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PECO
An Exelon Company

November 13, 2015

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

Re: PUC Docket No. M-2008-2069887
Energy Efficiency and Conservation Program Final Annual Report
June 1, 2014 through May 31, 2015

Dear Secretary Chiavetta:

In accordance with the Commission's Secretarial Letter dated May 25, 2011, enclosed is PECO's 2015 Final Annual Energy Efficiency & Conservation Report for the program year of June 1, 2014 through May 31, 2015.

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

PECO PROGRAM YEAR 6 ANNUAL REPORT

Program Year 6: June 1, 2014 – May 31, 2015

Presented to:

PENNSYLVANIA PUBLIC UTILITY COMMISSION

Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared for:

PECO

November 13, 2015

Prepared by:

Navigant Consulting, Inc.

NAVIGANT

PECO PROGRAM YEAR 6
ANNUAL REPORT

Program Year 6: June 1, 2014 – May 31, 2015

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Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared by Navigant Consulting, Inc.

For

PECO

November 13, 2015

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ACRONYMS

C&I	Commercial and Industrial
CFL	Compact Fluorescent Lamp
Phase II Verified / (Phase II-VG)	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 (this is cumulative Phase II verified savings)
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
PY8	Program Year 2016, from June 1, 2016 to May 31, 2017
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 PY5, 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).

Verified Net

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 spillover, 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 net-to-gross (NTG) ratio.

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 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, 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, EDCs submitted energy efficiency and conservation (EE&C) plans pursuant to these goals, which were approved by the Pennsylvania Public Utility Commission (Commission, or 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. These plans were approved by the PUC in 2013.

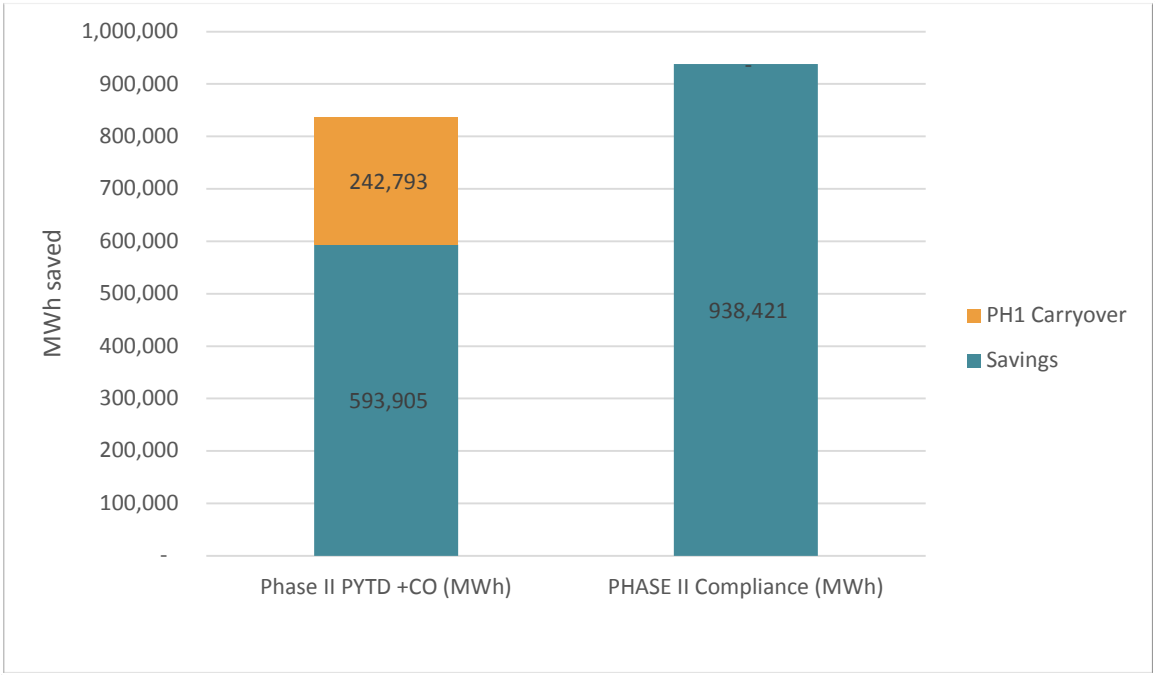
Implementation of Phase II Act 129 programs began June 1, 2013. This report documents the progress and effectiveness of the Phase II EE&C accomplishments for PECO in Program Year 6 (PY6), defined as June 1, 2014 through May 31, 2015, as well as the cumulative accomplishments of the programs since inception of Phase II. This report additionally documents the energy savings carried over from Phase I. The Phase I carryover 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 86%[2] of the Phase II energy savings compliance target of 938,421 MWh, 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

[2] Compliance target shown includes Phase I carryover savings.

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[3]. Table 1-1 shows the incremental annual MWh savings from Phase I that PECO is carrying over into Phase II. Table 1-2 shows the lifetime MWh savings from Phase I that PECO is carrying over into Phase II. Table 1-3 provides verified net first-year and lifetime savings.

Table 1-1: Phase II Verified Gross Savings and Verified Gross Savings from PY4 Carried Into Phase II

Sector	PYTD Verified Gross Savings (MWh)	Phase II Verified Gross Savings (Cumulative Phase II MWh/Yr) [1]	Verified Gross Savings Carried Over from Phase 1 (Cumulative Annual MWh/Yr)	Phase II+CO Verified Gross Savings (Cumulative MWh/Yr)
Residential (non Low Income) [2]	115,379	180,271	103,295	283,566
Residential (Low Income)	18,716	53,654	6,593	60,247
Total Residential (Non Low Income Plus Low Income)	134,143	233,925	109,888	343,813
Commercial and Industrial [2]	143,414	257,443	54,944	312,387
GNI	30,118	102,584	77,961	180,545
Total	**307,626**	**593,953**	**242,793**	**836,746**

[1] The PY5 Annual Report dated November 24, 2014 included the residential verified savings for Smart Usage Profile (SUP), however PY5 SUP verified savings of 3,068 MWh and PY6 SUP verified savings of 16,891 MWh are not included in this PY6 annual report per the goals stated in Table 1 of the Phase II EE&C Plan dated March 20, 2014. See Section 5 of this document for further information on the SUP program, and Section 5.2 for specific information about the SUP Impact Evaluation.
[2] PECO does not project or report the SHR cross-sector (non-residential) lighting savings in its quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings while the PECO Reported value includes only non-lighting savings in the C&I sector.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

[3] Phase II Implementation Order.

Table 1-2: Phase II Verified Gross Lifetime Savings and Verified Gross Lifetime Savings from PY4 Carried Into Phase II

Sector	PYTD Verified Gross Lifetime Savings (MWh)	Phase II Verified Gross Lifetime Savings (MWh)	Verified Gross Lifetime Savings Carried Over from Phase 1 (MWh)	Phase II+CO Verified Gross Lifetime Savings (MWh)
Residential (non Low Income) [1]	1,091,916	1,919,799	718,061	2,637,860
Residential (Low Income)	112,380	236,487	0	236,487
Total Residential (Non Low Income Plus Low Income)	1,204,296	2,156,286	718,061	2,874,347
Commercial and Industrial	1,644,287	2,297,555	954,726	3,252,281
GNI	399,548	1,466,916	1,055,854	2,522,771
Total	**3,248,131**	**5,920,757**	**2,728,641**	**8,649,399**

[1] PECO does not project or report the SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

Table 1-3: Phase II Verified Net First-Year and Lifetime Savings

Sector	PYTD Verified Net Savings (MWh/year)	Phase II Verified Net Savings (Cumulative Phase II MWh/Yr)	PYTD Verified Gross Savings (Lifetime MWh)	PYTD Verified Net Savings (Lifetime MWh)	Phase II Verified Net Savings (Lifetime MWh)
Residential (Non Low Income) [1]	68,492	93,396	1,091,916	569,879	989,541
Residential (Low Income)	18,716	44,395	112,380	112,3801	236,487
Total Residential (Non Low Income Plus Low Income)	87,208	137,797	1,204,296	682,259	1,226,028
Commercial and Industrial (C&I)	113,868	202,276	1,644,287	1,227,046	1,709,246
GNI	13,132	79,105	399,548	173,628	1,008,577
Total	**214,208**	**419,175**	**3,248,131**	**2,083,050**	**3,943,851**

[1] PECO does not project or report the SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector.

