolved quickly and completely.

Recommendation #8: In the course of its impact evaluation, Navigant noted that, in most cases, the HOU employed to develop the ex ante savings estimate was either the TRM default or was justified based on the customer reported schedule. However, there were a small number of cases where the ex ante estimates used operating hours far in excess of both the TRM and customer-reported hours. Navigant recommends that the SmartWatt sales representative be required to document customer-reported schedules where they diverge from default TRM hours, so that a review of HOU can become part of SmartWatt's internal quality control process. This may assist in appropriately setting participant savings expectations.

Table 13-8: SBS Status Report on Recommendations

Recommendations	*EDC Status of Recommendation* (Implemented, Being Considered, Rejected, and Explanation of Action Taken by EDC)
Recommendation 1: Evaluate additional measures for incorporation in the program to help reduce dependence on T12 retrofits.	*Being considered. PECO is continuously* evaluating the need to modify the portfolio based on research findings.
Recommendation 2: Calculate project subsidies to provide the participant with a one-year payback.	Being considered. PECO is working with the CSP to ensure the appropriate training and skills necessary to accurately determine incentives at the approved levels.
Recommendation 3: In future CSP contracts, consider an administrative fee structure that does not depend on magnitude of energy savings.	*PECO will consider this for future phases.* However, a broad range of strategies and approaches will be considered based on program design.
Recommendation 4: SmartWatt should determine whether any changes can be implemented to speed up the process of collecting removed equipment.	*PECO is investigating to see if this is an* issue and how significant. PECO will take steps to address as appropriate.
Recommendation 5: SmartWatt should follow up with survey respondents who indicated that they have unresolved problems with their installations. SmartWatt should review its dispute resolution procedures to identify any gaps that may have resulted in the lack of satisfactory resolution of project issues.	PECO is investigating to see if this is an *issue and how significant. PECO will take* steps to address as appropriate.
Recommendation 6: Contact information for both the PECO and SmartWatt program managers should be left with each participant at the conclusion of each project, so that participants know whom to contact with problems and so that these problems can be resolved quickly and completely.	Implemented. This has been an ongoing *process since the inception of the* program.
Recommendation 7: SmartWatt sales representatives should document customer-reported schedules where they diverge from default TRM hours, so that a review of HOU can become part of SmartWatt's internal QC process.	Being considered. SmartWatt currently documents customer reported schedules when they diverge from default TRM hours. Will ensure the schedules make it into reports and are easier identifiable *for EM&V purposes.*

Source: Navigant analysis and PECO

13.6 Financial Reporting

Navigant's cost-effectiveness analysis, presented in Table 13-9, indicates that the SBS program was highly cost-effective in PY5, with a benefit-cost ratio of 3.06.

Table 13-9: Summary of SBS Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	1,476	1,476
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	1,476	1,476
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	443	443
Marketing[2]	3	3
Subtotal EDC Implementation Costs	446	446
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	1,921	1,921
Participant Costs[4]	2,745	2,745
Total NPV TRC Costs[5]	3,190	3,190
Total NPV Lifetime Energy Benefits	8,187	8,187
Total NPV Lifetime Capacity Benefits	1,535	1,535
Total NPV TRC Benefits[6]	9,773	9,773
TRC Benefit-Cost Ratio[7]	3.06	3.06

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

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

[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.

[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.

[5] Total TRC Costs includes Total EDC Costs and Participant Costs.

[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.

[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis and PECO program data

14 Smart Multi-Family Solutions -Nonresidential

The purpose of the PECO SMF Solutions program is to increase awareness of energy savings opportunities in MF buildings and assist MF residents and building owners/managers to act on those opportunities. The program is designed for both MF property owners and MF customers. Existing commercial, residential, governmental, institutional, and nonprofit MF buildings, including master-metered common areas and individual tenant accounts, with four or more living units, are eligible to participate in this program.

This program is designed to encourage and assist customers by offering two main participation channels. The prescriptive channel offers incentives to MF property owners who install high-efficiency equipment in common areas. The measures offered in the prescriptive channel include Energy Star heat pump water heaters (incentives ranging from $200 to $350 per unit), exterior high-wattage, pin-based CFLs (incentives ranging from $10 to $40 per unit), T8/T5 fluorescent lamps and fixtures (incentives ranging from $0.25 to $12 per unit), common area air source A/C and heat pumps, common area PTACs and heat pumps (incentives ranging from $25 to $80 per unit), and LED exit signs (incentives ranging from $15 to $25 per unit).

The direct install channel offers free TRM lighting and non-lighting measures, such as CFLs, low-flow showerheads, and low-flow faucet aerators to willing MF residents. The non-lighting measures are only offered for those units that have electric water heating.

The PECO SMF Solutions program has two segments: SMFRES and SMFNR. The non-residential segment includes projects completed in SMF Commercial and Industrial (SMFCI) and SMFGNI multi-family buildings. The SMF Solutions program was evaluated as a whole, including both the residential segment and the non-residential segment. The non-residential segment of SMF Solutions program PY5 impact evaluation activities, findings, and recommendations is discussed in this section. The residential segment is discussed in a separate section.

14.1 Program Updates

The SMF Solutions program is a new Phase II program. The program design and planning started on June 1, 2013. The PY5 implementation launched in September 2013 and ended in May 2014.

Despite the lack of participation in the prescriptive channel, the SMF Solutions program as a whole, exceeded the PY5 planned MWh goals. However, the program underachieved the demand reduction goals. The SMFNR segment achieved 180 percent of the planned PY5 energy savings goal and 76 percent of the demand reduction goal. For both the program components, a majority of the participation was in the TRM Lighting category. These measures have lower peak demand coincidence factors than the non-lighting measures, which contributed to the underattainment of the program peak demand reduction.

Program staff reported the program has a good pipeline of direct install projects for PY6 and should have no problem meeting PY6 goals.

14.1.1 Definition of Participant

Every C&I and GNI master utility account ID completing energy efficiency upgrades either in the direct install channel or in the prescriptive channel is counted as a participant in the SMFNR segment.

14.2 Impact Evaluation Gross Savings

In PY5, the SMFNR segment of the SMF Solutions program did not see any participation in the prescriptive channel and 100 percent of the verified savings were from direct install measures. Eighty percent of these direct install measure savings were from TRM-lighting measures. In PY5, the SMF Solutions program completed 219 C&I and 15 GNI direct install projects. The program had no prescriptive measure participation and therefore did not incur any incentive payments.

Table 14-1 shows the SMFNR segment-level energy and demand reported savings estimates and gross impact results. Totals may not equal the sum of each sector due to rounding.

Table 14-1: Phase II SMF Solutions - Residential Segment Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Commercial and Industrial	219	2,801	0.24	0
Government, Non-Profit, and Institutional	15	160	0.02	0
Phase II Total	**234**	**2,961**	**0.25**	**0**

Source: Evaluation Team Analysis

14.2.1 M&V Methodology

In PY5, the evaluation team calculated the SMF Solutions program gross impacts. Net impacts are scheduled to be evaluated in PY6 and PY7.

The PY5 evaluation methods consisted of in-depth phone interviews with program management and implementation staff, tracking data analysis, and project application file reviews. The evaluation approach for deemed measures was to verify both the reported quantity and that the measure matched the TRM-required specifications. The evaluation team conducted a record-by-record review of the projects listed in the tracking database by recalculating the savings estimates using the 2013 TRM guidance.

To support the impact evaluation, project documentation in electronic format was obtained from the implementer for each of the 30 sampled SMFCI projects and for the census of 15 SMFGNI projects. Documentation included project direct installation forms and summary sheets, which included premise-level ex ante savings, measure type, and measure count information. The evaluation team verified all

measures installed at a sampled facility and verified the counts and that the ex ante savings adhered to the 2013 TRM.

14.2.2 Sampling

The sample design for the PY5 SMF Solution program used stratified ratio estimation. The evaluation team designed the final program sample to achieve the required 85/15 confidence and precision level with a 0.5 CV. Within the SMFNR segment, the evaluation team stratified the sample by ex ante kWh savings recorded in the program tracking database. The evaluation team grouped projects into three strata: *Large, Medium,* and *Small.* The evaluation team designed the initial kWh cutoffs for the strata such that one-third of overall energy savings falls into each stratum. This resulted in the *Large* stratum containing very few projects and the *Small* stratum containing a large portion of the projects. The evaluation team then adjusted the kWh cutoffs to account for natural breakpoints in the project sizes and to create an efficient sample design. However, the size stratum was considered strictly to capture a large portion of the program kWh savings while still sampling a variety of differently sized projects.

In accordance with the Evaluation Plan, the evaluation team targeted a sample of 30 participants for the SMFCI sub-segment for PY5. However, the SMFGNI program sub-segment only had 15 participants in PY5, and therefore the original target sample of 30 for this segment was not met. A census of SMFGNI participants was included in the sample. Table 14-2 shows the details of the SMFNR segment and sub-segment-level sampling efforts.

Table 14-2: SMF Solutions – Non-Residential Segment Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
SMFCI - Large	6	85/15	10	5	Impact: File Reviews
SMFCI - Medium	23	85/15	10	8	Impact: File Reviews
SMFCI - Small	190	85/15	10	17	Impact: File Reviews
SMFGNI	15	85/15	15	15	Impact: File Reviews
Program Total	**234**	**85/15**	**45**	**45**	N/A

Source: Evaluation Team Analysis

14.2.3 Gross Impact Evaluation Findings

The evaluation team developed ex post gross impacts, informed via file reviews and tracking database verification, for each sampled project within the SMFNR program segment and analyzed these results to determine the ex post gross impacts. The final impact analysis for the SMFNR segment resulted in an energy and demand realization rate of 1.00. Table 14-3 presents the strata-level relative precision levels for verified gross energy savings for the SMFNR segment.

Table 14-3: PY5 SMF Solutions – Non-Residential Segment Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
SMFCI - Large	1,079	1.00	1,079	0.0	0%
SMFCI - Medium	843	1.00	843	0.0	0%
SMFCI - Small	878	1.00	878	0.0	0%
SMFGNI	160	1.00	160	0.0	0%
Program Total	**2,961**	**1.00**	**2,961**	**0.0**	**0.0%**

Source: Evaluation Team Analysis

Table 14-4 presents the strata-level relative precision levels for verified gross demand savings for the SMFNR segment.

Table 14-4: PY5 SMF Solutions – Non-Residential Segment Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
SMFCI - Large	0.09	1.00	0.1	0.0	0%
SMFCI - Medium	0.07	1.00	0.1	0.0	0%
SMFCI - Small	0.08	1.00	0.1	0.0	0%
SMFGNI	0.02	1.00	0.0	0.0	0%
Program Total	**0.25**	**1.00**	**0.3**	**0.0**	**0.0%**

Source: Evaluation Team Analysis

14.3 Impact Evaluation Net Savings

Net impacts were not measured in PY5.

14.4 Process Evaluation

The PY5 process evaluation is informed mainly by in-depth interviews of the PECO program management staff and Franklin Energy staff. The process evaluation was also supported by the program materials review, program tracking data review, and verification and due diligence review. Each of these data collection activities provided qualitative and quantitative information on the program's structure, design, and performance in comparison with intentions, or a combination of these factors.

14.4.1 *PECO Program Management Staff and Franklin Energy Staff Interviews*

The evaluation team conducted three in-depth interviews. Two of these in-depth interviews were with PECO staff and one with Franklin Energy staff, during the months of June and July 2014. The interviews were designed to enable the evaluation team to ask questions about the program's design, development, administration, and delivery during the program year (PY5) and also to obtain "real-time" information about current program activity through asking open-ended questions that created a "free-flowing" conversation.

During the in-depth interviews, the program staff reported that a lot of the MF property owners or managers perceive their participation in PECO's SMF Solutions program as an opportunity to market their properties as "green and energy-efficient". This is a resounding validation of PECO's objective to strengthen customer trust in PECO as their partner in saving energy.

Despite the lack of prescriptive channel participation, program staff all agree that the SMF Solutions program is working well to meet the planned MWh goals as it was designed. The program staff reported *having good communication and coordination between PECO and Franklin Energy, and indicated that they* have worked together to identify and work on program improvements. In the past year they have worked together to update the website, create a tri-fold brochure, create a stand-alone mail marketing piece, and complete a case study. Currently, they are looking for the next possible case study candidate and working to update the site-specific audit report template to incorporate better/more useful information such as *payback and return on investment.*

The program staff is working with trade allies to find prescriptive projects, putting a strong focus on benchmarking to figure out where building owners are spending their money, simplifying the application, and increasing participation in smaller buildings. Currently, Franklin Energy has the primary responsibility for program marketing.

Program staff reported that attendance of the Greater Philadelphia Apartment Association conference was "the single best event for marketing". The program staff reported that the SMF Solutions team went from struggling to find leads to being swamped with leads in the following week. The program staff reported that interest in the program during this meeting has made the pipeline very strong and has built up a healthy backlog of direct install participants for PY6.

Program staff also noted that feedback from customers comment cards and the call center has been overwhelmingly positive. Customers emphasized that they are especially happy with the water heating measures and 9-watt CFL bulbs in bathrooms and that residents are impressed with how quickly the direct install team does their job. But most importantly, program staff report the program has a good pipeline of projects for PY6 and should have no problem meeting PY6 goals. This pipeline is mainly a result of the Greater Philadelphia Apartment Association conference, which the program staff attended.

All program staff reported the main concern with the current program is getting customers to participate in the prescriptive portion of the program. The prescriptive channel is a specialized portion of the program, as it only applies to the common areas within commercial MF buildings. One program staff mentioned a desire to see custom measures included in the program offerings as well as prescriptive measures offered to in-unit residents, such as programmable thermostats, and PTACs. The evaluation team looks forward to discussing the barriers for prescriptive participation with the customers as part of the PY6 evaluation work.

Due to the healthy backlog of direct install projects, the program staff have been able to focus their energy less on recruitment and more on prescriptive participation. One barrier to prescriptive participation noted by program staff is access to the decision maker. Generally, the site manager can make decisions about direct install measures, but the decision to install prescriptive measures is made by the property management firm or the building owners. Program staff noted that they have been working on making good relationships at the site level to break down this barrier.

Another concern of the program staff is problems with scheduling. For example, maintenance staff have canceled the direct-install appointment to attend to more pressing issues. The program is trying to overcome this problem by putting more effort upfront. One example given was they are now placing reminder calls leading up to the scheduled appointment.

Program staff noted that the only real cross-program coordination is for refrigerator measures for the low-income program. If the implementation staff determine a refrigerator qualifies, the information gets passed onto the LEEP team via PECO staff. The program staff reported that the implementation staff is doing a good job in sending along any leads they encounter and encouraging participation in other programs.

The program staff reported that the benchmarking feature has been slow to get started. Benchmarking is a marketing feature provided by Franklin Energy, which compares the participating building's performance against other similar buildings in PECO's territory. This value-added feature, provided by Franklin Energy, compares the participating building's performance data against similar buildings in PECO territory and identifies potential EE improvement measures. The benchmarking feature is offered to SMFCI and SMFGNI customers with >50,000 sq. ft. of common space and for MF sites with >40 dwelling units. This feature provides the property managers and owners with a report detailing the potential EE measures feasible at the facility, in addition to the comparison of building performance. Program staff reported that there was one pilot property that agreed to participate during PY5, but due to staff turnover, the property was no longer interested in participating.

During the course of the interviews, program staff indicated that there is no tracking of the success of the coordination with other PECO programs. The evaluation team suggests that PECO consider the following ideas to enhance cross-program coordination:

- PECO program managers should work with the CSP staff to look for opportunities to promote participation in other programs. PECO program managers for similar program sectors (e.g., SHR and SMF) should be communicating regularly to know what is going on in each other's programs and how they can support each other. PECO program managers should leverage the on-site scoping audits conducted as part of the pre-installation visit to identify the potential for installation of cross-program measures.
- PECO program managers should track the conversion rate of SMF Solutions program generated leads into installed projects under other programs. This will help PECO measure and control cross-*program coordination.*

14.5 Recommendations for Program

A key finding from the SMF Solutions program PY5 evaluation was the absence of prescriptive channel participation. In PY5, 100 percent of the verified savings were from direct install measures and the program did not see any participation in the prescriptive channel. In order to better manage the program to the portfolio goals of achieving deeper, non-lighting savings, PECO should consider adding a few more prescriptive measures such as LEDs, programmable thermostats, and in-unit PTACs, which are not currently offered in the SMF Solutions program's prescriptive channel. The program might also benefit from coordinating with programs such as SEI or SHR, which currently offer similar measures. Alternatively, PECO could consider offering as an incentive, the LED direct install for those buildings that also receive certain levels of prescriptive participation.