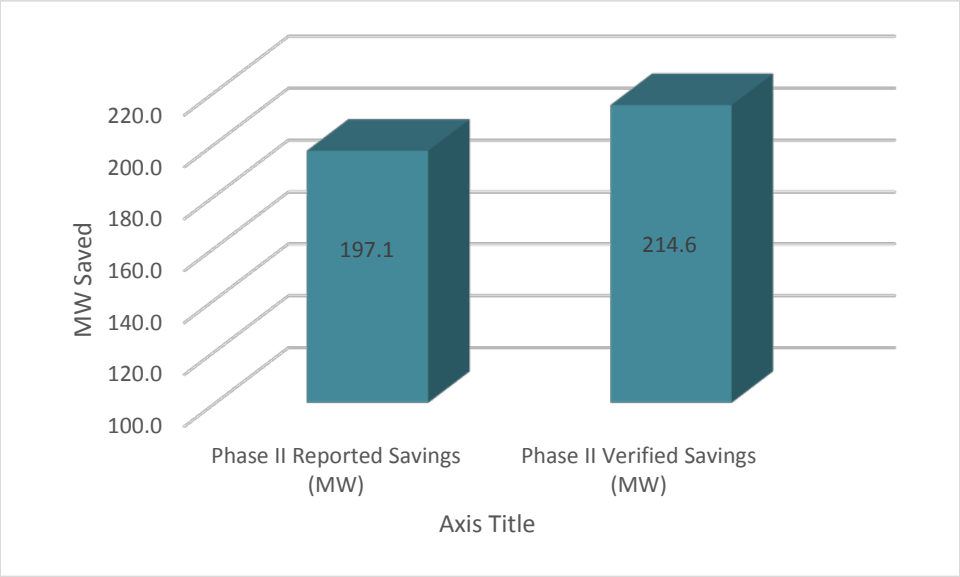
Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

In addition, PECO has achieved 214.6 MW of gross verified demand reduction during Phase II[4]. See Figure 1-2 below. Additional detail on achieved demand reduction by program can be found in Table 1-9 and Table 1-10 of this section.

[4] Unlike Phase I, there is no compliance target for demand reduction in Phase II. The Commission, however, requires that demand reduction savings in Phase II be reported including line losses, as was done in Phase I.

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



Source: Navigant

There are 20 measures available at no cost to low income customers. These measures offered to the low-income sector comprise 16.4% 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 7.6 percentage points.[5] These values are shown in Table 1-4 and Table 1-5.

Table 1-4: Low-Income Sector Compliance (Number of Measures)

	Low-Income Sector	All Sectors	% Low-Income	Goal
# of Measures Offered	20	122	16.4%	8.8% [1]
[1] 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).				

Source: Navigant

[5] 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 1-5: Low-Income Sector Compliance (Percentage of Savings)

	Phase II Gross Verified
Low Income Verified Gross Savings from Low Income Programs (LEEP) (Incremental Annual MWh/Yr) [1]	35,480
Low Income Verified Gross Savings from Other Residential Programs (SAR, SHR, SHC) (Incremental Annual MWh/Yr)	18,174
All Low Income Verified Gross Savings [Sum of First Two Rows]	53,564
Progress Towards Low Income Goal [Previous Row divided by Phase II MWh Target]	4.9%
Goal (MWh/Yr)	4.5% of portfolio savings

[1] The "Low Income Verified Gross Savings from Low Income Programs" MWh in the first row of this table is from the LEEP program. The "Other Residential Programs" savings in the second row are from SAR, SHR, and SHC. This is the only table where SAR, SHR, and SHC low income savings are broken out separately from the LEEP savings.

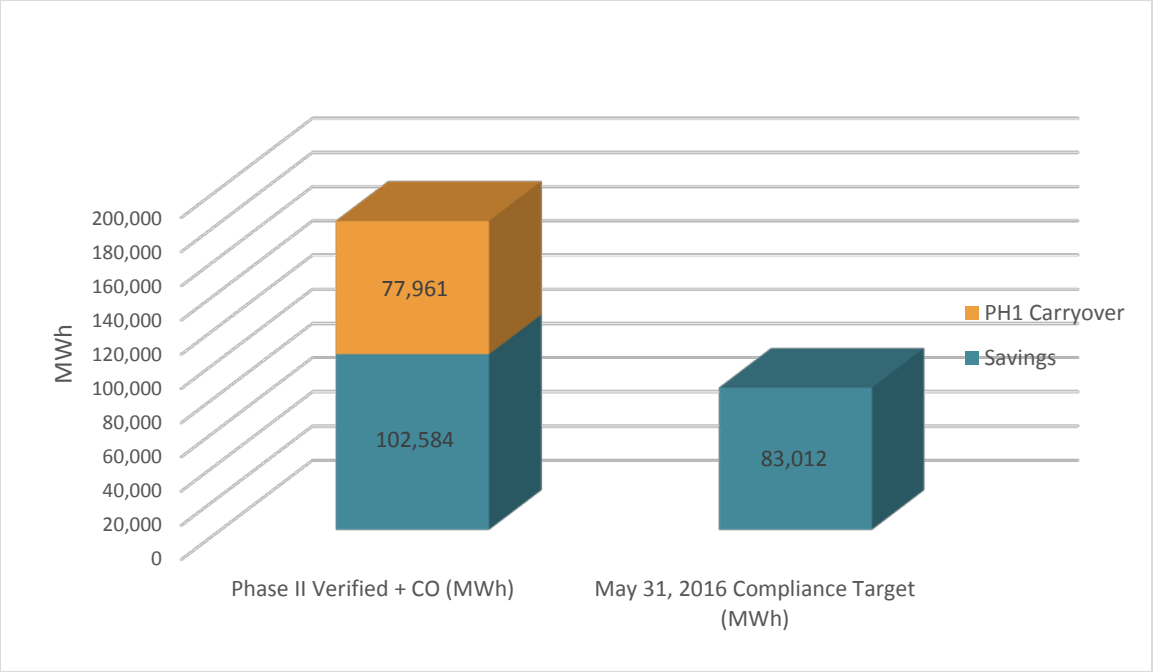
Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

The Phase II verified gross energy savings achieved through programs specifically designed for income-eligible customers are 35,480 MWh/yr and 18,174 MWh/year through other programs; this is 4.9% percent which slightly more than the 4.5% minimum Phase II total portfolio verified gross energy savings target for the low-income sector, therefore low income targets have already been met prior to PY7.

PECO achieved 217% percent of the May 31, 2016 energy reduction compliance target for the government, nonprofit, and institutional (GNI) sector based on cumulative program/portfolio savings from Phase II+CO verified gross energy savings achieved from the inception of Phase II through Program Year 6 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 Gross Energy Impacts



Source: Navigant

A summary of the number of participants, Phase II verified gross energy savings (MWh/Yr), Phase II demand reduction (MW), and incentives paid ($1,000s) are shown in Table 1-6.