Strengthening prescriptive program participation will help PECO meet portfolio objectives and also aid in moving away from lighting only savings. Additionally, breaking away from lighting only savings may also help PECO achieve the planned demand reduction goals. The recommendations from the PY5 evaluation are summarized in Table 14-5 below.

Table 14-5: SMF Solutions – Non-Residential Segment Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Given the healthy backlog of direct install projects, PECO should consider the experiment of making participation in the prescriptive channel mandatory in order to participate in the direct install program. As an example experiment, PECO should consider the following: if a single building of a multi-property building management firm participates in the direct install channel and if the management firm is interested in future participation, the program could get customer commitment for at least some level of participation in the prescriptive channel. This will help PECO adjust the program participation to align better with the program design, which focuses on moving away from savings resulting from lighting measure installations.	Being considered. PECO and the Implementation CSP are continually evaluating customer response to programs and are identifying opportunities to drive more participation in prescriptive measures.
Recommendation 2: PECO should consider establishing specific prescriptive participation savings targets with Franklin Energy to enhance prescriptive channel participation and help PECO achieve deeper savings. This will ensure that the prescriptive channel gets added traction and increase the CSP's incentive to promote the prescriptive channel offerings more aggressively.	Being considered. PECO and the Implementation CSP are continually identifying opportunities to drive more participation in prescriptive measures.
Recommendation 3: PECO should consider the following cross-cutting recommendation: PECO's program managers need to track the program goals and attainment targets against the plan while holding the ICSP accountable for program performance This will ensure that PECO is on track to meeting the sector- and segment-specific EE&C plan goals.	Implemented. PECO continuously monitors program performance relative to plan and makes adjustments as warranted.

Source: Navigant analysis and PECO

14.6 Financial Reporting

The PY5 TRC ratio for the nonresidential component (including both SMFCI and SMFGNI segments) was 1.12, showing that the program was cost effective. A summary of program finances, including the breakout of costs and benefits, for the non-residential segment, is shown in Table 14-6.

Table 14-6: Summary of SMFNR Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	**0**	**0**
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	937	937
Marketing[2]	0	0
Subtotal EDC Implementation Costs	**937**	**937**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	937	937
Participant Costs[4]	281	281
Total NPV TRC Costs[5]	**1,218**	**1,218**
Total NPV Lifetime Energy Benefits	**1,152**	**1,152**
Total NPV Lifetime Capacity Benefits	**93**	**93**
Total NPV TRC Benefits[6]	**1,365**	**1,365**
TRC Benefit-Cost Ratio[7]	**1.12**	**1.12**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals.Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Evaluation Team Analysis

15 Smart Construction Incentives

The SCI program completed 29 projects in PY5, including 7 projects in the GNI sector. Navigant's impact evaluation included on-site measurement and verification as well as file reviews and whole-building energy simulation. The SCI program achieved verified gross savings of 6,027 MWh and 0.9 MW, and the resulting realization rates were 1.06 for energy and 1.01 for demand. The program spent $1.6 million in PY5, roughly one-half of the $3.2 million budget for this program year, and achieved a TRC benefit-cost ratio of 1.51.

The program did not achieve its PY5 goal of 19,949 MWh. This is primarily due to a slow start of PECO's new Phase II marketing and outreach efforts. PECO has since fully implemented the new marketing strategy, and program managers are confident that the program will be able to meet the overall Phase II goals despite low participation in PY5.

Navigant observed that, despite the increased outreach in the latter half of PY5, participation remained low through PY5, indicating that the longer lead times for new construction projects may keep SCI participation rates from rebounding quickly after periods of reduced outreach.

15.1 Program Updates

The SCI program changed the program requirements in PY5 to no longer accept retroactive applications for projects that have been already completed. Another program update focused on marketing. During the first half of PY5 (June 1, 2013, to mid-January 2014), PECO developed a new marketing plan for Phase II to align with their revised EE&C plan. During this period, PECO delayed marketing activities in order to implement the new marketing strategy. While PECO has since fully ramped up their marketing efforts based on the new strategy, this delay resulted in lower participation than expected compared to PECO's planned program participation for PY5. Strategies in the new marketing plan include marketing the program to decision makers earlier in the building cycle and expanding upstream marketing within the design community to reach a greater number of architects, engineers, and designers. Program staff also worked to increase program awareness among the design community by hosting educational seminars, presenting case studies, and promoting success stories. PECO is now staffing specific managers and engineers on projects based on their project type or industry, which aims to create longer term relationships with customers.

15.2 Definition of Participant

Each participant in the SCI program is defined by a completed project. Each project may include the installation of one or more measures, and each can be of different measure types.

15.3 Impact Evaluation Gross Savings

Table 15-1 shows the program reported savings by sector. Overall, the program achieved gross realization rates of 1.06 for energy and 1.01 for demand. The program-level relative precision was just under the 15 percent target (14.0 percent at 85 percent confidence) for the energy estimate and very high for the demand estimate (34.9 percent at 85 percent confidence).

Table 15-1: Phase II SCI Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Commercial and Industrial	22	3,538	0.6	317
Government, Nonprofit, and Institutional	7	2,127	0.3	234
Phase II Total	**29**	**5,665**	**0.9**	**551**

Source: Navigant analysis and program data

The impact evaluation consisted of a combination of desk reviews and on-site verifications for a sample of projects. Selection of sampled projects for the impact evaluation followed a dynamic sampling methodology executed on a batch-wise basis. The approach used a stratified random sample of projects from the population of program participants in the PY5 tracking database. Sampling was conducted after Q3 and Q4, when all projects completed in PY5 were captured in the tracking database. The sample design targeted program-level confidence and precision of 85/15 (two-tailed) based on the kWh savings for measures incented by the SCI program and reported in PY5. The sampling strategy used in PY5 is presented in Table 15-2.

Table 15-2: SCI Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	6	85/15	6	6	On-site Verification
Small	17	85/15	3	3	Desk Review
Whole Building	6	85/15	4	4	On-site Verification
Program Total	**22**	N/A	**13**	**13**	N/A

Source: Navigant analysis

Although the program is small, it encompasses an extensive range of measures and has many complex whole-building and custom projects. Navigant used the following three main approaches for evaluating the sampled projects. For all projects, Navigant paid close attention to baseline choices, which are not

always obvious for new construction measures. The team carefully reviewed relevant sections of ASHRAE 90.1-2007 as well as federal standards from the DOE.

Desk Review

Navigant reviewed a sample of prescriptive projects for compliance with the PY5 TRM. To qualify for a desk review, projects had to be in the small stratum and have measures where the PY5 TRM or IMPs applied. In addition, the project documentation had to be complete and could be used to verify the measures installed. The desk review made use of project applications, associated calculations, and submitted invoices and specification sheets. Measures included prescriptive, custom lighting, and HVAC.

PECO provided project-specific analysis files, invoices, specification sheets, and other construction documents for the sampled projects so the evaluation team could conduct the desk reviews. Documentation included scanned files of hard-copy application forms and supporting documentation from the applicant (e.g., ex ante impact calculations, invoices, and measure specification sheets), CSP inspection reports, photos of installed measures, and important email and memoranda. For whole-building projects, PECO also provided the output files from the projects' simulation files. When executable modeling files were available, PECO provided them as well.

On-Site M&V

Navigant conducted on-site verification for projects in the large stratum or whole-building stratum to supplement the desk reviews. Navigant visited ten projects in the sample (four whole-building projects and six non-whole-building large projects) to verify measure installation. For the majority of the sites, the primary objective of the visits was to collect the data identified in the SSMVP, including verification of installed quantities and type, equipment nameplate data, operating schedules, and a careful description of site conditions. Navigant achieved the verification through visual inspection of the measures and by interviewing the customers. For one project, Navigant also installed data loggers to measure VFD operation.

Whole-Building Verification and Modeling

Four of the projects in the on-site sample were whole-building custom projects. Although these projects were complex and included a large number of measures, Navigant limited site visits to verification only for PY5 due to the small size of the program and to enable more extensive model review after the site visits. Subsequent analysis included comparing model inputs to parameters verified on-site and making adjustments to modeled savings if needed. In all cases, Navigant was able to directly adjust the original models.

The summary of evaluation results for energy and demand are presented in Table 15-3 and Table 15-4, respectively.

Table 15-3: Program Year 5 SCI Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Large	2,973	0.98	2,915	0.30	0.0%
Small	656	1.44	946	0.55	132.2%
Whole Building	2,036	1.06	2,166	0.04	2.5%
Program Total	**5,665**	**1.06**	**6,027**	N/A	**14.0%**

Source: Navigant analysis and program data

Table 15-4: Program Year 5 SCI Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Large	0.43	0.94	0.4	0.30	0.0%
Small	0.18	0.57	0.1	0.83	293.1%
Whole Building	0.25	1.43	0.4	1.75	78.0%
Program Total	**0.86**	**1.01**	**0.9**	N/A	**34.9%**

Source: Navigant analysis and program data

15.4 Impact Evaluation Net Savings

The program has changed in Phase II but, due to the small size of the program and limited participation, Navigant did not conduct a net impact evaluation in PY5. The evaluation team will conduct new NTG research in PY6 and will apply the results during the remainder of Phase II.[91] Therefore, Table 15-5 is not applicable for the SCI program.

[91] As detailed in *Evaluation Plan: PECO Act 129 – Phase II, Energy Efficiency and Conservation Portfolio Phase II.*

Table 15-5: PY5 SCI Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

15.5 Process Evaluation

The evaluation team did not perform a process evaluation in PY5 but will conduct one in PY6.[92]

15.6 Recommendations for Program

The evaluation team used various analytical methods to complete the evaluation including performing a tracking system review, a verification and due diligence review, and a gross impact evaluation. This subsection details the findings and recommendations for each method.

Tracking System Review

The evaluation team reviewed the program tracking system to ensure that it accurately recorded the data required to document program savings, support future evaluation, allow program managers to monitor key aspects of program performance at regular intervals, and enable the SWE to perform its required audit. The evaluation team identified several tracking system issues that PECO should consider addressing in order to improve the usability of the tracking system as the portfolio of programs continues into PY6 of Phase II. The findings, and some recommended steps for improvement, are listed below. We understand that some of these recommendations may already be in the process of being addressed.

The tracking system had blank fields: On several occasions, the columns titled "Measure Quantity" and "Measure Size" were blank. This meant that the evaluation team was unable to verify the quantity of measures installed for several projects in the tracking system. In addition, the column titled "Operating Hours For Calculation" was blank on several occasions. This meant that the evaluation team was unable to verify the hours of operation used to calculate savings for several projects by only using the tracking system. In those cases, reviewing the project files was necessary.

Measure incentives were not recorded at the measure level: Some projects have recorded incentives that appear to have been redistributed across measures instead of having recorded the actual measure-level incentive amount. This limits the accuracy of measure-level benefit-cost analysis.

[92] As detailed in *Evaluation Plan: PECO Act 129 – Phase II, Energy Efficiency and Conservation Portfolio Phase II.*

Algorithm nomenclature in the tracking system did not match the TRM: The tracking system did not always use the same algorithm nomenclature used in the PY5 TRM to perform calculations. This made mapping the algorithms in the tracking system to the PY5 TRM more difficult than if all nomenclature were consistent. This does not in itself indicate that incorrect algorithms were used, but using the same TRM algorithm nomenclature in the tracking system will facilitate PECO's internal QC of the tracking system against the TRM as well as the evaluation.

The tracking system did not include information about custom savings approaches: The tracking system did not include information about the algorithms or approaches used to calculate savings for custom measures. This made it difficult to know which approach was taken to calculate these savings. Including this information in the tracking system will allow an initial verification of the approach used to calculate savings within the tracking system itself.

Units in the tracking system were inconsistent: On many occasions, columns titled "Measure Quantity Unit" and "Measure Size Unit" were filled in inconsistently, even for the same measure types. For example, sometimes the same lighting measures listed the measure quantity unit as "per fixture" and other times "per kWh saved." Knowing both data points is useful to the evaluation team, but many times only one or the other was provided. These inconsistencies made it difficult to compare quantities and savings among projects and customers. The tracking system should include consistent units to describe quantities for all measures that fall under the same measure types. This will help evaluation efforts, and it will allow PECO to know the quantities and specifications of each of the measures installed through the program.

Savings in the tracking system did not match the project files in 23 percent of the sampled projects: The savings recorded in the tracking system did not match the savings presented in the project files in 3 of the 13 sample projects. There was no information in the project files or in the tracking system to explain this discrepancy. In one project this resulted in a realization rate of over 2.00 for energy and 0.19 for demand.

Identifying measures as "IMP" was not possible: The tracking system does not include "IMP" as an option to identify whether the measure is a TRM, IMP, or custom measure. Adding "IMP" as an option will better define the type of protocol used to calculate project savings.

The source of incremental cost data was not available: The tracking system does not include columns that list the sources for the incremental cost data, or the units used. In many cases, the incremental cost data in the tracking system are different than third-party sources. Adding these data columns will help to track the information and to verify the data.

The recommendations from this section include the following:

- **Recommendation #1:** PECO should direct the CSP to take the following steps to improve data tracking:

- Make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells. This will allow verification of all the parameters that go into calculating project savings.
- Develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct.
- Make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct.

- **Recommendation #2:** PECO should direct the CSP to make sure that the incentives recorded in the "Capped Incentive" column reflect the incentive that applies to each individual measure. Correcting this redistribution would improve the accuracy of measure-level benefit-cost results.
- **Recommendation #3:** The CSP should make sure that the project files clearly and accurately document how savings were calculated and are up to date at the moment of providing them to PECO and the evaluation team for verification. This will eliminate discrepancies between savings presented in the tracking system and savings presented in the project files.

Verification and Due Diligence

The evaluation team performed a verification and due diligence review for the SCI program, including a review of the program's quality assurance and savings verification procedures. The team conducted interviews with key PECO and DNV GL staff during February of 2014. In these interviews the evaluation team focused on the tracking systems and QA/QC procedures. The evaluation team then scored the program based on the metric definitions contained in the ACEEE Energy Efficiency Best Practices tool.[93]

The evaluation found that PECO and DNV GL have continued to work to align their QA/QC, program tracking, and verification procedures with Pennsylvania requirements and guidance from the SWE. Additional evaluation findings, and some recommended steps for improvement, are listed below.

The program complied with its Operations Manual: The program's Operations Manual includes guidelines that generally meet or exceed expected quality assurance safeguards. The program is complying with the policies and procedures set forth in the Operations Manual, including criteria for project eligibility and collecting supporting documentation for projects.

The program added a new method for customers to apply: PECO implemented an on-line application form in PY5.

[93] http://www.eebestpractices.com/benchmarking.asp.

There were discrepancies in the data transfer process: Program data is currently being transferred monthly from the CSP to PECO using a batch process. The evaluation team found discrepancies in the data transfer process including formatting issues and missing fields.

Gross Impact Results

Overall, the program achieved gross realization rates of 1.06 for energy and 1.01 for demand. The program-level relative precision was just under the 15 percent target (14.0 percent at 85 percent confidence) for the energy estimate and high for the demand estimate (34.9 percent at 85 percent confidence). The high relative precision results are due to the following factors:

- **Energy**
  - One small project had a high realization rate because the tracking system-reported savings were half that of the calculated savings in the project files. Navigant's analysis confirmed the higher savings found in the project files. This project caused high relative precision in the small stratum.
- **Demand**
  - One small project (the same one discussed above) had a low realization rate because the tracking system-reported savings were much higher than the calculated savings in the project files. Navigant's analysis again confirmed the savings found in the project files, and this project caused high relative precision in the small stratum for demand as well.
  - The CSP continues to estimate whole-building demand savings through the inaccurate method of dividing annual energy savings by 8,760 hours. Navigant performed peak demand savings analyses on each project using model outputs and found demand realization rates ranging from 0.61 to 5.89 due to seasonal variation in electric loads.

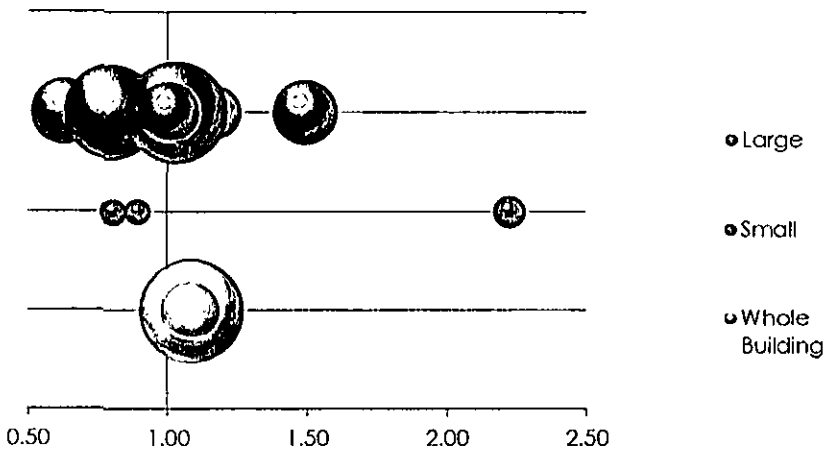
Energy Gross Realization Rate

Energy realization rates were close to 1.0 for most projects, with a few notable exceptions. Figure 15-1 shows all of the energy realization rates for sampled PY5 projects. The size of each circle represents the relative claimed savings of each project. Navigant found the following issues leading to the three highest energy realization rates:

- Use of default TRM assumptions for a mix of medium and cold temperature refrigerated cases when in fact the majority of cases were colder temperature cases with higher deemed savings, combined with longer hours of use for lighting measures
- Error in tracking database underreported calculated savings

The major factors contributing to energy realization rates of less than 1.0 were low actual hours of use, inaccurately high savings claims for electronically commutated motors (ECMs) on walk-in coolers and freezers, and adjustments for code-required lighting controls.