Table 1-6: Summary of Phase II Performance by Sector

Sector	Participants	Phase II Verified Gross Energy Savings (MWh/yr)	Phase II Verified Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential [1], [2]	174,032	180,223	157.2	$35,571
Low-Income [3]	22,343	53,654	4.7	$746
Small Commercial and Industrial [4], [5]	1,148	56,194	7.1	$5
Large Commercial and Industrial	3,692	201,249	33.0	$10,810
Government, Nonprofit, and Institutional	409	102,584	12.7	$9,452
Phase II Total	**201,624**	**593,905**	**214.6**	**$56,584**

[1] Residential savings do not include the PY5 SUP reported savings of 3,068 MWh or PY6 of 16,891 MWh because SUP savings will not be applied to Phase II compliance targets until PY7.
[2] PECO does not extraplolate the SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector.
[3] The Low-Income participants do not include particpants form other Residential programs in PY6
[4] For programs such as SBS for which the evaluation stratification did not distinguish between the customer size classes, Navigant pro-rated the PY6 Verified MWh split based on the PECO-Reported PY6 MWh split between customer size class, prior to adding to the PY5 Verified MWh.
[5] For Smart Home Rebates (SHR) Navigant used the PECO-Reported customer class size split for SEI as an approximation for SHR-C&I Large/Small savings.
* All reported and verified demand savings in this report include line losses as required.

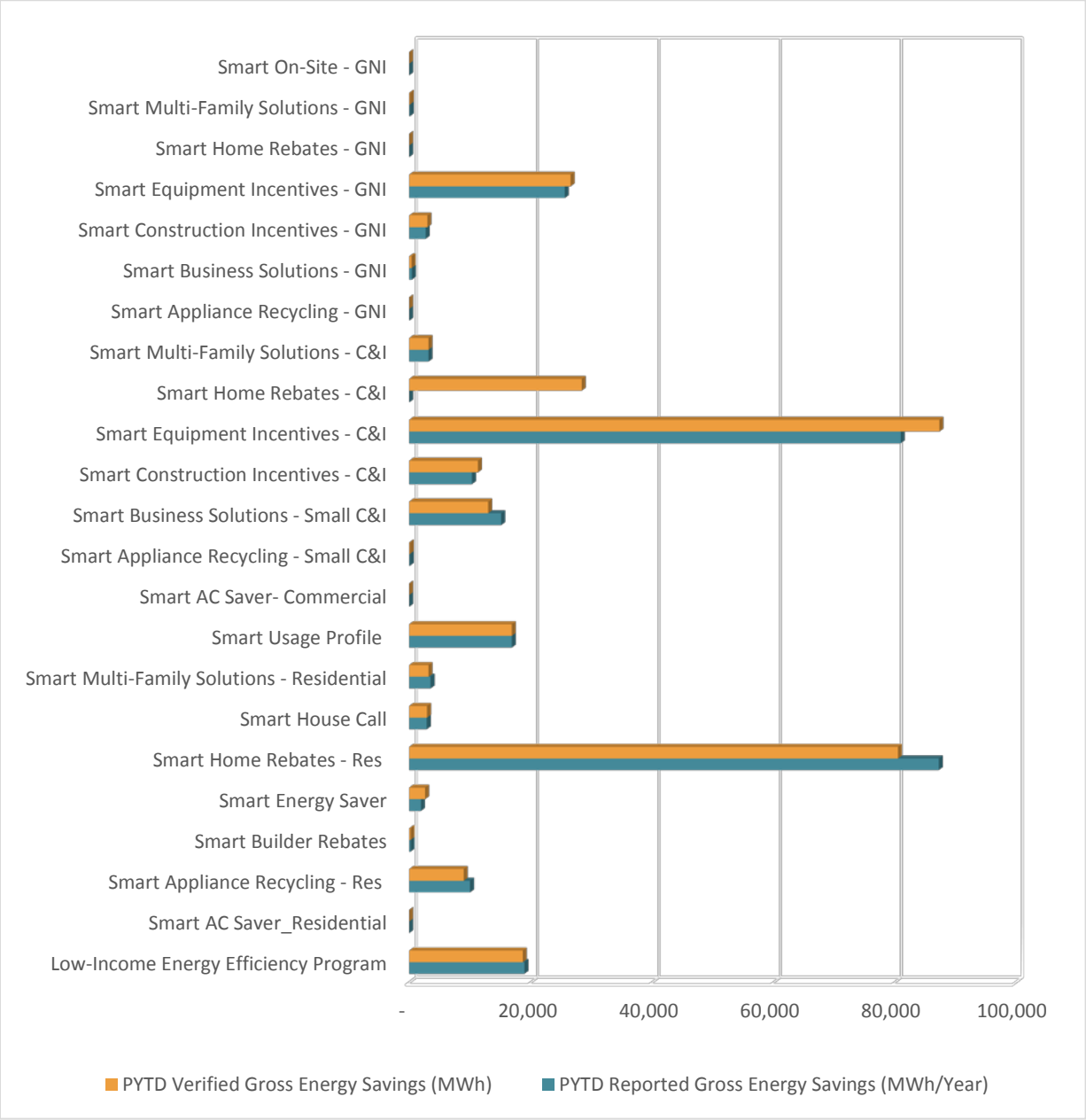
Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

1.2 SUMMARY OF ENERGY IMPACTS

A summary of the reported and verified energy savings by program for Program Year 6 is presented in Figure 1-4**.**