Figure 15-1:Energy Realization Rates

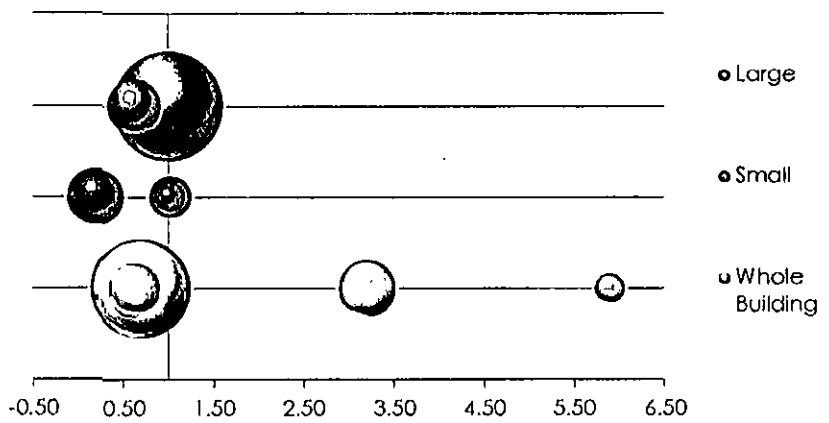


Source: Navigant analysis

Demand Gross Realization Rate

Navigant found demand realization rates ranging from 0.19 to 5.89. This range is shown in Figure 15-2. The primary causes of demand realization rates much higher or lower than 1.0 were the same factors, which led to high relative precision in demand results: a database error and inaccurate calculation methods for whole-building projects.

Figure 15-2: Demand Realization Rates



Source: Navigant analysis

The following findings provide additional detail on factors contributing to realization rates above or below 1.0 for SCI projects.

Lighting and ECM projects still do not account for codes and standards: Navigant has highlighted the need for baseline adjustments for both of these measures in the PY3 and PY4 evaluations:

- In lighting projects with occupancy sensors and daylight controls, the CSP used savings factors from the TRM for retrofit projects. Since ASHRAE 90.1-2007 requires some lighting controls (such as manual dimming requirements for most spaces), claiming the full 24 percent savings factor for occupancy sensors, for example, is not appropriate. ASHRAE 90.1-2007 Appendix G specifies savings factors for occupancy sensor and programmable timing controls. The Appendix G savings factor for occupancy sensors is 10 percent. Taken in combination with the PA TRM, this implies that code-required controls in non-24/7 applications account for a reduction in operating hours of 14 percent. Navigant applied this adjustment to all lighting projects.
- Two grocery projects included ECMs on walk-in coolers and freezers. ECMs are required for all walk-in coolers and freezers less than 3,000 square feet in typical applications (exceptions for medical and scientific units only).

Navigant adjusted other savings based on evaluation findings: Navigant made several adjustments to both whole-building and non-whole-building projects as a result of evaluation and on-site verification. These adjustments included the following:

- Adjusting equipment counts due to Navigant on-site verification
- Adjusting hours of operation based on interviews with customers on-site
- Adjusting equipment efficiencies for
  - Installed equipment, based on on-site findings
  - Baseline equipment, to be consistent with ASHRAE 90.1-2007
- Using input values for actual equipment types (e.g., freezer or cooler) instead of TRM default equipment mixes
- Updating demand savings for whole-building projects using model outputs and peak period definition

Project files were incomplete, especially for whole-building projects: Navigant initially received incorrect or incomplete documentation for 5 out of 13 sampled projects, including modeling files. The correct modeling files were ultimately provided in all cases. In previous years, PECO has provided a summary description for each whole-building project, but in many cases this document was not available in PY5.

The recommendations from this section include the following:

- **Recommendation #4:** PECO should direct the CSP to:
  - Adjust for code-required controls in ex ante lighting calculations by subtracting 14 percent from TRM savings factors in order to accurately represent lighting savings in new construction projects.
  - Remove ECMs on walk-in coolers and freezers from the prescriptive SCI measure list.

- **Recommendation #5**: PECO should direct the CSP to run the proposed and baseline models for each modeled project in order to obtain 8,760 hour outputs and conduct a peak period analysis to determine demand savings. This will enable the program to estimate demand savings for these projects with much greater accuracy. Navigant also made this recommendation in the PY3 and PY4 evaluations.
- **Recommendation #6**: PECO should direct the CSP to archive any outdated versions of project calculations in order to ensure the final calculations and supporting documentation can be easily identified. Whole building and other complex projects should include a written summary of the project scope.

A summary of each recommendation's status is included in Table 15-6.

Table 15-6: SCI Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should direct the CSP to take the following steps to improve data tracking: • Make sure that all relevant columns in the tracking system are populated with the appropriate data, leaving no blank cells. This will allow verification of all the parameters used to calculate project savings. • Develop a data dictionary for the tracking system that provides the definition of each field in the system. This will clarify the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. • Make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct.	Implemented/in-process. This is an area of continuous monitoring to insure the quantity and quality of data in the data tracking system. As we continue to identify areas in columns where data is missing, we will work with the Implementation CSP and Tracking System CSP to make corrections in the process. Will consider building a data dictionary to provide definitions for each field in the system.
Recommendation 2: PECO should direct the CSP to make sure that the incentives recorded in the "Capped Incentive" column reflect the incentive that applies to each individual measure. Correcting this redistribution would improve the accuracy of measure-level benefit-cost results.	Under consideration/investigating further.
Recommendation 3: The CSP should make sure that the project files clearly and accurately document how savings were calculated and are up to date when they are provided to PECO and the evaluation team for verification. This will eliminate discrepancies between savings presented in the tracking system and savings presented in the project files.	Implementing. Working with CSP on developing a process for displaying the project savings calculations to PECO and evaluation team.
Recommendation 4: PECO should direct the CSP to: • Adjust for code-required controls in ex ante lighting calculations by subtracting 14% from TRM savings factors in order to accurately represent lighting savings in new construction projects. • Remove ECMs on walk-in coolers and freezers from the prescriptive SCI measure list.	Partially implemented. PECO will discuss lighting adjustments with the Implementation CSP. ECMs have been removed from measure list.
Recommendation 5: PECO should direct the CSP to run the proposed and baseline models for each modeled project in order to obtain 8,760 hour outputs and conduct a peak period analysis to determine demand savings. This will enable the program to estimate demand savings for these projects with much greater	Being considered. PECO will discuss this recommendation with the Implementation CSP.

Recommendations	EDC Status of Recommendation (*Implemented, Being Considered,* Rejected AND Explanation of Action Taken by EDC)
accuracy. Navigant also made this recommendation in the PY3 and PY4 evaluations.	
Recommendation 6: PECO should direct the CSP to archive any outdated versions of project calculations in order to ensure the final calculations and supporting documentation can be easily identified. Whole building and other complex projects should include a written summary of the project scope.	Implemented/in-process. PECO is in discussions with the CSP to ensure that outdated projects are archived for easy access as well a summary of included with each project.

Source: Navigant analysis

15.7 Financial Reporting

The SCI program achieved a TRC benefit-cost ratio of 1.51 in PY5. This shows that the program continues to operate cost-effectively. A breakdown of the program finances is presented in Table 15-7.

Table 15-7: Summary of SCI Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	552	552
EDC Incentives to Trade Allies	64	64
Subtotal EDC Incentive Costs	615	615
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	1,019	1,019
Marketing[2]	0	0
Subtotal EDC Implementation Costs	1,019	1,019
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	1,634	1,634
Participant Costs[4]	2,285	2,285
Total NPV TRC Costs[5]	**3,304**	**3,304**
Total NPV Lifetime Energy Benefits	4,523	4,523
Total NPV Lifetime Capacity Benefits	456	456
Total NPV TRC Benefits[6]	**4,979**	**4,979**
TRC Benefit-Cost Ratio[7]	**1.51**	**1.51**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

16 Smart On-Site

The PECO SOS program is designed to build interest in CHP technologies by making the customer economics attractive. The program offers incentives to customers who install CHP technologies to reduce facility energy use. CHP technologies generate electric and thermal energy from a single fuel source. Customers with steady base load electricity usage coupled with steady thermal demand can realize significant efficiencies and savings by incorporating CHP (sometimes referred to as cogeneration) in their facilities. The best economics are realized for CHP systems that are sized to match the minimum electric and thermal loads. The PECO SOS program is designed to ensure participating customers install economic CHP projects that maximize operational savings and minimize operational and maintenance costs.

The program incentives are paid on a declining tiered incentive rate by installed capacity with a bonus performance payment. The capacity tiers are as follows:

- Less than 0.5 MW
- Between 0.5 MW and 1.5 MW
- Between 1.5 MW and 10.0 MW

Each tier has a fixed per-MW incentive paid toward the incremental capacity within each tier. Capacity-based incentives will not be paid for incremental capacity above 10 MW.

The performance payment is paid on a fixed per-kWh basis based on actual energy savings after a one-year monitoring period. For projects occurring within the final year of the program, an accelerated performance payment will be available based on the project's expected first year energy savings. Savings for all projects are claimed upon implementation and can be adjusted based on the performance monitoring results.

16.1 Program Updates

Two projects were completed and received rebates through the SOS program during PY5. One project provides electricity and heat to a Philadelphia-area hospital and is driven by a nominally 2-MW natural gas-fired reciprocating engine. The other project provides electricity and process heat to a municipal water treatment facility. This project has a nominal electrical capacity of 5.4 MW and runs on biogas produced at the same facility.

16.1.1 Definition of Participant

A participant in the SOS program is considered to be one project at one facility.

16.2 Impact Evaluation Gross Savings

Table 16-1 presents the gross reported energy and demand savings for the SBS program, distributed across customer sectors. As the table demonstrates, all PY5 program activity was in the GNI sector.

Table 16-1: Phase II SOS Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0	0
Low-Income	0	0	0	0
Small Commercial and Industrial	0	0	0	0
Large Commercial and Industrial	0	0	0	0
Government, Non-Profit, and Institutional	**2**	**59,945**	**7.8**	**$4,993**
Phase II Total	**2**	**59,945**	**7.8**	**$4,993**

Source: PECO program database

Navigant's evaluation of the SOS program consisted of on-site verification, telephone interviews with program participants and the project developers they worked with, interviews with other CHP project developers who either have active CHP projects or may have such projects in the future, and interviews with the PECO and DNV GL program managers.

All participants in the SOS program are required to log all parameters necessary to calculate electricity generation net of parasitic loads (such as pumps necessary to operate the heat recovery systems) and thermal energy recovery. These data are used to develop the estimates of system capacity and annual generation that PECO's capacity and performance incentives are based upon. As described in the Phase II evaluation plan, Navigant's impact evaluation consists of on-site verification of the installation and operation of the CHP equipment, validation of the customer-installed instrumentation logging the necessary performance parameters, and analysis of the logged data.

For both of the projects completed in PY5, gross impacts were calculated in accordance with the approved custom measure protocol (CMP) for CHP systems. SSMVPs were developed in accordance with the CMP and reflected the fact that PECO requires SOS participants to continuously log all relevant parameters necessary to calculate the CHP system's net electrical generation and the facility's net change in fuel consumption.

As Table 16-2 indicates, Navigant conducted site visits for both projects in June 2014. While on site, Navigant engineers verified the nameplate ratings of all equipment and verified that all parameters necessary for the calculation of energy generation, peak demand reduction, and net change in fuel

consumption were being accurately logged. Specifically, Navigant verified that the following variables were being logged:

1. Gas input (MCH)
2. Generator power (kW)
3. Parasitic loads (kW)
4. Waste heat recovery (BTU/h)

While on site, Navigant collected approximately six months of logged data for each of the systems. Navigant subsequently analyzed the data to calculate net electric generation, peak demand reduction, and net change in gas consumption.

Table 16-2: SOS Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
All Participants	2	85/15	2	2	On-site Verification
Program Total	2	85/15	2	2	On-site Verification

Source: Navigant analysis

Since Navigant's evaluation sample included the entire population of completed projects, there is no sampling uncertainty for this program in PY5, as indicated in Table 16-3. Since both projects had very nearly the same realization rate, the CV is quite small.

Table 16-3: Program Year 5 SOS Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
All Participants	59,945	1.01	60,427	0.0	0%
Program Total	59,945	1.01	60,427	0.0	0%

Source: Navigant analysis

Table 16-4 presents results for peak demand reduction. Again, the relative precision is zero, and the similarity of the realization rates for the individual projects results in a small CV.

Table 16-4: Program Year 5 SOS Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
All Participants	7.8	0.99	7.7	0.1	0%
Program Total	7.8	0.99	7.7	0.1	0%

Source: Navigant analysis

16.3 Impact Evaluation Net Savings

As Table 16-5 indicates, Navigant conducted net savings analysis for both projects, utilizing the SWE-approved NTG battery of questions and methodology for interpreting responses. The analysis indicates significant evidence of free ridership at one of the projects and none at the other. At the program level, Navigant estimates free ridership at 0.2. Neither participant provided any evidence of spillover savings (like or unlike) for the program, so the program-level NTG ratio is 0.8. These results are presented in Table 16-6.

Table 16-5: SOS Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[94] to Achieve Sample
Program Total	Census	2	N/A	85/15	2	2	100%

Source: Navigant analysis

[94] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

Table 16-6: Program Year 5 SOS Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Program Total	0.2	0.0	0.8	NA	+/- 0%

Source: Navigant analysis

16.4 Process Evaluation

Navigant's process evaluation of the PY5 SOS program consisted of in-depth interviews with program staff, participants, and project developers.

16.4.1 Program Staff Interviews

Navigant offers the following findings based on information gathered through interviews with the PECO and DNV GL program managers.

Program staffing is adequate. Both the PECO and DNV GL program managers expressed the opinion that the program does not need additional staff. None of the participating customers or project developers that Navigant interviewed offered any evidence to the contrary.

Existing program promotional efforts are adequate. PECO has promoted the SOS program primarily by making presentations at trade association events and through direct contact with customers. This approach has been sufficient to generate program activity that is currently on track to exceed the program's Phase II goals.

PECO faces considerable uncertainty and risk due to the timing of completion of very large projects that have significant impact on portfolio-level savings. At the time this report was written, the project pipeline for SOS included three projects with projected completion dates within the last few months of Phase II. These projects have cumulative annual generation (i.e., savings) estimated at over 50 GWh. That value is 49 percent of the Phase II target for the SOS program and 4.6 percent of the Phase II portfolio-level compliance target. As such, the uncertainty in the completion dates for these projects considerably challenges PECO's ability to achieve its Phase II goal and exposes PECO to the risk of a compliance penalty.

PECO is devoting adequate attention to the impacts of the SOS program on sector- and portfolio-level savings. The PECO program manager indicated that projected SOS savings levels are reviewed with the program managers from other programs and portfolio-level managers on a biweekly basis. Given the uncertainties inherent in the timing of CHP project completion discussed above, this in itself does not guarantee that the program's Phase II savings results will be close to its target, but it does indicate that program management is aware of and focused on the uncertainty and inherent risk that these projects pose.

16.4.2 Project Developer Interviews

Navigant was able to interview three project developers, one who had completed a project through the SOS program and two who were in the process of doing so. The following findings are based on information collected through these interviews.

CHP project developers often have well-established relationships with SOS participants. All three of the project developers Navigant interviewed had conducted prior work for the SOS program participants, and all either had worked with these same customers in completing EE projects through SEI or were in the process of doing so.

Project developers learned about the SOS program through personal contacts. The project developers Navigant interviewed all indicated that they had learned about the SOS program through direct contact with program personnel. This confirms that this mode of marketing the program has been effective.

The SOS program is competently managed. Both the PECO and DNV GL program managers keep close tabs on all projects in all stages of development, have developed good relationships with project developers, and are in frequent communication with them to update the status of their CHP projects. One developer offered the following comment: "[The program managers] have done a fantastic job of interfacing with interested parties. They came to my office and gave me a presentation on the program. They are very diligent, open and available."