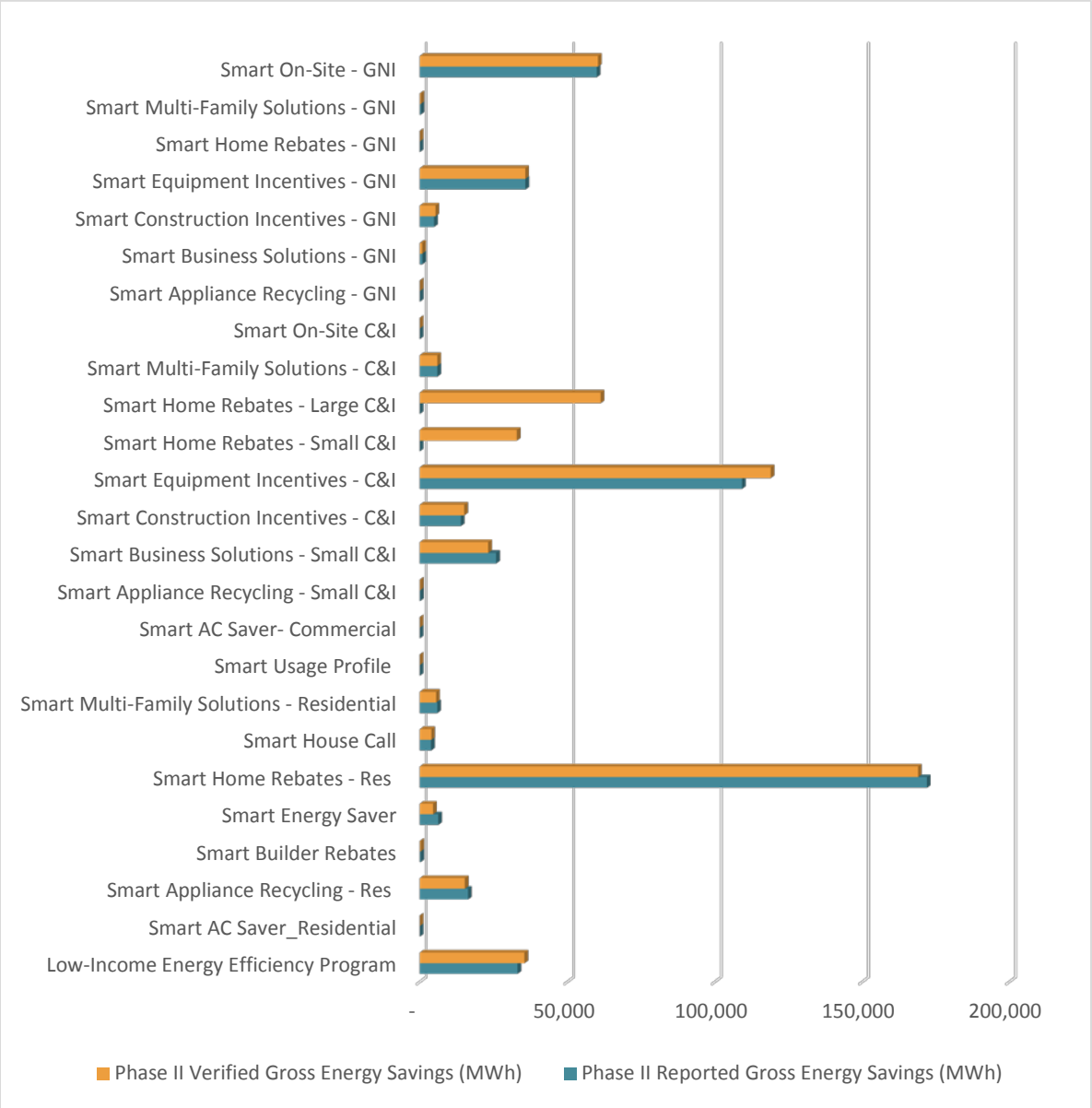
Figure 1-4. PYTD Reported and Verified Gross Energy Savings by Program (MWh/yr)



Source: Navigant

A summary of the Phase II reported and verified energy savings by program is presented in Figure 1-5.

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



Source: Navigant

Summaries of energy impacts by program through Program Year 6 are presented in Table 1-7 and Table 1-8.

Table 1-7: Reported Participation and Gross Energy Savings by Program

	Participants		Reported Gross Impact (MWh/Yr) [1]	
Program	PYTD	Phase II	PYTD	Phase II
Low-Income Energy Efficiency Program	10,572	19,539	18,971	33,098
Smart AC Saver Residential	69,192	69,192	0	0
Smart Appliance Recycling - Residential	11,615	18,724	10,034	16,371
Smart Builder Rebates	88	90	219	225
Smart Energy Saver	12,919	25,503	1,932	6,232
Smart Home Rebates - Residential [2]	27,843	39,952	87,309	172,022
Smart House Call	4,440	5,622	2,870	3,825
Smart Multi-Family Solutions - Residential	11,308	17,753	3,512	5,886
Smart Usage Profile [3]	44,982	0	16,891	0
Total Residential [3]	**192,959**	**196,375**	**141,737**	**237,657**
Smart AC Saver- Commercial	1,824	1,824	0	0
Smart Appliance Recycling - Small C&I	78	121	87	130
Smart Business Solutions - Small C&I	559	967	15,178	25,866
Smart Construction Incentives - C&I	56	78	10,338	13,876
Smart Equipment Incentives - C&I	788	1,117	81,048	109,273
Smart Home Rebates - C&I [2]	60	60	7	7
Smart Multi-Family Solutions - C&I	454	673	3,199	6,000
Smart On-Site C&I	0	0	0	0
Total Commercial & Industrial	**3,819**	**4,840**	**109,860**	**155,151**
Smart Appliance Recycling – GNI	12	12	12	12

Program	Participants		Reported Gross Impact (MWh/Yr) [1]	
	PYTD	Phase II	PYTD	Phase II
Smart Business Solutions - GNI	7	16	425	864
Smart Construction Incentives - GNI	17	24	2,705	4,833
Smart Equipment Incentives – GNI	226	327	25,645	35,818
Smart Home Rebates – GNI	5	5	1	1
Smart Multi-Family Solutions - GNI	8	23	118	278
Smart On-Site - GNI	0	2	0	59,945
Total GNI	**275**	**409**	**28,906**	**101,751**
TOTAL PORTFOLIO	**197,053**	**201,624**	**280,499**	**494,558**

[1] The savings reported are total Phase II.
[2] PECO does not extrapolate SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings include non-residential sector using based on in-store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector while the PECO Reported value includes only non-lighting savings in the C&I sector.
[3] The SUP numbers are for information only, will not be actual until PY7, and is not included in the Residential Sector Phase II total.

Values in tables may not reconcile as presented due to numerical precision.

Source: *Navigant*

Table 1-8: Verified Gross Energy Savings by Program

Program	PYTD Reported Gross Energy Savings (MWh/Year)	PYTD Adjusted Ex-Ante Gross Energy Savings	PYTD Energy Realization Rate	PYTD Verified Gross Energy Savings (MWh)	PYTD MWh Achieved Precision[1]	Phase II Verified Gross Energy Savings (MWh)	Phase II Achieved Precision[2]
Low-Income Energy Efficiency Program	18,971	18,971	0.99	18,716	4.0%	35,480	2.6%
Smart AC Saver-Residential	0	0	0.00	0	N/A	0	N/A
Smart Appliance Recycling - Residential	10,034	10,034	0.90	8,982	2.4%	15,250	1.7%
Smart Builder Rebates	219	219	1.02	224	3.1%	229	3.4%
Smart Energy Saver	1,932	1932	1.35	2,611	1.0%	4,459	1.5%
Smart Home Rebates – Residential [3]	87,309	87,072	0.92	80,537	0.6%	168,963	4.0%
Smart House Call	2,870	2,870	1.02	2,939	3.9%	3,926	3.3%
Smart Multi-Family Solutions - Residential	3,512	3,512	0.91	3,195	5.7%	5,569	3.9%
Smart Usage Profile [4]	16,891	16,891	N/A	16,891	0.0%	0	0.0%
Total Residential	**141,737**	**141,500**	**0.95**	**134,095**	**0.7%**	**233,877**	**2.9%**
Smart AC Saver- Commercial	0	0	0	0	N/A	0	N/A
Smart Appliance Recycling - Small C&I	87	87	0.76	66	2.4%	109	1.8%
Smart Business Solutions - Small C&I	15,178	15,178	0.86	13,011	8.7%	23,211	6.6%
Smart Construction Incentives - C&I	10,338	10,338	1.09	11,318	4.4%	15,058	5.5%
Smart Equipment Incentives - C&I	81,048	81,048	1.08	87,435	5.0%	118,939	6.3%