Two of three developers believe that projects might have been built absent the SOS program. None of the project developers felt that the availability of the PECO subsidy impacted the design of the systems they proposed. When asked whether their customers would have installed the same system without the subsidy, one indicated that the subsidy definitely made the project move forward, but two were less definitive, and indicated that their projects might well have been completed anyway. However, when Navigant asked if the program "...is having any noticeable impact on the market for CHP systems so far", two of the three developers indicated that the incentives will help to make some projects viable that otherwise would not be. These responses reflect the fact that MW-scale CHP projects are sometimes economically viable without subsidy, whereas the economics become less attractive at smaller scale.

CHP projects tend to have very long development cycles, and potential customers are often uninformed. Although facilities managers at the types of facilities where CHP can be a good fit are often aware of the technology, those holding the purse strings at these organizations tend not to be. The complexity of CHP and its novelty to many decision makers results in sales cycles that are often very long and challenging for developers. One project developer noted that all of the CHP projects on which he is working have had minimum development cycles of two years *prior* to the beginning of construction. In some cases, project developers are covering substantial costs for engineering, consulting, financial analysis, and authoring applications for grants and incentives in the hope that they will ultimately be able to convince the customer to install a system and thereby recoup these costs.

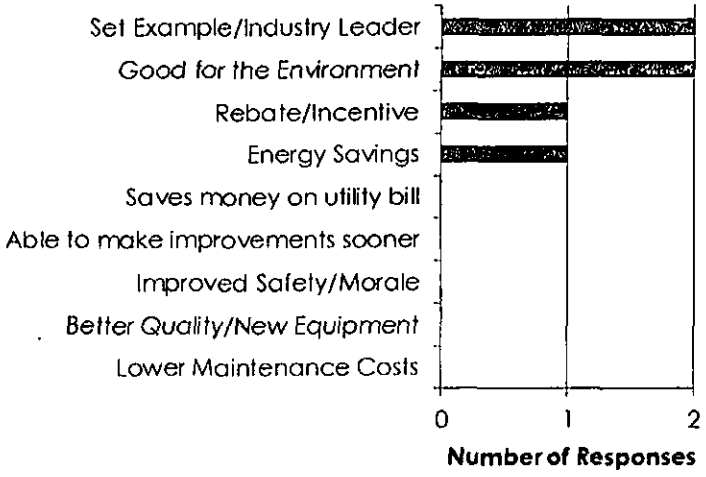
Obtaining an operating permit from the Pennsylvania Department of Environmental Protection (DEP) can delay projects considerably. When asked about the primary factors that contribute to delays in completing CHP systems, two developers pointed to the DEP as the source of considerable delay and uncertainty. Their estimates of the delay ranged from four months to a full year.

16.4.3 Participant Interviews

Navigant conducted in-depth interviews with the individuals at the participating organizations who were most knowledgeable about the two CHP projects completed in PY5. The following findings are based on the responses of these two individuals. Navigant cautions that such a small sample cannot adequately represent the entire population of eligible SOS participants. Additional research in subsequent program years will likely result in more robust findings and recommendations.

It's not just about money. As Figure 16-1 demonstrates, for the two organizations that completed projects in PY5, the systems' intangible environmental and industry leadership benefits played an important role in the decision-making process.

Figure 16-1: Benefits of Participation Mentioned by Participants

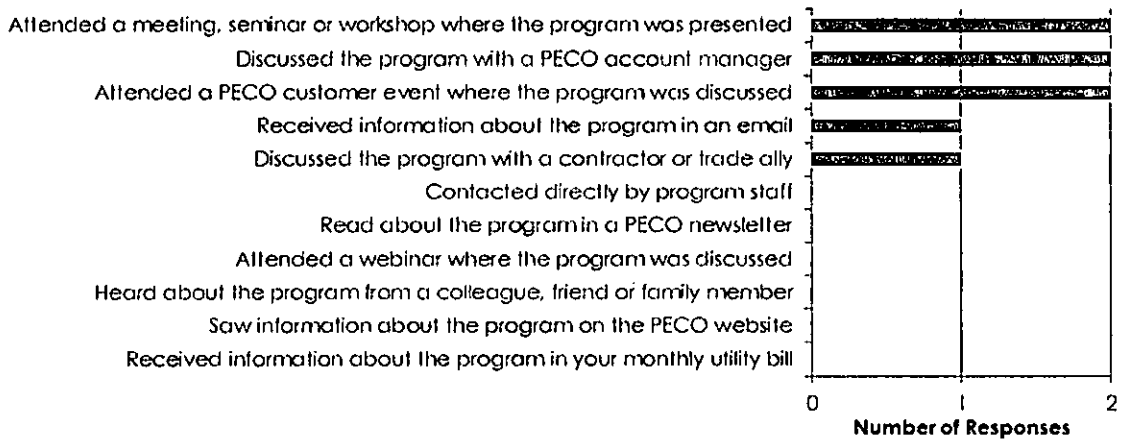


Source: Participant survey

Marketing the SOS program by in-person contact is effective. Figure 16-2 demonstrates that when asked to select from a set of eleven potential marketing channels, the two participants indicated that they had learned of the availability of CHP incentives primarily through channels involving personal contact with a PECO representative or trade ally. More importantly, these participants indicated that the best ways to

market CHP to their peers were the same channels PECO is already using: account managers, trade associations, and trade allies.

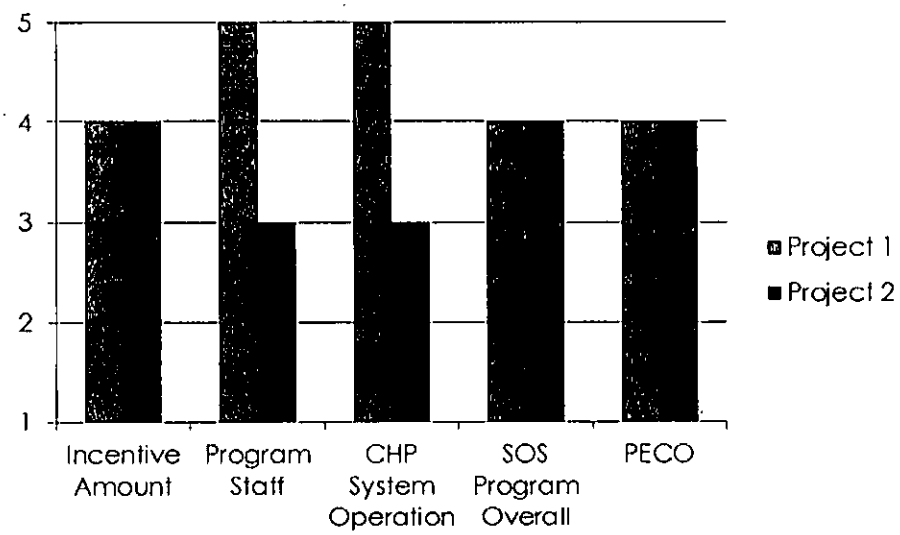
Figure 16-2: Channels by which SOS Participants Learned About the Program



Source: Participant survey

Participants are generally pleased with the program and with PECO. On a 5-point scale for which 1 indicates very dissatisfied and 5 indicates very satisfied, the participants were asked to describe their satisfaction with program incentives, interactions with program staff, the operation of their CHP systems, and their overall ratings for the program and for PECO. As shown in Figure 16-3, ratings were positive for three of these categories, but one participant gave a neutral rating for the program staff and the operation of the CHP system.

Figure 16-3: Participant Satisfaction with Aspects of the SOS Program



Source: Participant survey

The process for developing and finalizing the interconnection agreement can be problematic. One participant indicated that confusion about whom to work with and lengthy delays in finalizing the interconnection agreement created unnecessary anxiety for the customer. This participant indicated that the agreement was not finalized until after the system was built, creating risk for the customer. The participant noted that the PECO account manager was very helpful in resolving this issue.

Participants perceive few drawbacks to participating in the SOS program. The only drawback to participation, mentioned by one participant, was that the M&V process (including customer metering requirements and work conducted by DNV GL and Navigant) was "...more intense than I was originally led to believe."

The incentive structure available in Phase II may be insufficient to encourage CHP adoption by some customers. In response to a question about why other similar organizations might not participate in the SOS program, one participant stated that the cap on incentives available for Phase II CHP projects would have undermined his project, implying that the available incentive may currently be insufficient to motivate similar customers. Recall that both projects completed in PY5 received incentives under the more generous incentive structure available through the SEI program in Phase I. In response to a question about hypothetical future CHP installations, this participant indicated that his organization would not work with the SOS program in the future due to the reduced incentive levels.

Additional participant recommendations for program improvement. When asked for suggestions on how to improve the SOS program, one participant suggested increasing the incentive levels, stating that "They are nice to get, but they don't change people's minds." The other participant focused his comments on communication: "They need to appeal to the CFOs [chief financial officers], they're all about numbers" and "They need to communicate how the program works and what is available—provide examples so that lay people can understand how the program may apply to them."

16.5 Recommendations for Program

Navigant offers the following recommendations for the SOS program, based on the findings of its impact and process evaluation. Navigant notes that due to the very long time periods associated with decision-making, planning, permitting and building CHP projects, many of these recommendations will be relevant only for Phase III and subsequent phases, should PECO choose to continue offering the SOS program in the future.

Recommendation #1: Conduct market research to support a change in incentive design. To assist PECO's understanding of the marketplace and to focus its CHP investments to minimize free-ridership, Navigant proposes to conduct market research to assess the financial requirements of organizations in specific targeted segments (such as hospitals, steel mills, pharmaceutical manufacturers, or sewage treatment facilities). The goal of this research would be to gain understanding of the payback period required to make CHP attractive in different market segments. Navigant proposes to use this information to

reformulate the incentive structure for SOS in Phase III to limit incentives such that the project payback period does not drop below a specific threshold. That threshold might vary by market segment. In conjunction with this research, Navigant recommends that it work with DNV GL in developing and piloting a model to assess project finances. This model would then be used in Phase III to determine the incentive level necessary to provide the participant with a specific payback. This research and model development could be incorporated into the evaluation plans for the SOS program in PY6 and PY7.

Recommendation #2: Consider providing design support to customers. If PECO wishes to foster the market for CHP in its service territory, providing financial support for system design could help in the following ways:

- Reducing barriers by reducing costs. Providing financial support for the early stages of project development could make it easier for customers to move beyond the barrier posed by the costs incurred to determine whether CHP is even a viable option.
- Lending credibility to the technology and to project developers. Early market intervention by PECO could overcome a credibility gap among customers who are unfamiliar with the technology.
- Assisting customers in identifying qualified project developers. If PECO were to adopt this recommendation, Navigant further recommends that it protect its design assistance investment by developing a list of qualified project developers who satisfy a set of rigorous screening criteria.

Recommendation #3: Leverage completed SOS (and SEI CHP) projects to promote the technology. The CHP system owners Navigant interviewed are very pleased with their systems and would probably welcome the opportunity to publicize their success and help peers make similar decisions. If PECO wishes to foster the market for CHP in its service territory, it could invite CHP owners to speak about their experiences with the technology and PECO's program at relevant industry events. Some CHP owners might be willing to host such events at their facility and provide tours of the system.

Recommendation #4: Create a liaison with the DEP. By creating a relationship with the relevant parties at the DEP and making them aware of the SOS program, PECO may be able increase the priority of SOS project reviews, or at least reduce the uncertainty about the timing of a project's completion that is due to the permitting process.

Recommendation #5: Consider marketing to organizations that value CHP's environmental benefits. Should PECO wish to boost program participation in a future phase of Act 129, PECO could make such organizations a target for focused marketing. Assuming a sufficiently large and constant thermal load, governmental organizations, organizations for which environmental stewardship is a core value (perhaps those that have a stated environmental target), and those that would derive substantial public relations benefits from the "green-ness" of CHP are likely candidates for such a campaign. Examples are religiously affiliated hospitals and perhaps refineries, pharmaceutical, or other chemical processing plants.

Recommendation #6: PECO's program manager should coordinate with those responsible for approving interconnection agreements to alert them of upcoming projects and to identify opportunities to streamline the process. Doing so may mitigate perceived risk for the participant and may reduce some of the uncertainty in the timing of project completion.

Recommendation #7: Require projects above a size threshold to apply prior to some deadline in first year of a phase. To reduce the potential of missing a compliance target due to CHP projects not completing within a phase as anticipated and not having enough time to make portfolio adjustments to make up the savings gap, Navigant recommends that PECO set an early deadline, such as the close of Q2 in the first PY of a subsequent phase of Act 129, by which all proposed CHP projects above a given capacity threshold (e.g., 1 MW) must submit applications. The timing of this deadline and the capacity threshold would have to be tailored based on the targets set for the SOS program in any future phase and the duration of that phase. Doing so would mitigate PECO's risk and also exclude large projects that are unable to apply by the deadline. A variant of this would be to require that all projects, regardless of size, submit applications (including sufficient evidence of project viability to discourage spurious or unlikely projects) by a certain date that is early enough in a subsequent phase that PECO could have confidence of project completion well in advance of the end of the phase.

Recommendation #8: Set a firm deadline, such as six months prior to the end of a phase, by which all projects must be completed and fully commissioned in order to be eligible for incentives. This will help PECO to manage the portfolio to ensure PECO meets its overall Phase II compliance targets with enough time to make up any shortfall due to non-completion of a large CHP project. A steep reduction in incentive levels would be imposed as the commercial date of operation draws nearer to the end of the phase, perhaps going to zero for projects with CDOs in the final quarter of the phase.

Recommendation #9: Include project completion timing bonus. The program could offer bonus incentives if a project is completed within a certain timeframe. This encourages customers rather than penalizes them. This is a way to partially manage, not control, project completions to reduce completion timing risk.

Table 16-7 presents the status of those of the above recommendations that can be practically implemented during Phase II. The remainder will be considered for implementation in Phase III.

Table 16-7: SOS Status Report on Recommendations

Recommendations for Phase II	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider providing design support to customers.	Being considered.
Recommendation 2: Leverage completed SOS (and SEI CHP) projects to promote the technology.	Being considered.
Recommendation 3: Consider marketing to organizations that value CHP's environmental benefits.	Being considered.

Source: Navigant analysis and PECO
Note: These recommendations are for Phase II only.

16.6 Financial Reporting

Navigant's application of the TRC test, presented in Table 16-8, indicates that the SOS program was not cost effective in PY5. The net present value of all costs, including the cost of estimated additional participant gas purchases over the next 15 years, exceeds the net present value of benefits over that time period, resulting in a benefit-cost ratio of 0.68. Although the lifetime of these CHP systems is likely considerably longer than 15 years, Act 129 caps measure lifetimes at 15 years. This cap artificially suppresses the value of these systems and results in a cost-benefit ratio that is artificially low.

A breakdown of the program finances is presented in Table 16-8.

Table 16-8: Summary of SOS Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	4,993	4,993
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	4,993	4,993
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	343	343
Marketing[2]	0	0
Subtotal EDC Implementation Costs	343	343
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	5,336	5,336
Participant Costs[4]	62,363	62,363
Total NPV TRC Costs[5]	62,706	62,706
Total NPV Lifetime Energy Benefits	37,981	37,981
Total NPV Lifetime Capacity Benefits	4,567	4,567
Total NPV TRC Benefits[6]	42,548	42,548
TRC Benefit-Cost Ratio[7]	0.68	0.68

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer. For the SOS program, Participant Costs include the net present value of 15 years of increased fuel consumption costs. This cost amounts to $13.04 million for the two projects completed in PY5.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

17 Smart AC Saver - Commercial

In the Smart AC Saver program, PECO remotely cycles or shuts down a customer's CAC unit on short notice during times of peak demand. In return, participants receive financial incentives for allowing PECO to control their equipment. Conservation events are called during time periods that coincide with the highest peak demand.

A programmable control thermostat (PCT) is installed on participating business CAC units. When activated by a control signal, the switches will not allow the equipment to operate for some predetermined portion of each hour. For the Smart AC Saver program, the compressor is shut down during an event while the fan continues to operate. This allows cool air to be circulated throughout the business while the compressor is disabled. The operation of the PCT is controlled through a digital paging network. CAC units are controlled for the four months during summer (i.e., June through September).

Participation in the Smart AC Saver program varies month to month based on participants dropping from the program for a variety of reasons, including moving, closing of businesses, etc. During PY5, PECO maintained a list of customers seeking to join the program and continually backfilled some of the participants who left the program. As of the end of PY5, PECO had 3,511 active PCTs representing 1,993 participating businesses.