Program	PYTD Reported Gross Energy	PYTD Adjusted Ex-Ante Gross Energy	PYTD Energy Realization Rate	PYTD Verified Gross Energy	PYTD MWh Achieved [1]	Phase II Verified Gross	Phase II Achieved [2]
Smart Home Rebates - Small C&I [3]	7	7	N/A [5]	3	0.6%	32,873	0.7%
Smart Home Rebates - Large C&I [3]				28,412	0.6%	61,281	8.4%
Smart Multi-Family Solutions - C&I	3,199	3,199	0.99	3,168	2.1%	5,970	1.3%
Smart On-Site C&I	-	0	0.00	0	N/A	-	N/A
Total Commercial & Industrial	**109,856**	**109,856**	**1.31**	**143,414**	**3.9%**	**257,443**	**3.6%**
Smart Appliance Recycling – GNI	12	12	0.76	9	2.4%	9	2.7%
Smart Business Solutions - GNI	425	425	0.95	402	8.7%	821	6.3%
Smart Construction Incentives - GNI	2,705	2,705	1.11	3,009	4.4%	5,295	7.6%
Smart Equipment Incentives – GNI	25,645	25,645	1.04	26,599	5.0%	35,773	4.6%
Smart Home Rebates – GNI	1	1	1.00	1	0.6%	1	0.7%
Smart Multi-Family Solutions - GNI	118	118	0.83	98	2.1%	258	1.0%
Smart On-Site - GNI	-	0	0.00	0	0.0%	60,427	0.0%
Total GNI	**28,906**	**28,906**	**1.04**	**30,118**	**4.5%**	**102,584**	**1.7%**
TOTAL PORTFOLIO	**280,499**	**280,262**	**1.10**	**307,626**	**1.6%**	**593,905**	**1.9%**
Phase 1 Carryover						**242,793**	**N/A**
Total Ph II+CO	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**836,698**	**N/A**

[1] At the 85% confidence level
[2] At the 90% confidence level
[3] PECO does not project or report the SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector while the PECO Reported value includes only non-lighting savings.

Program	PYTD Reported Gross Energy	PYTD Adjusted Ex-Ante Gross Energy	PYTD Energy Realization Rate	PYTD Verified Gross Energy	PYTD MWh Achieved [1]	Phase II Verified Gross	Phase II Achieved [2]

[4] The Phase II MWhs do not include the PY5 SUP savings of 3,068MWh or PY6 SUP savings of 16,891 MWh since for regulatory compliance purposes SUP savings will only be claimed in PY7.
[5] Due to cross-sector Navigant Verified lighting savings, the SHR-C&I realization rate is very high (4306.00). The overall SHR program realization rate including cross-sector Navigant Verified lighting savings is 1.25, including all sectors (Residential, C&I, GNI). The SHR-C&I Small Customer Verified savings in the table above is due to non-lighting measures. The SHR-C&I Large Customer Verified savings in the table above is due to Verified cross-sector lighting savings, and Verified non-lighting measures.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

1.3 SUMMARY OF FUEL SWITCHING IMPACTS

PECO customers completed projects in PY6 in which services originally provided by electricity were converted to run on natural gas (i.e. "fuel switching measures"[6]). In PY5, the Smart Home Rebate (SHR) and Smart On-Site (SOS) programs included fuel-switcting measures but in PY6 only SHR included these measures:

- Electric heat (furnace, baseboard and heat pump) to gas heat (furnace)
- Electric heat to gas/propane or oil heat (air source heat pump to gas)
- Electric domestic hot water (DHW) heater to gas
- Electric clothes dryer to gas

Total energy savings for SHR fuel-switching measures was 2,265 MWh in PY6. Since these measures are primarily space heating measures, and the TRM states that DHW and clothes dryers have zero demand savings, Navigant assigned zero demand savings to the fuel-switching measures.[7] The ex ante and verified savings were based on the 2014 TRM[8] algorithms. The total value of SHR rebates for fuel-switching measures was $147,600.

1.4 SUMMARY OF DEMAND IMPACTS

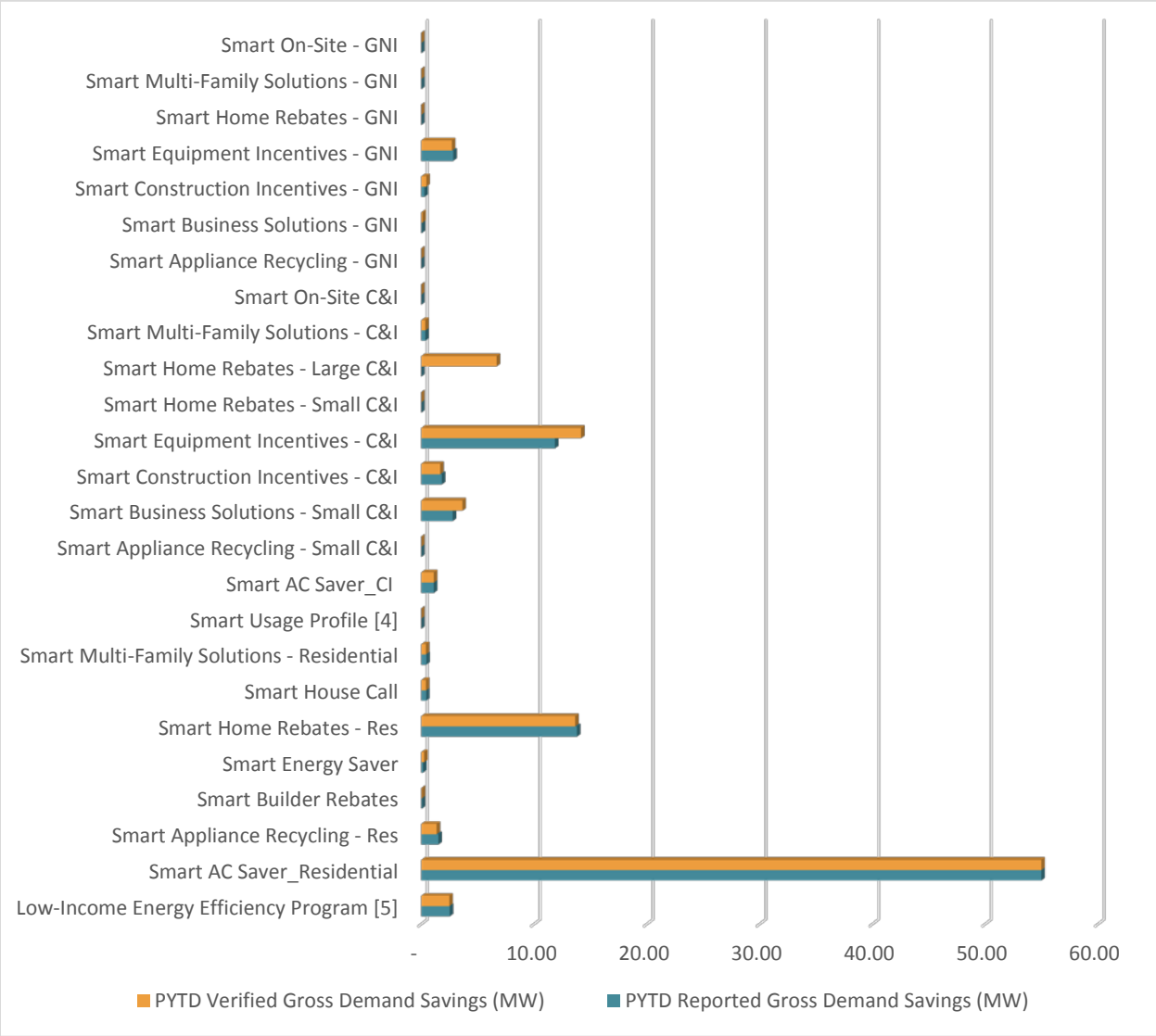
A summary of the reported and verified demand reduction by program for Program Year 6 is presented in Figure 1-6.

[6] The Act 129 Fuel Switching Working Group Staff Report. April 30, 2010. Page2.

[7] Pennsylvania Public Utility Commission, "Technical Reference Manual," June 2014, Page 103.

[8] Pennsylvania Public Utility Commission, "Technical Reference Manual," June 2014.