Total verified gross savings were 2.9 MW for the commercial Smart AC Saver program, which was 112 percent of the PY5 target of 2.6 MW. There are no energy savings goals for the Smart AC Saver program, and Navigant does not conduct an analysis of NTG or spillover for this program.

Program expenditures for commercial Smart AC Saver program PY5 totaled $0.3 million, approximately 59 percent of the PY5 budget of $0.5 million. Navigant calculated the Total Resource Cost (TRC) benefit/cost ratio of the commercial Smart AC Saver program at 1.81. The program was cost effective in PY5.

17.1 Program Updates

PECO designed the Phase II Smart AC Saver program to call conservation events for fewer hours than in PY4. In Program Year 5 (PY5), PECO called three conservation events that totaled less than nine hours, compared to 15 conservation events in PY4 totaling 51 hours. PECO based events on reaching 95 percent of the 2013 forecasted peak and/or PJM Emergency DR curtailment requests. In PY5, PECO registered a portion of their program load (approximately 40 MW) into the PJM Emergency DR program via their CSP, Comverge, to offset program costs. In PY5, PJM called two of the conservation events, and PECO called the third conservation event.

In Phase II, the PECO Smart AC Saver program reduced the incentives paid to participants during the months of June through September from $30 per month to $20 per month. Program staff anticipated that

the reduced incentive could cause some participants to drop from the program, but PECO was able to backfill participants from a list of customers who had requested to join the program.

17.1.1 Definition of Participant

For the purposes of reporting, a participant is defined as a single address.

17.2 Impact Evaluation Gross Savings

Impact Evaluation

In PY4, Navigant obtained five-minute interval data for the measurement and verification (M&V) sample of commercial Smart AC Saver program participants. Navigant analyzed interval data for a sample of participants to determine program impacts during events, the one hour preceding events, and the two hours following events.

Because there are no peak demand reduction targets for the Phase II EE&C Programs, Navigant proposed relying on the results of the PY4 commercial analysis to validate the results of the load study[95] that Comverge prepared to quantify commercial program saving for PY5.

Gross Impacts

For the PY5 evaluation, the Navigant team utilized the PY4 average calculated savings for the commercial sector and compared those results to the results that Comverge calculated for the PY5 curtailment season.

Gross Impact Results

In their Load Control Impact Evaluation Report[96] to PECO, Comverge reported that PECO called a total of three conservation events in PY5. In all three conservation events, the M&V population was also curtailed. Comverge utilized a load comparison approach to calculate the maximum hourly average reduction for the curtailment season of 0.64 kW for the commercial segment. For the commercial segment, a total savings of 2.4 MW (2.9 MW adjusted for line losses) was calculated, with 3,804 active switches participating.

[95] *PECO Energy Company 2013 Load Control Impact Evaluation Report.*

[96] *PECO Energy Company 2013 Load Control Impact Evaluation Report.*

The Navigant team sought to validate Comverge's findings utilizing average calculated savings from PY4. The results of the commercial population are illustrated below in Table 17-1.

Table 17-1: PY5 Commercial Average Impact (kW)

Event Date	Hour Beginning	Average Impact (kW)	# of participating switches	Total Load Reduction (MW)
July 17, 2013	14	0.714	3,855	2.8
July 17, 2013	15	0.714	3,855	2.8
July 17, 2013	16	0.714	3,855	2.8
July 18, 2013	14	0.714	3,855	2.8
July 18, 2013	15	0.714	3,855	2.8
July 18, 2013	16	0.714	3,855	2.8
September 11, 2013	15	0.714	3,804	2.7
September 11, 2013	16	0.714	3,804	2.7
Average	N/A	**0.714**	**3,842**	**2.7**

Source: Navigant analysis

Program impacts were calculated by applying kW reduction values to all event hours (0.714 for commercial).

The PY4 Navigant analysis calculated average impacts at WTHI = 83.2 and the hour from 4:00-5:00 p.m.

As illustrated in Table 17-2, Navigant's analysis yielded a higher average kW impact and total MW savings for the commercial sector on a post-line-loss-adjusted basis.

Table 17-2: Comparison of Impact Results after Line Loss Adjustment

Savings Analysis	Average Impact (kW)	Total Load Reduction (MW)
Navigant Commercial Analysis	0.851	3.3
Comverge Commercial Analysis	0.763	2.9

Source: Navigant

Tracking System Review

Navigant reviews a tracking system data extract that PECO provides on a quarterly basis. This data extract includes detailed customer information and information on the CAC equipment and the type of control device that Comverge installed. The team has observed no issues with this tracking system to date.

Verification and Due Diligence

In previous program years, Navigant has conducted on-site verification visits as part of the verification and due diligence process. Because PECO obtained a switch operability study from Comverge in PY2, which is suitable for load research studies submitted to PJM for five years , the team did not conduct any

on-site verification visits in PY5 and thus Table 17-3, Table 17-4, Table 17-5, and Table 17-6 are not applicable to this program.

Table 17-3: Phase II Commercial Smart AC Saver Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Commercial	1,993	0	2.9	314
Phase II Total	1,993	0	2.9	314

Source: Navigant analysis

Table 17-4: Commercial Smart AC Saver Sampling Strategy for Program Year 5

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Commercial	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

Table 17-5: Program Year 5 Commercial Smart AC Saver Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Commercial	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

Table 17-6: Program Year 5 Commercial Smart AC Saver Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	*Demand* Realization Rate	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Commercial	2.9	1.0	2.9	N/A	N/A
Program Total	2.9	1.0	2.9	N/A	N/A

Source: Navigant analysis

17.3 Impact Evaluation Net Savings

Navigant did not conduct research to determine free ridership for this program. Navigant assumes 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. Therefore, Table 17-7 and Table 17-8 are not applicable to this program.

Table 17-7: Commercial Smart AC Saver Sampling Strategy for Program Year 5 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Sample Frame Contacted[97] to Achieve Sample
Commercial	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

Table 17-8: Program Year 5 Commercial Smart AC Saver Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative precision
Commercial	N/A	N/A	N/A	N/A	N/A
Program Total[98]	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

17.4 Process Evaluation

For PY5, the evaluation team proposed a greatly scaled down process evaluation for the Smart AC Saver program, given that there are no demand goals as part of Act 129 in Phase II. For PY5, the team sought to answer the following key researchable process questions for the commercial program:

1. Has the program, as implemented, changed from last year? If so, how, why, and was this an advantageous change?
2. Are program incentive levels appropriate to maintain participation?

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[97] Percent contacted means of all the sample frame list (those drawn specifically for the survey) how many were called to get the completes, often 100 percent will be the answer.

[98] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

3. What is the influence of the incentive level on participation levels?

Process Evaluation

In its petition of the Pennsylvania PUC to continue the mass-market DLC program (i.e., the Smart AC Saver program) in Phase II, PECO stated the program was designed to preserve the small commercial DLC measure as a DR resource and to retain existing participants.

Furthermore, PECO desired to maintain the population of active load control devices by replacing customers that exited the Smart AC Saver program once the new program was implemented.

Conservation Events

Informal discussions with PECO program staff indicated conservation events in PY5 were anticipated to be far fewer in number than in PY4, and, in fact, only three conservation events were called in PY5, compared to 14 events in PY4.

Events were based on PECO reaching 95 percent of the 2013 forecasted peak and/or PJM Emergency DR curtailment requests. Additionally, a portion of program load (approximately 40 MW) was registered in the PJM Emergency DR Program via Comverge to offset program costs.

Continued Program Participation

In PY4, Navigant and PECO developed a study to determine the most cost-effective solution that would enable the Smart AC Saver program to contribute to the Phase III targets.

The Navigant team developed a willingness to accept (WTA) survey addressing the issue of how much customers would have to be paid to accept a change in program design and incentive levels.

One of the conclusions of the study was that, at an $80 incentive level, PECO could expect approximately 81 percent of participants to remain in the program. Utilizing the results of this study, PECO modified the incentive level of the program to $80 per program year, or $20 per month for the months of June, July, August, and September. The program was only marketed to new customers to the extent that PECO could maintain the population of customers present at the end of PY4.

PECO finished PY4 with 2,169 commercial participants representing 3,794 PCTs. At the end of PY5, PECO had 1,993 commercial participants representing 3,511 PCTs.

By successfully recruiting new participants to backfill for those customers leaving the program, PECO has been able to retain 93 percent of its commercial PCT count into the PY5 curtailment season.

Program Materials

The evaluation team reviewed the program's marketing and outreach materials available on the program's website at www.peco.com/SmartIdeas. The hyperlink redirects the user to an easy-to-navigate page that allows the customer to select from a number of residential and commercial programs and rebates. Information on the website includes FAQs, brief explanations of how the Smart AC Saver program works, and an easy-to-follow link to receive email conservation event notices.

Program Management and Staff Interviews

The Navigant team conducted informal discussions with program staff during PY5 to understand the reasons for resurrecting the program for PY5 and the goals for PY5, document conservation event days, and examine the plans for the future of the program in PY6 and PY7.

Participant Survey

No participant surveys were conducted during PY5 for the Smart AC Saver program.

On-Site Surveys

On-site surveys were not conducted for the Smart AC Saver program in PY5.

Sampling

The Navigant team applied the PY4 evaluation findings to verify the results of the impact study performed by the program CSP, Comverge in PY5. The team verified the commercial results by applying the findings of the Navigant PY4 load study that relied on Comverge's installed M&V meters on 108 participating units at 66 premises. A sample of this size was sufficient to estimate program impacts within the 90 percent confidence and 20 percent precision targets, assuming the coefficient of variation for the estimate is slightly greater than 1. Comverge selected the M&V using stratified random sampling.

For the PY5 program year Comverge obtained a statistically representative sample from the population of enrolled Smart AC Saver sites for the commercial program. In order to represent the population as closely as possible, the M&V units were distributed by air conditioner tonnage and the number of AC units per premise.

The Navigant team relied on the Comverge sampling strategy when reporting savings for the Smart AC Saver program in PY5 and thus Table 17-9 is not applicable to this program.

Program Theory and Logic Model

Though the evaluation team did not develop a program theory and logic model for the Smart AC Saver program, the program's barriers, activities, and outcomes are characterized below:

- Barriers – Customers seeking to participate in conservation events face the following:
  - No knowledge of peak demand times
  - No ability to cycle their ACs automatically during conservation events.
- Activities – The program actively engages in:
  - Marketing and lead generation
  - Customer screening for load control switch compatibility
  - Conservation events
  - Test events
- Outcomes – The outcome of these activities include:
  - Customer awareness of the program
  - Financial benefits of the program
  - Customer participation in conservation events
  - Correct operation of load control switches
  - Improved customer satisfaction with PECO
  - Demand savings for PECO

Table 17-9: Commercial Smart AC Saver Sampling Strategy for Program Year 5

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Evaluation Activity
Commercial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

17.5 Recommendations for Program

Recommendation #1: PECO should utilize AMI data for the PY7 Smart AC Saver program impact evaluation. Assuming PECO continues to deploy its AMI infrastructure during PY6, the Navigant team recommends that the PY7 year-end load study and estimation of commercial savings be completed utilizing AMI customer data. We expect the sample size to be sufficiently large to evaluate this voluntary program. The Navigant team will check for any evidence of bias, make recommendations about whether

bias is likely to be an issue in Phase III, and suggest ways to mitigate the bias if it is a possibility. Table 17-10 shows the status of this recommendation.

Table 17-10: Commercial Smart AC Saver Status Report on Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should utilize AMI data for the PY7 Smart AC Saver program impact evaluation.	Being considered. Currently the AMI meter installation is underway and scheduled to be finished prior to the beginning of PY7, which would allow PECO and the Smart A/C Saver program to adopt Navigant's recommendation for PY7.

Source: Navigant analysis and PECO

17.6 Financial Reporting

A breakdown of the program finances is presented in Table 17-11. The table indicates that the program was cost effective in PY5.

Table 17-11: Summary of Commercial Smart AC Saver Finances

	PYTD ($1,000)	Phase II ($1,000)
EDC Incentives to Participants	0	0
EDC Incentives to Trade Allies	0	0
Subtotal EDC Incentive Costs	*0*	*0*
Design & Development	0	0
Administration, Management, and Technical Assistance[1]	0	0
Marketing[2]	314	314
Subtotal EDC Implementation Costs	**314**	**314**
EDC Evaluation Costs	0	0
SWE Audit Costs	0	0
Total EDC Costs[3]	314	314
Participant Costs[4]	0	0
Total NPV TRC Costs[5]	**314**	**314**
Total NPV Lifetime Energy Benefits	319	319
Total NPV Lifetime Capacity Benefits	249	249
Total NPV TRC Benefits[6]	**567**	**567**
TRC Benefit-Cost Ratio[7]	**1.81**	**1.81**

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Per the 2013 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only. EDC costs include EDC Incentive Costs; Design & Development; Administration, Management, Technical Assistance; Marketing, EDC Evaluation Costs, and SWE Audit Costs categories.
[4] Per the 2013 Total Resource Cost Test Order, the Participant Costs are the costs for the end-use customer.
[5] Total TRC Costs includes Total EDC Costs and Participant Costs.
[6] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[7] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Navigant analysis

Appendix A: EM&V Information

Participant Definitions

Table A-0-1: Program Year 5 Participant Definition by Program

Program	Participant Definition	Can there be more than one measure per participant?	Sample Defined By:
Smart Appliance Recycling Program [1]	One Appliance	Yes	One Appliance
Smart Home Rebates Program	One purchased Measure	Yes	One Purchased Measure
Smart House Call Program	One Home	Yes	One Home
Smart Builder Rebates Program	One Home	Yes	N/A
Smart Energy Saver Program	One Kit	Yes	One Kit
Smart Usage Profile Program	One Home	No	One Home
Smart Multi-Family Solutions Program (Residential)	Utility Account ID	No	kWh
Low-Income Energy Efficiency (LEEP) Program	One Audit/One Giveaway recipient/One Household	Yes	Participant
Smart Equipment Incentives Program (C&I)	One Project	Yes	Project (Impact); Participant (Process)
Smart Construction Incentives Program	One Project	Yes	Project
Smart Business Solutions Program	One Project	Yes	Project
Smart On-Site Program	One Project	No	Project
Smart Multi-Family Solutions Program	Master Utility Account ID	Yes	kWh
Smart Equipment Incentives Program (GNI)	One Project	Yes	Project (Impact); Participant (Process)
Smart AC Saver Program (Residential)	One address	Yes	N/A
Smart AC Saver Program (Commercial)	One address	Yes	N/A

[1] Smart Appliance Recycling participation in Table 1-5 and Table 1-6 was based on JACO orders rather than units, as was completed in quarterly reports.

Source: Navigant analysis

Program Year 5 Evaluation Activities

Table A-0-2: Program Year 5 Actual Evaluation Activities

Programs (Sub Programs if necessary)	*Sectors*	Records Review	Participant Surveys	Non-participant Surveys	Site Visits	*Metering*
Smart Appliance Recycling Program	Residential	7,484	65	0	0	0
Smart Home Rebates Program	Residential	68,994	530	489	0	0
Smart House Call Program	Residential	40	70	0	0	0
Smart Builder Rebates Program	Residential	2	0	0	0	0
Smart Energy Saver Program	Residential	12,584	82	0	0	0
Smart Usage Profile Program	Residential	48,003	0	0	0	0
Smart Multi-Family Solutions Program (Residential) [1]	Residential	30	0	0	0	0
Low-Income Energy Efficiency (LEEP) Program	Low-income	4,423	121	0	10	0
Smart Equipment Incentives Program (C&I) [1]	Commercial, Industrial	32	19	0	30	6
Smart Construction Incentives Program	Commercial, GNI	13	0	0	10	1
Smart Business Solutions Program	Commercial	50	50	11	0	0
Smart On-Site Program [2]	Commercial, GNI	2	2	0	2	0
Smart Multi-Family Solutions Program (C&I) [3]	Commercial and Industrial	30	0	0	0	0
Smart Equipment Incentives Program (GNI)	Government, Nonprofit and Institutional	28	20	0	23	4
Smart Multi-Family Solutions Program (GNI) [3]	Government, Nonprofit and Institutional	15	0	0	0	0
Smart AC Saver Program (Residential)	Residential	0	0	0	0	0
Smart AC Saver Program (Commercial)	Small Commercial	0	0	0	0	0

[1] The Smart Equipment Incentives program also completed 7 phone verifications with participants as part of the impact evaluation; One SEI C&I participant did not complete the entire process questionnaire; 19 refers to the 19 completed surveys for NTG analysis. For SEI C&I, the total completes for the process findings is 18. The team also conducted focus groups with 15 participating and non-participating contractors.
[2] Navigant utilized metering data provided by each participant.
[3] The record reviews for the SMF program entailed file reviews of the project documentation. The installed measure counts and types were verified as part of the file review activities.

Source: Navigant analysis

Appendix B: TRC Incremental Costs

Table B-0-1 shows the incremental costs by program and measure that the team used in the TRC analysis. In determining the proper source to use for incremental costs, Navigant's source order began with the PECO EE&C Plan filed with the SWE, then the SWE Incremental Cost Database, then actual program costs (where appropriate), and finally other sources (such as the California Database on Energy Efficient Resources or TRMs from other jurisdictions). Per the PA PUC TRC order referenced in the PECO EE&C Plan, the costs associated with the purchase and installation of low-cost, efficient equipment given to residential customers free of charge are treated as program delivery costs. As such, the incremental costs for these measures were set to $0, and they are not included in the table below. Measures are not included in the table if the incremental cost source was the SWE Incremental Cost Database.

Table B-0-1: TRC Incremental Costs by Program and Measure

Program	Measure	Incremental Cost	Incremental Cost Source
Smart On-Site	Combined Heat and Power	$24,659,299.50	Actual Project Costs
Smart House Call	Blown-in insulation: R-49 and up	$2,080.00	PECO EE&C Plan
Smart House Call	Duct Sealing with ASHP	$538.00	PECO EE&C Plan
Smart House Call	Home Air Sealing	$420.00	PECO EE&C Plan
Smart House Call	Maintenance on ASHP	$88.00	PECO EE&C Plan
Smart House Call	Blown-in insulation: R-19 and up	$1,620.00	PECO EE&C Plan
Smart Equipment Incentives	Controls: EMS	$0.51 per square foot	PECO EE&C Plan
Smart Equipment Incentives	Controls: Interior Occupancy Sensor	$0.32 per watt controlled	PECO EE&C Plan
Smart Equipment Incentives	Custom HVAC	$0.30 per kWh saved	PECO EE&C Plan
Smart Equipment Incentives	Custom Lighting	$0.27 per kWh saved	PECO EE&C Plan
Smart Equipment Incentives	Custom Motors and Drives	$0.20 per kWh saved	PECO EE&C Plan
Smart Equipment Incentives	Custom Refrigeration	$0.30 per kWh saved	PECO EE&C Plan
Smart Equipment Incentives	Custom	$0.30 per kWh saved	PECO EE&C Plan
Smart Equipment Incentives	ENERGY STAR Glass Door Freezer	$804.75	PECO EE&C Plan
Smart Equipment Incentives	ENERGY STAR Solid Door Freezer	$804.75	PECO EE&C Plan

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Equipment Incentives	Heat Pump: PTHP	$2.62	PECO EE&C Plan
Smart Equipment Incentives	ENERGY STAR Interior Recessed LED Downlighting	$0.79 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	LED Replacing Exterior HID	$0.77 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	LED Replacing Garage HID	$1.03 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	Linear Fluorescent: HP/RW T8 Lamp - Lamp only	$0.07 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	Linear Fluorescent: HPT8 Ballast with Low Ballast Factor	$1.74 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	Linear Fluorescent: T8/T5 Fluorescent Fixture w/ Electronic Ballast	$0.75 per watt reduced	PECO EE&C Plan
Smart Equipment Incentives	Permanent Lamp Removal	$25.75 per lamp removed	PECO EE&C Plan
Smart Construction Incentives	Controls: Anti-Sweat Heater Controls	$34.00 per linear foot	PECO EE&C Plan
Smart Construction Incentives	Controls: Interior Occupancy Sensor	$0.32 per watt controlled	PECO EE&C Plan
Smart Construction Incentives	Custom Lighting	$0.31 per kWh saved	PECO EE&C Plan
Smart Construction Incentives	Custom Motors and Drives	$0.24 per kWh saved	PECO EE&C Plan
Smart Construction Incentives	Custom Refrigeration	$0.34 per kWh saved	PECO EE&C Plan
Smart Construction Incentives	Custom HVAC	$0.34 per kWh saved	PECO EE&C Plan
Smart Construction Incentives	Custom	$0.26 per kWh saved	PECO EE&C Plan
Smart Construction Incentives	ENERGY STAR Glass Door Freezer	$804.75	PECO EE&C Plan
Smart Construction Incentives	New Construction Lighting	$1.25 per watt reduced	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (general service, dimmable)	$1.77	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (general service, non-dimmable)	$1.77	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: 3-way)	$3.00	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: A-Line)	$3.00	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: Candelabra)	$3.00	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: Globe)	$3.00	PECO EE&C Plan

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: Reflector-Dimmable)	$3.00	PECO EE&C Plan
Smart Home Rebates	CFL: ENERGY STAR Screw-in CFL Bulbs (Specialty: Reflector)	$3.00	PECO EE&C Plan
Smart Home Rebates	LED: A19, General Service Incandescent Lamp Replacement	$20.00	PECO EE&C Plan
Smart Home Rebates	LED: Globe	$20.00	PECO EE&C Plan
Smart Home Rebates	LED: PAR20	$24.00	PECO EE&C Plan
Smart Home Rebates	LED: PAR30	$24.00	PECO EE&C Plan
Smart Home Rebates	LED: PAR38	$24.00	PECO EE&C Plan
Smart Home Rebates	LED: R20	$24.00	PECO EE&C Plan
Smart Business Solutions	23W CFL	$45.70	Actual Direct Install Costs
Smart Business Solutions	7W CFL	$36.40	Actual Direct Install Costs
Smart Business Solutions	13W CFL	$25.93	Actual Direct Install Costs
Smart Business Solutions	9W CFL	$26.02	Actual Direct Install Costs
Smart Business Solutions	16W CFL	$22.38	Actual Direct Install Costs
Smart Business Solutions	Ceiling Mount Interior Occupancy Sensor	$184.19	Actual Direct Install Costs
Smart Business Solutions	Fixture Mount Interior Occupancy Sensor	$119.77	Actual Direct Install Costs
Smart Business Solutions	Wall Switch Interior Occupancy Sensor	$110.95	Actual Direct Install Costs
Smart Business Solutions	New LED Plug-In "OPEN" Sign	$192.24	Actual Direct Install Costs
Smart Business Solutions	Interior LED Exit Signs	$72.54	Actual Direct Install Costs
Smart Business Solutions	16W LED Refrigeration Case Lighting	$608.73	Actual Direct Install Costs
Smart Business Solutions	176W LED Refrigeration Case Lighting	$3,614.57	Actual Direct Install Costs
Smart Business Solutions	32W LED Refrigeration Case Lighting	$903.64	Actual Direct Install Costs
Smart Business Solutions	40W LED Refrigeration Case Lighting	$903.64	Actual Direct Install Costs
Smart Business Solutions	48W LED Refrigeration Case Lighting	$1,204.86	Actual Direct Install Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	60W LED Refrigeration Case Lighting	$1,204.86	Actual Direct Install Costs
Smart Business Solutions	64W LED Refrigeration Case Lighting	$1,506.07	Actual Direct Install Costs
Smart Business Solutions	80W LED Refrigeration Case Lighting	$1,807.28	Actual Direct Install Costs
Smart Business Solutions	96W LED Refrigeration Case Lighting	$2,108.50	Actual Direct Install Costs
Smart Business Solutions	120W LED Refrigeration Case Lighting	$2,108.50	Actual Direct Install Costs
Smart Business Solutions	140W LED Refrigeration Case Lighting	$2,409.71	Actual Direct Install Costs
Smart Business Solutions	7W LED: A19, General Service Incandescent Lamp Replacement	$36.50	Actual Direct Install Costs
Smart Business Solutions	8W LED: A19, General Service Incandescent Lamp Replacement	$36.50	Actual Direct Install Costs
Smart Business Solutions	11W LED: A19, General Service Incandescent Lamp Replacement	$43.09	Actual Direct Install Costs
Smart Business Solutions	12W LED: A19, General Service Incandescent Lamp Replacement	$82.66	Actual Direct Install Costs
Smart Business Solutions	13W LED: BR30	$83.15	Actual Direct Install Costs
Smart Business Solutions	New 93W LED Area/Pole Mount Fixture replacing HID 250-400 W	$956.40	Actual Direct Install Costs
Smart Business Solutions	New 40W LED Canopy replacing HID 250-400W	$746.82	Actual Direct Install Costs
Smart Business Solutions	New 22W LED Flood replacing HID 100-175 W	$433.44	Actual Direct Install Costs
Smart Business Solutions	New 41W LED Flood replacing HID 175-320 W	$528.51	Actual Direct Install Costs
Smart Business Solutions	New 45W LED Flood replacing HID 175-320 W	$549.00	Actual Direct Install Costs
Smart Business Solutions	New 79W LED Flood replacing HID 400 W	$991.65	Actual Direct Install Costs
Smart Business Solutions	New 90W LED Flood replacing HID 400 W	$991.65	Actual Direct Install Costs
Smart Business Solutions	New 13W LED Wallpack replacing HID 100-150 W	$423.65	Actual Direct Install Costs
Smart Business Solutions	New 20W LED Wallpack replacing HID 151-175 W	$451.62	Actual Direct Install Costs
Smart Business Solutions	New 26W LED Wallpack replacing HID 176-250 W	$424.05	Actual Direct Install Costs
Smart Business Solutions	New 30W LED Wallpack replacing HID 176-250 W	$501.99	Actual Direct Install Costs
Smart Business Solutions	New 40W LED Wallpack replacing HID 251-400 W	$668.48	Actual Direct Install Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	New 60W LED Wallpack replacing HID 400 W	$746.82	Actual Direct Install Costs
Smart Business Solutions	5W LED: MR16	$36.90	Actual Direct Install Costs
Smart Business Solutions	6W LED: MR16	$45.45	Actual Direct Install Costs
Smart Business Solutions	8W LED: PAR20	$46.43	Actual Direct Install Costs
Smart Business Solutions	12W LED: PAR30	$75.81	Actual Direct Install Costs
Smart Business Solutions	13W LED: PAR30	$75.81	Actual Direct Install Costs
Smart Business Solutions	18W LED: PAR38	$85.60	Actual Direct Install Costs
Smart Business Solutions	13W LED: PAR38	$66.36	Actual Direct Install Costs
Smart Business Solutions	10.5W LED:BR30	$45.86	Actual Direct Install Costs
Smart Business Solutions	4W LED:CLBR	$61.55	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-5: T5 3F54HO	$270.54	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-5: T5 4F54HO	$287.42	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-5: T5 6F54HO	$374.99	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-8: HPT8 3F32 ISH	$232.91	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-8: HPT8 4F32 ISH	$243.00	Actual Direct Install Costs
Smart Business Solutions	High Bay Fluorescent T-8: HPT8 6F32 ISH	$287.64	Actual Direct Install Costs
Smart Business Solutions	HPT8 2' Relamp and Reballast: HPT8 1F17 ISL	$7.18	Actual Direct Install Costs
Smart Business Solutions	HPT8 2' Relamp and Reballast: HPT8 2F17 ISL	$62.94	Actual Direct Install Costs
Smart Business Solutions	HPT8 2' Relamp and Reballast: HPT8 3F17 ISL	$68.82	Actual Direct Install Costs
Smart Business Solutions	HPT8 2x2 Troffer Retrofit: HPT8 2F17 ISL	$80.50	Actual Direct Install Costs
Smart Business Solutions	HPT8 2x2 Troffer Retrofit: HPT8 3F17 ISL	$90.98	Actual Direct Install Costs
Smart Business Solutions	HPT8 2x4 Troffer Retrofit: HPT8 2F28 ISL	$87.90	Actual Direct Install Costs
Smart Business Solutions	HPT8 2x4 Troffer Retrofit: HPT8 2F32 ISH	$98.56	Actual Direct Install Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	HPT8 2x4 Troffer Retrofit: HPT8 2F32 ISL	$91.70	Actual Direct Install Costs
Smart Business Solutions	HPT8 2x4 Troffer Retrofit: HPT8 2F32 ISN	$91.70	Actual Direct Install Costs
Smart Business Solutions	HPT8 3' Relamp and Reballast: HPT8 1F25 ISL	$59.69	Actual Direct Install Costs
Smart Business Solutions	HPT8 3' Relamp and Reballast: HPT8 2F25 ISL	$64.04	Actual Direct Install Costs
Smart Business Solutions	HPT8 3' Relamp and Reballast: HPT8 4F25 ISL	$92.00	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Industrial Retrofit: HPT8 1F28 ISL	$80.59	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Industrial Retrofit: HPT8 1F32 ISL	$82.49	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Industrial Retrofit: HPT8 1F32 ISN	$82.49	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Industrial Retrofit: HPT8 2F28 ISL	$81.22	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Industrial Retrofit: HPT8 2F32 ISL	$81.22	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 1F28 ISL	$58.83	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 1F32 ISL	$60.73	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 2F28 ISL	$62.31	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 2F32 ISL	$66.11	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 2F32 ISN	$60.05	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 3F28 ISL	$67.88	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 3F32 ISL	$73.58	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 4F28 ISL	$72.89	Actual Direct Install Costs
Smart Business Solutions	HPT8 4' Relamp and Reballast: HPT8 4F32 ISL	$73.34	Actual Direct Install Costs
Smart Business Solutions	HPT8 6' Industrial Retrofit: HPT8 2F25 ISL	$113.35	Actual Direct Install Costs
Smart Business Solutions	HPT8 6' Industrial Retrofit: HPT8 4F25 ISL	$139.81	Actual Direct Install Costs
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 2F28 ISL	$94.32	Actual Direct Install Costs
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 2F32 ISH	$104.98	Actual Direct Install Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 2F32 ISN	$98.12	Actual Direct Install Costs
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 4F28 ISL	$111.09	Actual Direct Install Costs
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 4F32 ISH	$129.78	Actual Direct Install Costs
Smart Business Solutions	HPT8 8' Industrial Retrofit: HPT8 4F32 ISN	$118.69	Actual Direct Install Costs
Smart Business Solutions	New HPT8 2X4 Recessed Troffer: HPT8 2F32 ISN	$129.62	Actual Direct Install Costs
Smart Business Solutions	New HPT8 2X4 Recessed Troffer: HPT8 3F28 ISL	$166.99	Actual Direct Install Costs
Smart Business Solutions	New HPT8 2X4 Recessed Troffer: HPT8 3F32 ISL	$130.50	Actual Direct Install Costs
Smart Business Solutions	New HPT8 2X4 Recessed Troffer: HPT8 3F32 ISN	$172.69	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Industrial Fixture: HPT8 1F28 ISL	$100.89	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Industrial Fixture: HPT8 1F32 ISL	$102.79	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Industrial Fixture: HPT8 2F28 ISL	$98.54	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Industrial Fixture: HPT8 2F32 ISH	$118.36	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Industrial Fixture: HPT8 2F32 ISL	$102.34	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Wrap Fixture: HPT8 2F28 ISL	$116.34	Actual Direct Install Costs
Smart Business Solutions	New HPT8 4' Wrap Fixture: HPT8 2F32 ISL	$120.14	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Industrial Fixture: HPT8 2F28 ISL	$133.68	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Industrial Fixture: HPT8 2F32 ISH	$144.92	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Industrial Fixture: HPT8 4F28 ISL	$145.43	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Industrial Fixture: HPT8 4F32 ISH	$163.67	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Industrial Fixture: HPT8 4F32 ISN	$168.60	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Vaportight Fixture: HPT8 2F32 ISH	$253.63	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Vaportight Fixture: HPT8 4F28 ISL	$298.31	Actual Direct Install Costs
Smart Business Solutions	New HPT8 8' Vaportight Fixture: HPT8 4F32 ISH	$266.16	Actual Direct Install Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	New HPT8 8' Wrap Fixture: HPT8 4F28 ISL	$194.58	Actual Direct Install Costs
Smart Business Solutions	Removed Lighting Fixture	$27.50	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	18W CFL	$5.47	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	9W CFL	$7.05	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	13W CFL	$4.97	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	18W CFL	$5.47	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	23W CFL	$5.56	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	23W CFL	$5.56	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	13W CFL	$4.97	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	13W CFL	$4.97	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	1 GPM Low Flow Faucet Aerators	$4.00	Actual Direct Install Costs
Smart Multi-Family Solutions (C&I, GNI)	1.5 GPM Low Flow Showerheads	$15.49	Actual Direct Install Costs

Source: Navigant analysis

Appendix C: Low-Income Participation in Non-Low-Income Programs

All Low-Income Energy Efficiency Program (LEEP) participants are assumed to be low-income participants. In order to determine the rate of participation of low-income customers outside of LEEP, Navigant fielded a standard battery of demographics questions for all other residential programs. These batteries include questions regarding the following:

- Number of people (including the respondent) who lived in the respondent's household full time for at least six month of the year
- Total household income for 2013

For those respondents who would not provide total household income, the survey included questions regarding ranges of income.

The survey language is as follows:

QD5A. How many people, including yourself, live in your home full-time at least six months of the year?