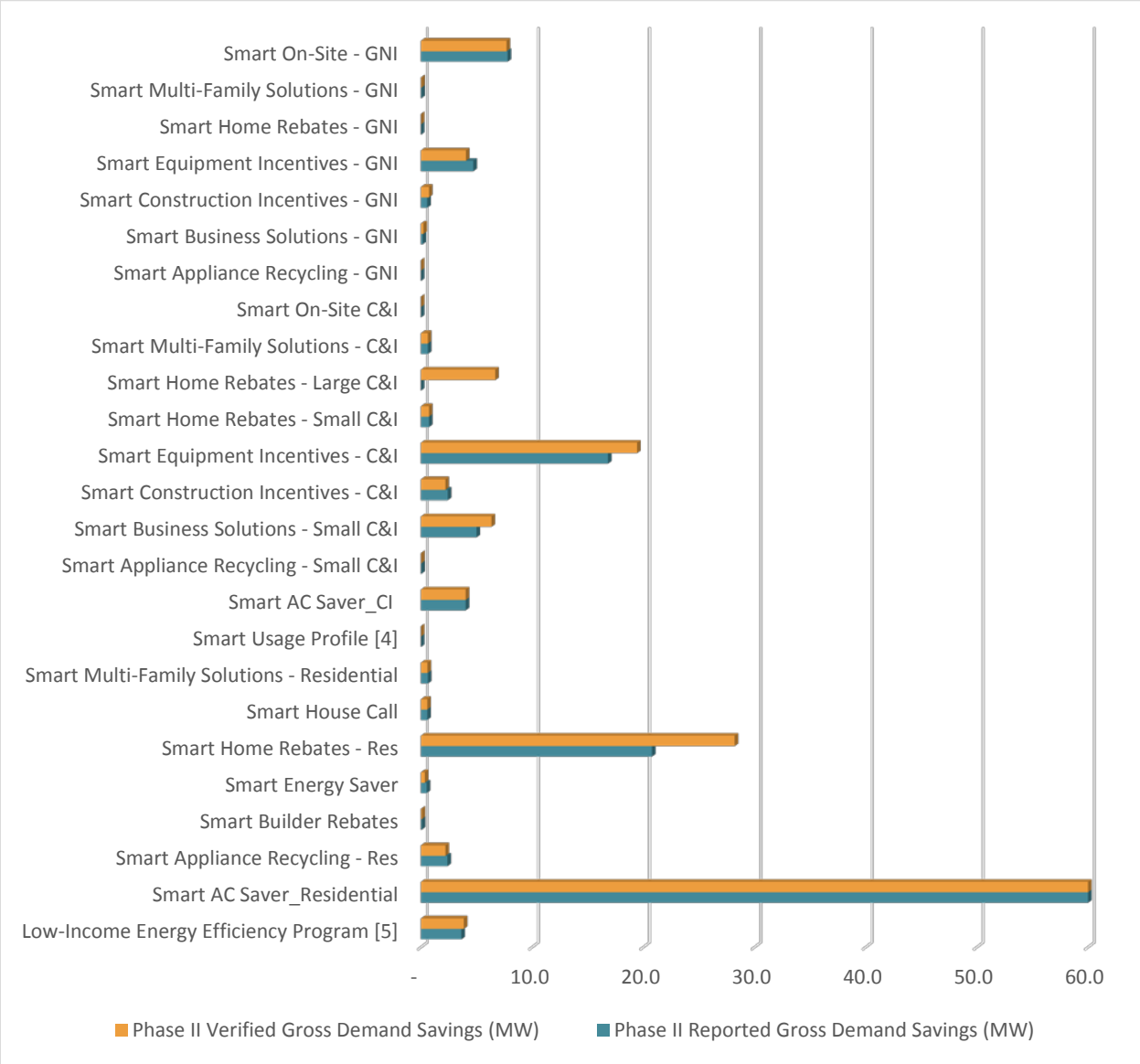
Figure 1-6: PYTD Reported and Verified Gross Demand Reduction by Program



Source: Navigant

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 Gross Demand Reduction by Program



Source: Navigant

A summary of demand reduction impacts by program through Program Year 6 is presented in Table 1-9 and Table 1-10.

Table 1-9: Reported Participation and Gross Demand Reduction by Program*

Program	Participants		Reported Gross Impact (MW)*	
	PYTD	Phase II	PYTD	Phase II
Low-Income Energy Efficiency Program	10,572	19,539	2.5	3.6
Smart AC Saver-Residential	69,192	69,192	55.0	126.1
Smart Appliance Recycling – Residential	11,615	18,724	1.5	2.4
Smart Builder Rebates	88	90	0.1	0.1
Smart Energy Saver	12,919	25,503	0.2	0.5
Smart Home Rebates – Residential [1]	27,843	39,952	13.8	21.1
Smart House Call	4,440	5,622	0.4	0.6
Smart Multi-Family Solutions – Residential	11,308	17,753	0.4	0.6
Smart Usage Profile [2]	44,982	0	0.0	0.0
Total Residential	**192,959**	**196,375**	**73.9**	**155.0**
Smart AC Saver_CI	1,824	1,824	1.1	4.0
Smart Appliance Recycling - Small C&I	78	121	0.0	0.0
Smart Business Solutions - Small C&I	559	967	2.8	5.0
Smart Construction Incentives - C&I	56	78	1.8	2.4
Smart Equipment Incentives - C&I	788	1,117	11.8	16.8
Smart Home Rebates - C&I [1]	60	60	0.0	0.0
Smart Multi-Family Solution-C&I	454	673	0.4	0.6
Smart On-Site C&I	0	0	0.0	0.0
Total Commercial & Industrial	**3,819**	**4,840**	**18.0**	**28.9**
Smart Appliance Recycling – GNI	12	12	0.0	0.0
Smart Business Solutions - GNI	7	16	0.1	0.1
Smart Construction Incentives - GNI	17	24	0.3	0.5
Smart Equipment Incentives – GNI	226	327	2.8	4.7
Smart Home Rebates – GNI	5	5	0.0	0.0
Smart Multi-Family Solutions - GNI	8	23	0.0	0.0
Smart On-Site - GNI	0	2	0.0	7.8
Total GNI	**275**	**409**	**3.2**	**13.2**
TOTAL PORTFOLIO	**197,053**	**201,624**	**95.1**	**197.1**

[1] PECO does not extrapolate SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings include non-residential sector using based on in-store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings in the C&I sector while the PECO Reported value includes only non-lighting savings in the C&I sector.
[2] The SUP program does not track coincident demand savings. The Phase II participants for SUP are zero in this table because program metrics are not being counted for SUP until PY7.
* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