_____ [RECORD NUMBER OF OCCUPANTS]

96. DON'T KNOW
97. REFUSED

QD5B. What is your total 2013 income before taxes for all members of your household? Was it (***READ LIST) STOP ME WHEN I GET TO THE RIGHT RANGE***

1. Less than $30,000
2. $30,000 but under $50,000
3. $50,000 but under $75,000
4. $75,000 but under $100,000
5. $100,000 but under $150,000
6. $150,000 but under $200,000
7. Above $200,000

99. REFUSED

If the entirety of income range reported in QD5b is greater than the [INCOME_THRESHOLD_150] corresponding to the occupancy level reported in QD5A, Skip to QD7.

If the entirety of income range reported in QD5b is less than or equal to the [INCOME_THRESHOLD_150] corresponding to the occupancy level reported in QD5A, flag as "low income <150" and skip to QD7.

If some, but not all, of the income range reported in QD5b is equal to or less than the [INCOME_THRESHOLD_150] corresponding to the occupancy level reported in QD5A, then ask QD6A

QD6A. Just for clarification purposes, was your total 2013 household income before taxes below **[INCOME_THRESHOLD_150]**?

1. Yes **[FLAG AS "low income < 150" AND SKIP TO QD7]**
2. No
98. DON'T KNOW **[SKIP TO QD7]**
99. REFUSED **[SKIP TO QD7]**

QD6B. **[ASK IF QD6A=2 AND THE UPPER END OF THE INCOME RANGE REPORED IN QD5B IS GREATER THAN [INCOME_THERSHOLD_200] CORRESPONDING TO THE OCCUPANCY LEVEL REPORTED IN QD5A, ELSE SKIP TO QD7]** Was your total 2013 household income before taxes below **[INCOME_THRESHOLD_200]**?

1. Yes **[FLAG AS "low income <200"]**
2. No
98. DON'T KNOW
99. REFUSED

Table C-0-1: Income Threshold Table

QD5 (# People in HH)	Income_Threshold_150	Income_Threshold_200
1	$ 17,000	$ 23,000
2	$ 23,000	$ 31,000
3 or DK/REF	$ 29,000	$ 39,000
4	$ 35,000	$ 47,000
5	$ 41,000	$ 55,000
6	$ 47,000	$ 63,000
7	$ 53,000	$ 71,000
8	$ 59,000	$ 79,000
9	$ 65,000	$ 87,000
10	$ 72,000	$ 95,000
11	$ 78,000	$ 103,000
12 or more	$ 84,000	$ 111,000

Source: Navigant analysis

Based on the responses regarding size of household and income, Navigant determined the number of respondents who were below 150 percent and 200 percent of the 2013 Federal Poverty Line. Navigant then extrapolated the number of respondents below the sample to the total participant population.

Appendix D: Residential Lighting Upstream Program Cross-Sector Sales

The evaluation team conducted 802 in-store intercept surveys across 23 retail stores with lighting purchasers irrespective of whether they were purchasing program bulbs, non-program bulbs, or both. Intercepts survey data was collected in February through May 2014. The evaluation team developed the survey questionnaire, and average survey length was approximately 10 minutes. Survey respondents were given a $10 gift card in exchange for their willingness to participate in the survey. The sample of retail stores for the intercepts was based on the proportion of total PY5 program bulb sales by retail channel, subject to permission from individual store managers and retail chains to collect data in their stores. The final sample yielded an average of 35 completed intercepts per store in each of 23 retail stores.

In analyzing the collected data from the Smart Home Rebate (SHR) program in-store intercept survey for cross sector installation rate, the evaluation team dropped a record in which the respondent indicated the location where they expected to install the bulbs (in this case a home location) was not in PECO service territory. Four records were dropped where baseline wattage had erroneously been entered in place of number of packs purchased, so no accurate determination could be made about bulb quantity. Respondents saying they didn't know where they would be installing the bulbs were also dropped from analysis for this factor.

Since respondents were asked separately regarding standard CFLs, specialty CFLs, and light-emitting diodes (LEDs) whether they planned to install the program bulbs they were purchasing in their home, in a business, or both, the evaluation team was able to calculate distinct cross-sector installation rates for each program bulb type, as well as an average across all program bulbs, weighted by the total number of each type of bulb in the program tracking data.

Table D-0-1 below shows the results for cross-sector installation rate for each bulb type. Standard CFLs have by far the highest cross-sector installation rate at 11.5 percent, while LEDs have a lower cross- sector installation rate at 3.3 percent and specialty CFLs the lowest at 2.3 percent. The weighted average across all program bulb types based on total verified program bulb sales in the program tracking data is 8.5 percent.

Table D-0-1: Cross-Sector Installation Rate

QD5 (# People in HH)	Cross-Sector Bulbs	Total Bulbs	n	Cross-Sector Rate
Standard CFLs	111	966	176	11.5%
Specialty CFLs	4	173	66	2.3%
LEDs	7	209	76	3.3%
Overall:	122	1,348	313	8.5%

Note: The overall Cross-Sector Installation Rate across all bulb types is weighted by total verified program bulb sales by type in the tracking data and not by bulb type ratios in intercept shoppers' baskets.

Source: Navigant analysis of In-Store Intercepts Data

Note that the cross-sector installations rate of 8.5 percent comes from an approach that is slightly updated from the approach that was used in PY2, which yielded a cross-sector installation rate of 7.7 percent.

Specifically, in the PY2 intercepts, respondents who indicated they would be installing program bulbs in both home and business locations were not asked a follow-up question about how many they expected to install in business sockets. To account for this, in PY2 the evaluation team assumed that half of program bulbs would be installed in home sockets and half in business sockets for those respondents who indicated both home and business and who purchased up to twice the average number of program bulbs per in-store intercept respondent. For those PY2 intercept interviewees who indicated both home and business and were purchasing more than twice the average number of program bulbs, the evaluation team assumed that the number going into home sockets was equal to the overall average number of program bulbs going into home sockets across all intercept respondents. The evaluation team further assumed that the remainder of the total would be installed in business sockets. This approach yielded a cross-sector installations estimate of 10 percent, and the evaluation team recommended that the lower bound on the 90/10 confidence interval for that estimate, 7.7 percent, be used as a conservative estimate of cross-sector installations rate.

By contrast, in PY5, respondents who indicated they would be installing program bulbs in both home and business were asked the follow-up question about specifically how many of these bulbs they expected to install in business sockets. As such, no estimation or extrapolation of this portion was required, and the cross-sector installation rates in Table D-0-1 above by bulb type and for all program bulbs as a whole reflect that updated method.

Table D-0-2 shows cross-sector installation rate broken out for standard CFLs by typical incandescent equivalent bulb wattage. Based on this breakout, the cross-sector installation rates for 40 watt (W), 60 W, and 100 W equivalent standard CFLs are comparatively high, ranging from 10 percent to 19 percent, while no instances of cross-sector installations were observed for particularly low- or high-wattage standard CFLs.

Table D-0-2: Cross-Sector Installation Rate Detail

Bulb Type	Equivalent Wattage	Cross-Sector Bulbs	Total Bulbs	n	Cross-Sector Rate
Standard CFLs	25W	0	12	2	0%
	40W	37	192	30	19%
	60W	66	644	112	10%
	75W	2	61	18	3%
	100W	6	47	11	13%
	125W	0	4	1	0%
	150W	0	6	3	0%
Standard CFLs	N/A	111	966	176	11.5%
Specialty CFLs	N/A	4	173	66	2.3%
LEDs	N/A	7	209	76	3.3%
Overall:	N/A	233	1,348	313	8.5%

Note: The overall cross-sector installations rate across all bulb types in this and other tables is weighted by total verified program bulb sales by type in the tracking data and not by bulb type ratios in intercept shoppers' baskets.

Source: Navigant analysis of In-Store Intercepts Data

Table D-0-3 shows the distribution of nonresidential building types in which respondents said they would be installing SHR program bulbs. The most common nonresidential building types for cross-sector installation of bulbs are restaurants and offices, followed by common areas in lodging facilities and then grocery stores. These four business types represent approximately 80 percent of all cross-sector installations documents in the intercepts.

Table D-0-3: Cross-Sector Bulb Installations by Business Type

Bulb Type	Standard CFLs	Specialty CFLs	LEDs
Restaurant	37	3	--
Office	24	--	5
Lodging common areas	15	--	--
Grocery	12	--	--
Auto Related	9	--	1
Retail	8	--	--
Daycare	4	1	--
Religious Worship	2	--	--
Industrial/Manufacturing	--	--	1
Total	111	4	7

Source: Navigant analysis In-Store Intercepts Data

Based on this cross-sector installation rate, Navigant estimates that the SHR program delivered 32,870 MWh and 0.7 MW of savings in the non-residential sector (as detailed in the Table D-0-4 below). The value of the rebates issued to non-residential customers was approximately $258,000. Because individual bulb sales are not counted as participation, the number of program participants remains unchanged from its reported value.

Table D-0-4: Smart Home Rebates Verified Results by Sector

Sector	Participants	Verified Gross Energy Savings (MWh/yr)	Verified Gross Demand Reduction (MW)	Incentives (1,000)
Residential	10,777	78,699	13.0	$5,905
Low-Income	1,332	9,727	1.6	$730
Small Commercial and Industrial	0	0	0	0
Commercial and Industrial	0	32,870	0.7	$258
Government, Nonprofit, and Institutional	0	0	0	0
Phase II Total	**12,109**	**121,297**	**15.3**	**$6,893**

Source: Navigant analysis

Appendix E: Glossary of Terms

This Glossary of Terms was provided by the SWE.

– A –

Administration Management and Technical Assistance Costs: Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

Avoided Cost: In the context of energy efficiency, the costs that are avoided by the implementation of an energy efficiency measure, program, or practice. Such costs are used in benefit/cost analyses of energy efficiency measures and programs as defined by the Pennsylvania PUC in the 2013 TRC *Test Order*.

– B –

Baseline: Conditions that would have occurred without implementation of the subject measure or project. Baseline conditions are sometimes referred to as "business-as-usual" conditions and are used to calculate program-related efficiency or emissions savings. Baselines can be defined as either project-specific baselines or performance-standard baselines (e.g., building codes). For the purposes of Act 129, baselines are defined in the Pennsylvania TRM, in approved custom protocols, and in TRM interim approved protocols.

Baseline Data: The information representing the systems being upgraded before the energy efficiency activity takes place.

***Benefit/Cost Ratio**: The mathematical relationship between the benefits and costs associated with the* implementation of energy efficiency measures, programs, or practices. The benefits and costs are typically expressed in dollars. This is the ratio of the discounted total benefits of the program to the discounted total costs over the expected useful life of the energy efficiency measure. The explicit formula for use in Pennsylvania is set forth in the TRC Order. Also see *Benefit-Cost Test*.

Benefit-Cost Test: Also called *Cost-Effectiveness Test,* defined as the methodology used to compare the benefits of an investment to the costs. For programs evaluated under Act 129, the TRC Test is the required benefit-cost test as established in the TRC Order.

Bias: The extent to which a measurement, sampling, or analytic method systematically underestimates or overestimates a value. Some examples of types of bias include engineering model bias; meter bias; sensor bias; an inadequate or inappropriate estimate of what would have happened absent a program or measure installation; a sample that is unrepresentative of a population; and selection of other variables in an analysis that are too correlated with the savings variable (or each other) in explaining the dependent variable (such as consumption).

– C –

Coefficient of Variation: The mean (average) of a sample divided by its standard error.

Coincident Demand: The demand of a device, circuit, or building that occurs at the same time as the system peak demand. For purposes of Act 129 reporting, the coincident demand is during the peak period as defined in the TRM (June through August, excluding weekends and holidays between 2 and 6 PM.

Coincidence Factor: The ratio, expressed as a numerical value or as a percentage of connected load, of the coincident demand of an electrical appliance or facility type to the system peak.

Completed Project: A project in which the energy conservation measure has been installed and is commercially operable, and for which an incentive has been provided.

Confidence: An indication of the probability that an estimate is within a specified range of the true value of the quantity in question. Confidence is the likelihood that the evaluation has captured the true value of a variable within a certain estimated range. Also see *Precision*.

Correlation: For a set of observations, such as for participants in an energy efficiency program, the extent to which values for one variable are associated with values of another variable for the same participant. For example, facility size and energy consumption usually have a high positive correlation.

Cost-Benefit and Cost-Effectiveness Analysis: See *Benefit-Cost Test*.

Cost-Effectiveness: An indicator of the relative performance or economic attractiveness of an investment or practice. In the energy efficiency field, the present value of the estimated benefits produced by an energy efficiency program is compared to the estimated total costs to determine if the proposed investment or measure is desirable from a variety of perspectives (e.g., whether the estimated benefits exceed the estimated costs consistent with definitions in the TRC Order. See *Benefit-Cost Test*.

Cost-Effectiveness Test: See *Benefit-Cost Test*.

Cumulative Energy Savings: The summation of energy savings associated with multiple projects or programs over a specified period of time.

Custom Program: An energy efficiency program intended to provide efficiency solutions to unique situations not amenable to common or prescriptive solutions addressed by the Pennsylvania TRM. Each custom project is examined for its individual characteristics, savings opportunities, efficiency solutions, and often, customer incentives. Under Act 129, these programs fall outside of the jurisdiction of the Pennsylvania TRM, and thus the M&V protocols for each should be approved by the SWE.

– D –

Deemed Savings: An estimate of energy or demand savings for a single unit of an installed energy efficiency measure that: (1) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and (2) is applicable to the situation being evaluated. Individual parameters or calculation methods can also be deemed. Deemed savings for measures implemented under Act 129 are stipulated in the Pennsylvania TRM, which undergoes an annual review and update process, as well as in the Interim TRM Measures, which are subject to interim approval by the SWE.

Defensibility: The ability of evaluation results to stand up to scientific scrutiny. Defensibility is based on assessments by experts of the evaluation's validity, reliability, and accuracy. Under Act 129, it is the role of the SWE to determine the defensibility of the verified savings estimates reported by each of the EDCs.

Delta Watts: The difference in the connected load (wattage) between existing or baseline equipment and the energy-efficient replacement equipment, expressed in Watts or kilowatts.

Demand: The rate of energy flow. Demand usually refers to the amount of electric energy used by a customer or piece of equipment over a defined time interval (e.g., 15 minutes), expressed in kW (equals kWh/h). Demand can also refer to natural gas usage over a defined time interval, usually as Btu/hr, kBtu/hr, therms/day, or ccf/day.

Demand Reduction: See *Demand Savings*.

Demand Response: The reduction of customer energy usage at times of peak usage in order to help system reliability, to reflect market conditions and pricing, or to support infrastructure optimization or deferral of additional infrastructure. Demand response programs may include contractually obligated or voluntary curtailment, direct load control, and pricing strategies.

Demand Savings: The reduction in electric demand from the demand associated with a baseline system to the demand associated with the higher-efficiency equipment or installation. Demand savings associated with energy efficiency measures implemented under Act 129 are calculated according to the approved calculation methods stipulated in the TRM or subsequently approved through alternative methods (e.g., interim measures, custom protocols).

Demand-side Management: Strategies used to manage energy demand including energy efficiency, load management, fuel substitution, and load shedding.

– E –

Energy Efficiency and Conservation (EE&C) Plan: Plan as filed by the EDC and approved by the PUC.

EE&C Plan Estimate for Program Year: An estimate of the energy savings or demand reduction for the current program year as filed in the EDC EE&C plans.

Effective Useful Life: An estimate of the median number of years that efficiency measures installed under a program are still in place and operable. For measures implemented under Act 129, it is required that the effective useful life or 15 years, whichever is less, be used to determine measure assessments.

Electric Distribution Company (EDC): In reference to Act 129, there are seven EDCs with at least 100,000 customers that are required to adopt a plan to reduce energy and demand consumption within their service territory in accordance with 66 Pa. C.S. § 2608. The seven EDCs are: West Penn Duquesne Light, Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, PECO Energy Company, PPL Electric Utilities and West Penn Power.

End Use: An appliance, activity, system, or equipment that uses energy.

Energy Conservation: Using less of a service in order to save energy. The term often is used unintentionally instead of *energy efficiency*.

Energy Efficiency: The use of less energy to provide the same or an improved level of service to the energy consumer; or the use of less energy to perform the same function.

Energy Efficiency Measure: An installed piece of equipment or a system, modification of equipment systems, or modified operations in customer facilities that reduce the total amount of electrical or gas energy and the capacity that otherwise would have been needed to deliver an equivalent or improved level of comfort or energy service.

Energy Savings: A reduction in electricity use (kWh) or in fossil fuel use in thermal unit(s).

Evaluation: The conduct of any of a wide range of assessment studies and other activities aimed at documenting an enhanced understanding of a program or portfolio, including determining the effects of a program, understanding or documenting program performance, program-related markets and market operations, program-induced changes in energy efficiency markets, levels of potential demand or energy savings, and/or program cost-effectiveness. Market assessments, monitoring and evaluation, and M&V are aspects of evaluation.

Ex Ante Savings Estimate: Forecasted savings used for program and portfolio planning purposes.

Ex Post Savings Estimate: Savings estimate reported by an evaluator after the energy impact evaluation has been completed.

– F –

Free Driver: A program nonparticipant who adopted a particular efficiency measure or practice as a result of the evaluated program. Also see *Spillover*.

Free-Rider: A program participant who would have implemented the program measure or practice in the absence of the program. Free-riders can be: (1) total, in which the participant's activity would have completely replicated the program measure; (2) partial, in which the participant's activity

would have partially replicated the program measure; or (3) deferred, in which the participant's activity would have completely replicated the program measure, but after the program's timeframe.

Free-Ridership Rate: *The percent of savings attributable to free-riders.*

– G –

Gross Impact: See *Gross Savings*.

Gross Savings: *The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.*

Gross kW: Expected demand reduction based on a comparison of standard or replaced equipment with equipment installed through an energy efficiency program.

Gross kWh: Expected kWh reduction based on a comparison of standard or replaced equipment with equipment installed through an energy efficiency program.

– H –

– I –

Impact Evaluation: An evaluation of the program-specific, directly induced quantitative changes (kWh, kW, and therms) attributable to an energy efficiency program.

Incremental Cost: The difference between the cost of an existing or baseline equipment or service and the cost of an alternative energy efficient equipment or service.

Incremental Energy Savings: The difference between the amount of energy savings associated with a project or a program in one period and the amount of energy savings associated with that project or program in a prior period.

– J –

– K –

Kilowatt (kW): A measure of the rate of power used during a pre-set time period (e.g., minutes, hours, days, months) equal to 1,000 Watts.

Kilowatt-Hour (kWh): A common unit of electric energy; one kilowatt-hour is numerically equal to 1,000 Watts used for one hour.

– L –

Lifetime kW: The expected demand savings over the lifetime of an installed measure, equal to the annual peak kW reduction associated with a measure multiplied by the expected lifetime of that measure. It is expressed in units of kW-years.

Lifetime MWh: The expected electrical energy savings over the lifetime of an installed measure, calculated by multiplying the annual MWh reduction associated with a measure by the expected lifetime of that measure.

Lifetime Supply Costs: The net present value of avoided supply costs associated with savings, net of changes in energy use that would have happened in the absence of the program over the life of the energy efficiency measure, factoring in persistence of savings. See *Avoided Cost*.

Load Factor: A percentage indicating the ratio of electricity or natural gas used during a given timeframe to the amount that would have been used if the usage had stayed at the highest demand the whole time. The term is also used to indicate the percentage of capacity of an energy facility, such as a power plant or gas pipeline, that is utilized for a given period of time.

Load Management: Steps taken to reduce power demand at peak load times or to shift some of it to off-peak times. Load management may coincide with peak hours, peak days, or peak seasons. Load management may be pursued by persuading consumers to modify behavior or by using equipment that regulates some electric consumption. This may lead to complete elimination of electric use during the period of interest (load shedding) and/or to an increase in electric demand in the off-peak hours as a result of shifting electric usage to that period (load shifting).

– M –

Market Assessment: An analysis that provides an assessment of how and how well a specific market or market segment is functioning with respect to the definition of well-functioning markets or with respect to other specific policy objectives. Generally includes a characterization or description of the specific market or market segments, including a description of the types and number of buyers and sellers in the market, the key actors that influence the market, the type and number of transactions that occur on an annual basis, and the extent to which market participants consider energy efficiency as an important part of these transactions. This analysis may also include an assessment of whether a market has been sufficiently transformed to justify a reduction or elimination of specific program interventions. Market assessments can be blended with strategic planning analysis to produce recommended program designs or budgets. One particular kind of market assessment effort is a baseline study, or the characterization of a market before the commencement of a specific intervention in the market, for the purpose of guiding the intervention and/or assessing its effectiveness later.

Measurement and Verification (M&V): A subset of program impact evaluations that are associated with the documentation of energy savings at individual sites or projects using one or more methods that can involve measurements, engineering calculations, statistical analyses, and/or computer simulation modeling.

Measurement Error: In the evaluation context, a reflection of the extent to which the observations conducted in the study deviate from the true value of the variable being observed. The error can be random (equal around the mean) or systematic (indicating bias).

Megawatt (MW): A unit for measuring electricity equal to 1,000 kilowatts or one million Watts.

Megawatt-Hour (MWh): A unit of electric energy numerically equal to 1,000,000 Watts used for one hour.

Metered Data: Data collected over time through a meter for a specific end use, energy-using system (e.g., lighting, HVAC), or location (e.g., floors of a building, a whole premise). Metered data may be collected over a variety of time intervals. Usually refers to electricity or gas data.

Metering: The collection of energy consumption data over time through the use of meters. These meters may collect information about an end use, a circuit, a piece of equipment, or a whole building (or facility). *Short-term metering* generally refers to data collection for no more than a few weeks. *End-use metering* refers specifically to separate data collection for one or more end uses in a facility, such as lighting, air conditioning, or refrigeration. *Spot metering* is an instantaneous measurement (rather than over time) to determine equipment size or power draw.

Monitoring: The collection of relevant measurement data over time at a facility, including but not limited to energy consumption or emissions data (e.g., energy and water consumption, temperature, humidity, volume of emissions, and hours of operation) for the purpose of conducting a savings analysis or to evaluate equipment or system performance.

– N –

Net Impact: See *Net Savings*.

Net Present Value: The discounted value of the net benefits or costs over a specified period of time (e.g., the expected useful life of the energy efficiency measure).

Net Savings: The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of free drivers, free-riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand. Net savings are calculated by multiplying verified savings by a NTG ratio.

Net-to-Gross (NTG): A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.

Nonparticipant: Any consumer who was eligible but did not participate in the subject efficiency program in a given program year.

– O –

Off-Peak Energy kWh Savings: The kWh reduction that occurs during a specified period of off-peak hours for energy savings (see the PA TRM Table 1-1).

On-Peak Energy kWh Savings: The kWh reduction that occurs during a specified period of on-peak hours for energy savings (see the PA TRM Table 1-1).

– P –

Participant: A utility customer partaking in an energy efficiency program, defined as one transaction or one rebate payment in a program. For example, a customer receiving one payment for two measures within one program counts as one participant. A customer receiving two payments in two programs counts as two participants. A customer partaking in one program at two different times receiving two separate payments counts as two participants.

Participant Costs: Costs incurred by a customer participating in an energy efficiency program.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Peak Load: The highest electrical demand within a particular period of time. Daily electric peaks on weekdays typically occur in the late afternoon and early evening. Annual peaks typically occur on hot summer days.

Percent of Estimate Committed: The program year-to-date total committed savings as a percent of the savings targets established in each EDC EE&C Plan, calculated by dividing the PYTD total committed by the EE&C Plan program year estimate.

Portfolio: Can be defined as: (1) a collection of programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor efficiency programs), or mechanisms (e.g., loan programs); or (2) the set of all programs conducted by one or more organizations, such as a utility or program administrator, and which could include programs that cover multiple markets, technologies, etc.

Precision: An indication of the closeness of agreement among repeated measurements of the same physical quantity. It is also used to represent the degree to which an estimated result in social science (e.g., energy savings) would be replicated with repeated studies.

Preliminary Program Year-to-Date (PYTD) Net Impact: Net impacts reported in quarterly reports. These net impacts are preliminary in that they are based on preliminary realization rates.

Preliminary Program Year-to-Date (PYTD) Verified Impact: Verified impacts reported in quarterly reports. These verified impacts are preliminary in that they are based on preliminary realization rates.

Preliminary Realization Rate: Realization rates reported in quarterly reports based on the results of M&V activities conducted on the sample to date. These results are preliminary because the sample-to-date is likely not to have met the required levels of confidence and precision.

Prescriptive Program: An energy efficiency program focused on measures that are one-for-one replacements of the existing equipment and for which anticipated similar savings results across participants.

Process Evaluation: A systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources, while maintaining high levels of participant satisfaction.

Program Administrator: Those entities that oversee the implementation of energy efficiency programs. This generally includes regulated utilities, other organizations chosen to implement such programs, and state energy offices.

Program Year Energy Savings Target: Energy target established for the given program year as approved in each EDC EE&C Plan.

Program Year Sample Participant Target: Estimated sample size for evaluation activities in the given program year.

Program Incentive: An incentive, generally monetary, that is offered to a customer through an energy efficiency program to encourage their participation. The incentive is intended to overcome one or more barriers that keep the customer from taking the energy efficiency action on their own.

Program Participant: A consumer that received a service offered through an efficiency program in a given program year. The term "service" can refer to one or more of a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information, or other services, items, or conditions.

Program Year-to-Date (PYTD): Beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Net Impact: The total change in load that is attributable to an energy efficiency program from June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Participants: The number of utility customers participating in an energy efficiency program beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Reported Gross Impact: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated, beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30). This value is unverified by an independent third-party evaluator.

Program Year-to-Date (PYTD) Sample Participants: Total participant sample beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Total Committed: The estimated gross impacts, including reported impacts and in-progress impacts, beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30), calculated by adding PYTD reported gross impacts for projects in progress.

Project: An activity or course of action involving one or multiple energy efficiency measures at a single facility or site.

Projects in Progress: Energy efficiency and demand response projects currently being processed and tracked by the EDC, but that are not yet complete at the time of the report. See *Completed Project*.

– Q –

– R –

Realization Rate: The term is used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings that: 1) are adjusted for data errors, and 2) incorporate the evaluated or verified results of the tracked savings.

Rebate Program: An energy efficiency program in which the program administrator offers a financial incentive for the installation of energy-efficient equipment.

Rebound Effect: Also called "snap back," defined as a change in energy-using behavior that yields an increased level of service that is accompanied by an increase in energy use and occurs as a result of taking an energy efficiency action. The result of this effect is that the savings associated with the direct energy efficiency action are reduced by the resulting behavioral change.

Regression Analysis: Analysis of the relationship between a *dependent variable* (response variable) to specified *independent variables* (explanatory variables). The mathematical model of their relationship is the *regression equation*.

Regression Model: A mathematical model based on statistical analysis where the dependent variable is quantified based on its relationship to the independent variables that are believed to determine its value. In so doing, the relationship between the variables is estimated statistically from the data used.

Reliability: The quality of a measurement process that would produce similar results on: (1) repeated observations of the same condition or event, or (2) multiple observations of the same condition or event by different observers.

Renewable Energy: Energy derived from resources that are naturally replenishing. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

Reported Gross Impact: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated. This value is unverified by an independent third-party evaluator. Also referred to as "ex post" impact.

Reporting Period: The time following implementation of an energy efficiency activity during which results are to be determined.

Representative Sample: A sample that has approximately the same distribution of characteristics as the population from which it was drawn.

Rigor: The level of effort expended to minimize uncertainty due to factors such as sampling error and bias. The higher the level of rigor, the more confidence there is that the results of the evaluation are accurate and precise.

– S –

Sample: In program evaluation, a portion of the population selected to represent the whole. Differing evaluation approaches rely on simple or stratified samples (based on some characteristic of the population).

Sample Design: The approach used to select the sample units.

Sampling Error: The error in estimating a parameter caused by the fact that all of the disturbances in the sample are not zero.

Savings Factor (SVG): The percent of time the lights are off due to lighting controls relative to the baseline controls system (typically a manual switch). Also referred to as the *lighting controls savings factor.*

Simple Random Sample: A method for drawing a sample from a population such that all samples of a given size have an equal probability of being drawn.

Snap Back: *See Rebound Effect.*

Simulation Model: An assembly of algorithms that calculate energy use based on engineering equations and user-defined parameters.

Spillover: Reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program. There can be participant and/or nonparticipant spillover. *Participant spillover* is the additional energy savings that occur when a program participant independently installs energy efficiency measures or applies energy-saving practices after having participated in the efficiency program as a result of the program's influence. *Nonparticipant spillover* refers to energy savings that occur when a program nonparticipant installs energy efficiency measures or applies energy-saving practices as a result of a program's influence.

Spillover Rate: An estimate of energy savings attributable to spillover effects expressed as a percent of savings installed by participants through an energy efficiency program.

Standard Error: A measure of the variability in a data sample indicating how far a typical data point is from the mean of a sample. In a large sample, approximately two-thirds of observations lie within one standard error of the mean, and 95 percent of observations lie within two standard errors.

Statistically Adjusted Engineering Models: A category of statistical analysis models that incorporate the engineering estimate of savings as a dependent variable. The regression coefficient in these models is the percentage of the engineering estimate of savings observed in changes in energy usage. For example, if the coefficient of the statistically adjusted engineering term is 0.8, the customers are, on average, realizing 80 percent of the savings from their engineering estimates.

Stipulated Values: See *Deemed Savings*.

Stratified Random Sampling: The population is divided into subpopulations, called *strata*, which are non-overlapping and together comprise the entire population. A simple random sample of each stratum is taken to create a sample based on stratified random sampling.

Stratified Ratio Estimation: A sampling method that combines a stratified sample design with a ratio estimator to reduce the coefficient of variation by using the correlation of a known measure for the unit (e.g., expected energy savings) to stratify the population and allocate a sample from the strata for optimal sampling.

– T –

Takeback Effect: See *Rebound Effect*.

Total Resource Cost (TRC) Test: A cost-effectiveness test that measures the net direct economic impact to the utility service territory, state, or region. The TRC Order details the method and assumptions to be used when calculating the TRC Test for EE&C portfolios implemented under Act 129. The results of the TRC Test are to be expressed as both a net present value and a benefit-cost ratio.

Total Resource Cost (TRC) Test Benefits: Benefits calculated in the TRC Test that include the avoided supply costs, such as the reduction in transmission, distribution, generation, and capacity costs, valued at a marginal cost for the periods when there is a consumption reduction. The PA TRC benefits will consider avoided supply costs, such as the reduction in forecasted zonal wholesale electric generation prices, ancillary services, losses, generation capacity, transmission capacity, and distribution capacity. The avoided supply costs will be calculated using net program savings, defined as the savings net of changes in energy use that would have happened in the absence of the program. The persistence of savings over time will also be considered in the net savings.

Total Resource Cost (TRC) Test Costs: The costs calculated in the TRC Test will include the costs of the various programs paid for by an EDC (or by a default service provider) and the participating customers, and costs that reflect any net change in supply costs for the periods in which

consumption is increased in the event of load shifting. Note that the TRC Test should use the incremental costs of services and equipment. Thus, for example, this would include costs for equipment, installation, operation and maintenance, removal (less salvage value), and administrative tasks, regardless of who pays for them.

– U –

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall with some degree of confidence.

Upstream Program: A program that provides information and/or financial assistance to entities in the delivery chain of high-efficiency products at the retail, wholesale, or manufacturing level. Such a program is intended to yield lower retail prices for the products.

– V –

Verification: An independent assessment of the reliability (considering completeness and accuracy) of claimed energy savings or an emissions source inventory.

Verified Gross Impact: Calculated by applying the realization rate to reported gross impacts. Also referred to as "ex ante" impact.

– W –

Watt: A unit of measure of electric power at a point in time as capacity or demand. One Watt of power maintained over time is equal to one Joule per second. The Watt is named after Scottish inventor James Watt, and is shortened to W and used with other abbreviations, as in kWh (kilowatt-hours).

Watt-Hour: One Watt of power expended for one hour, or one-thousandth of a kilowatt-hour.

Whole-Building Calibrated Simulation Approach: A savings measurement approach (defined in the International Performance Measurement and Verification Protocol Option D and in the American Society of Heating, Refrigerating and Air-Conditioning Engineers Guideline 14) that involves the use of an approved computer simulation program to develop a physical model of the building in order to determine energy and demand savings. The simulation program is used to model the energy used by the facility before and after the retrofit. The pre- or post-retrofit models are developed by calibration with measured energy use, demand data, and weather data.

Whole-building Metered Approach: A savings measurement approach (defined in the International Performance Measurement and Verification Protocol Option C and in the American Society of Heating, Refrigerating and Air-Conditioning Engineers Guideline 14) that determines energy and demand savings through the use of whole-facility energy (end-use) data, which may be measured by utility meters or data loggers. This approach may involve the use of monthly utility billing data or data gathered more frequently from a main meter.

– X –

– Y –

– Z –

References

PAH Associations, prepared by Paul Horowitz. Facilitated by the Northeast Energy Efficiency Partnerships. Glossary of Terms Version 1.0. A project of the Regional Evaluation, Measurement and Verification Forum. March 2009.

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