Table 1-10: Verified Gross Demand Reduction by Program*

Program	PYTD Reported Gross Demand Savings (MW)*	PYTD Adjusted Ex-Ante Gross Demand Savings(MW)*	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)*	PYTD MW Achieved Precision[1]	Phase II Verified Gross Demand Savings (MW)*	Phase II Achieved Precision[2] [3]
Low-Income Energy Efficiency Program	2.5	2.5	0.99	2.5	3.9%	3.9	3.1%
Smart AC Saver-Residential	55.0	55.0	1.00	55.0	-	126.1	0.0%
Smart Appliance Recycling – Residential	1.5	1.5	0.89	1.4	2..0%	2.2	1.8%
Smart Builder Rebates	0.1	0.1	0.92	0.1	13.9%	0.1	15.6%
Smart Energy Saver	0.2	0.2	1.52	0.2	1.2%	0.3	3.3%
Smart Home Rebates – Residential [5]	13.8	13.7	1.00	13.7	2.5%	28.2	5.2%
Smart House Call	0.4	0.4	0.96	0.4	4.0%	0.6	3.6%
Smart Multi-Family Solutions – Residential	0.4	0.4	0.91	0.4	5.8%	0.6	4.8%
Smart Usage Profile [4]	0.0	0.0	0.0	0.0	0.0%	0.0	0.0%
Total Residential	**73.9**	**73.8**	**1.00**	**73.7**	**0.5%**	**161.9**	**0.9%**
Smart AC Saver-C&I	1.1	1.1	1.00	1.1	0.0%	4.0	0.0%
Smart Appliance Recycling - Small C&I	0.0	0.0	0.76	0.0	0.0%	0.0	0.0%
Smart Business Solutions - Small C&I	2.8	2.8	1.30	3.7	7.2%	6.3	5.8%
Smart Construction Incentives - C&I	1.8	1.8	0.93	1.7	9.3%	2.2	12.7%
Smart Equipment Incentives - Small C&I	-	-	1.20	5.5	37.0%	5.5	42.2%
Smart Equipment Incentives - C&I	11.8	11.8	1.20	14.2	12.1%	19.4	11.0%
Smart Home Rebates - Small C&I [5]	0.0	0.0	N/A [6]	0.0	2.5%	0.7	0.0%
Smart Home Rebates - Large C&I [5]				6.7	2.5%	6.7	14.1%
Smart Multi-Family Solutions - C&I	0.4	0.4	0.99	0.4	2.2%	0.6	1.5%
Smart On-Site C&I	0.0	0.0	0.00	0.0	0.0%	0.0	0.0%

Program	PYTD Reported Gross Demand Savings (MW)*	PYTD Adjusted Ex-Ante Gross Demand Savings(MW)*	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)*	PYTD MW Achieved Precision[1]	Phase II Verified Gross Demand Savings (MW)*	Phase II Achieved Precision[2] [3]
Total Commercial & Industrial	**18.0**	**18.0**	**1.54**	**27.7**	**10.7%**	**40.0**	**7.1%**
Smart Appliance Recycling – GNI	0.0	0.0	0.00	0.0	0.0%	0.0	0.0%
Smart Business Solutions - GNI	0.1	0.1	1.88	0.1	7.2%	0.2	5.8%
Smart Construction Incentives - GNI	0.3	0.3	1.59	0.4	9.3%	0.7	20.0%
Smart Equipment Incentives – GNI	2.8	2.8	0.96	2.7	12.1%	4.0	19.3%
Smart Home Rebates – GNI	0.0	0.0	1.00	0.0	2.5%	0.0	2.9%
Smart Multi-Family Solutions - GNI	0.0	0.0	0.79	0.0	2.2%	0.0	1.2%
Smart On-Site - GNI	0.0	0.0	0.00	0.0	0.0%	7.7	0.0%
Total GNI	**3.2**	**3.2**	1.03	**3.3**	**10.7%**	**12.7**	**6.2%**
TOTAL PORTFOLIO	**95.1**	**95.0**	**1.10**	**104.6**	**1.6%**	**214.7**	**1.7%**
Phase 1 Carryover						**0.0**	
Total Ph II+CO						**214.7**	

[1] At the 85% confidence level
[2] At the 90% confidence level
[3] Precision on MW distributions is reported for information only, and is not required for compliance with the EE&C Plan.
[4] The SUP program does not track coincident demand savings.
[5] PECO does not project or report the SHR cross-sector (non-residential) lighting savings in their quarterly reports. However, Navigant estimates SHR lighting savings in the non-residential sector using based on base store intercept research for the purpose of calculating verified savings. For this reason, the Navigant verified SHR energy and demand savings value includes both lighting and non-lighting savings while the PECO Reported value includes only non-lighting savings.
[6] Due to cross-sector Navigant Verified lighting savings, the SHR-C&I realization rate is not a number (NAN). The SHR-C&I Small Customer Verified savings in the table above is due to non-lighting measures. The SHR-C&I Large Customer Verified savings in the table above is due to Verified cross-sector lighting savings, and Verified non-lighting measures.

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

1.5 SUMMARY OF PROGRAM YEAR 6 NET-TO-GROSS RATIOS

EDCs are required to conduct net-to-gross (NTG) research[9]. NTG ratios are not used for compliance purposes, but are used for cost effectiveness reporting and future program planning purposes and should be applied to gross savings in order to calculate net verified energy and demand savings for Table 1-11. Table 1-11 presents a summary of NTG ratios by program.

Table 1-11: Program Year 6 NTG Ratios by Program*

Program Name	Free Ridership (%)	Spillover (%)	NTG Ratio Program Year 6	PY6 Verified Net Energy Savings (MWh/Yr)	PY6 Verified Net Demand Savings (MW/Yr)	NTG Categories Included[1]
Low-Income Energy Efficiency Program	0%	0%	1.00	18,716	2.5	N/A
Smart AC Saver-Residential	0%	0%	1.00	0	55.0	N/A
Smart Appliance Recycling – Residential	65%	0%	0.35	3,144	0.5	FR
Smart Builder Rebates	0%	0%	1.00	224	0.1	N/A
Smart Energy Saver	0%	0%	1.00	2,611	0.2	N/A
Smart Home Rebates – Residential	58%	7%	0.49	39,849	6.8	FR, PS
Smart House Call	19%	34%	1.15	3,382	0.5	FR, PS
Smart Multi-Family Solutions - Residential	25%	0%	0.75	2,392.	0.3	FR, PS
Smart Usage Profile	0%	0%	1.00	16,891	0.0	N/A
Total Residential	**40%**	**5%**	**0.65**	**87,208**	**65.8**	
Smart AC Saver-C&I	0%	0%	1.00	0	1.1	N/A

[9] 2013 TRC Order.

Program Name	Free Ridership (%)	Spillover (%)	NTG Ratio Program Year 6	PY6 Verified Net Energy Savings (MWh/Yr)	PY6 Verified Net Demand Savings (MW/Yr)	NTG Categories Included[1]
Smart Appliance Recycling - Small C&I	65%	0%	0.35	23	0.0	FR
Smart Business Solutions - Small C&I	8%	0%	0.92	12,029	3.4	FR, PS
Smart Construction Incentives - C&I	48%	0%	0.52	5,923	0.9	FR, PS
Smart Equipment Incentives - C&I	30%	11%	0.81	70,388	11.4	FR, PS
Smart Home Rebates - Small C&I	41%	11%	0.70	2	0.0	FR, PS
Smart Home Rebates - Large C&I	30%	11%	0.81	22,872	5.4	FR, PS
Smart Multi-Family Solutions - C&I	17%	0%	0.83	2,631	0.3	FR, PS
Smart On-Site C&I	0%	0%	1.00	0	0.0	FR, PS
Total Commercial & Industrial	**32%**	**9%**	**0.77**	**113,868**	**22.5**	FR, PS
Smart Appliance Recycling – GNI	65%	0%	0.35	3	0.0	FR,PS
Smart Business Solutions – GNI	8%	0%	0.92	372	0.1	FR, PS
Smart Construction Incentives – GNI	48%	0%	0.52	1,574	0.2	FR, PS
Smart Equipment Incentives – GNI	60%	2%	0.42	11,101	1.1	FR,PS
Smart Home Rebates – GNI	60%	2%	0.49	0	0.0	FR,PS
Smart Multi-Family Solutions – GNI	17%	0%	0.83	81	0.0	FR, PS
Smart On-Site – GNI	0%	0%	1.00	0	0.0	FR
Total GNI	**58%**	**2%**	**0.44**	**13,132**	**1.5**	
TOTAL PORTFOLIO	**39%**	**7%**	**0.68**	**214,208**	**89.8**	

Program Name	Free Ridership (%)	Spillover (%)	NTG Ratio Program Year 6	PY6 Verified Net Energy Savings (MWh/Yr)	PY6 Verified Net Demand Savings (MW/Yr)	NTG Categories Included[1]
[1] Free-ridership (FR), nonparticipant spillover (NPS), and participant spillover (PS).*Weighted by program savings for programs reporting NTG Ratios. *Values in tables may not reconcile as presented due to numerical precision.*						

Source: Navigant

1.6 SUMMARY OF PORTFOLIO FINANCES AND COST-EFFECTIVENESS

A breakdown of the portfolio finances is presented in Table 1-12.

Table 1-12: Summary of Portfolio Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	92,819	185,953
2	EDC Incentives to Participants	24,620	47,968
3	EDC Incentives to Trade Allies	246	311
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	67,954	137,674
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	55,959	90,384
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	36,040	63,970
8	Marketing[2]	14,261	18,345
9	EDC Evaluation Costs	5,658	8,068
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	13,044
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	148,778	289,381
13	Total NPV Lifetime Energy Benefits	213,814	389,169
14	Total NPV Lifetime Capacity Benefits	24,124	45,424
15	Total NPV TRC Benefits[4]	246,816	454,342
16	TRC Benefit-Cost Ratio[5]	1.66	1.57

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, Electric Distribution Company (EDC) and Conservation Service

Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

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 1-13 shows the TRC ratios by program and other key factors used in the TRC ratio calculation for Phase II programs.

Table 1-13: 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
Smart AC Saver - Residential	14,825	6,921	2.14	7.60%	1.076	1.1916
Low-Income Energy Efficiency Program	11,955	9,394	1.27	7.60%	1.076	1.1916
Smart Appliance Recycling	6,362	1,773	3.59	7.60%	1.076	1.111 - 1.1916
Smart Builder Rebates	258	607	0.43	7.60%	1.076	1.1916
Smart Energy Saver	2,009	483	4.16	7.60%	1.076	1.1916
Smart Home Rebates	91,141	55,108	1.65	7.60%	1.076	1.111 - 1.1916
Smart House Call	2,853	5,044	0.57	7.60%	1.076	1.1916
Smart Multi-Family Solutions - Residential	2,168	1,461	1.48	7.60%	1.076	1.1916
Smart Usage Profile	1,772	1,779	1.00	7.60%	1.076	1.1916
Total Residential	**133,344**	**82,570**	**1.61**	**7.60%**	**1.076**	**1.1916**
Smart AC Saver - Commercial	170	305	0.56	7.60%	1.076	1.1916
Smart Business Solutions	10,234	6,260	1.63	7.60%	1.076	1.111
Smart Equipment Incentives - Commercial and Industrial	66,311	26,867	2.47	7.60%	1.076	1.111
Smart Construction Incentives	16,743	7,943	2.11	7.60%	1.076	1.111
Smart Multi-Family Solutions - Nonresidential	1,340	1,185	1.13	7.60%	1.076	1.111
Smart On-Site	0	423	0.00	7.60%	1.076	1.111
Total Commercial & Industrial	**94,797**	**42,984**	**2.21**	**7.60%**	**1.076**	**1.111**
Smart Equipment Incentives - Government, Nonprofit and Institutional	18,675	11,052	1.69	7.60%	1.076	1.117

Total GNI	**18,675**	**11,052**	**1.69**	**7.60%**	**1.076**	**1.117**
TOTAL	**246,816**	**148,778**	**1.66**	**7.60%**	**1.076**	**n/a**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant

1.8 COMPARISON OF PROGRAM YEAR 6 PERFORMANCE TO APPROVED EE&C PLAN

Table 1-14 shows PY6 expenditures compared to the budget estimates set forth in the EE&C plan.

Table 1-14: Comparison of PY6 Program Expenditures to PY6 EE&C Plan

Program	PY6 Budget from EE&C Plan	PY6 Actual Expenditures	% Difference from PY6 EE&C Plan [(Planned – Actual)/Planned]
Low-Income Energy Efficiency Program	$ 8,584,982	$ 9,393,724	-9%
Smart AC Saver - Residential	$ 9,646,570	$ 6,921,237	28%
Smart Appliance Recycling	$ 1,781,135	$ 1,773,487	0%
Smart Builder Rebates	$ 569,380	$ 424,448	25%
Smart Energy Saver	$ 454,694	$ 483,324	-6%
Smart Home Rebates	$ 18,701,671	$ 17,520,775	6%
Smart House Call	$ 5,640,418	$ 4,220,804	25%
Smart Multi-Family Solutions - Residential	$ 1,131,824	$ 1,460,965	-29%
Smart Usage Profile [1]	$ 992,400	$ 1,779,394	-79%
Total Residential	**$ 47,503,074**	**$ 43,978,158**	**7%**
Smart AC Saver - Commercial	$ 544,554	$ 305,200	44%
Smart Business Solutions	$ 1,518,955	$ 2,614,805	-72%
Smart Equipment Incentives - Commercial and Industrial	$ 11,803,542	$ 11,296,368	4%
Smart Construction Incentives	$ 3,712,547	$ 2,970,813	20%
Smart Multi-Family Solutions - Nonresidential	$ 1,181,484	$ 1,184,970	0%
Smart On-Site	$ 1,606,103	$ 422,654	74%
Total Commercial & Industrial	**$ 20,367,185**	**$ 18,794,810**	**8%**
Smart Equipment Incentives - Government, Nonprofit and Institutional	$ 6,969,794	$ 5,879,005	16%
Total GNI	**$ 6,969,794**	**$ 5,879,005**	**16%**
Support Services	$ 12,535,472	$ 12,172,705	3%

TOTAL	**$ 87,375,525**	**$ 80,824,678**	**7%**

[1] PECO will begin claiming Smart Usage Profile savings in PY7.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

Across the entire portfolio of programs, PECO fell slightly short of the PY6 plan goal of 309,198 MWh of total energy savings with 307,675 MWh (~100% of target).[10] The combined energy savings from programs in the PY5 and PY6 amounted to 581,042 MWh[11] or 94% of planned PY5 and PY6 combined goal of 616,017 MWh.[12] The Phase II compliance savings to date for PY5 and PY6 are 561,083 MWh,[13] which is 60% of the Phase II energy savings goal of 938,421 MWh.[14] Including 242,793 MWh in carry-over savings, PECO has accumulated 803,876 MWh toward the Phase II compliance target.[15]

Table 1-15 shows the actual PECO-reported program energy savings compared to the projected values in the EE&C plan. SBR, SHR, SMFS-Res, SBS, and SEI-C&I exceeded planned savings while SHC, SCI, SMF-NonRes, SEI-GNI, and SOS contributed significantly less savings than anticipated to the portfolio. Cross-sector installation of lighting measures was the driver to the most significant over delivery of absolute energy savings (SHR) and slower than expected implementation drove the most substantial under delivery (SOS).

Lighting savings continue to dominate overall portfolio verified energy savings, constituting 64%. HVAC and other measures constituted 8% and 28% respectively. This dependence on lighting may allow PECO to achieve its Phase II goals but does not fulfil the objective of a balanced portfolio that addressed the comprehensive end-uses of the service territory.

In terms of contribution to PECO's overall Phase II energy savings goal, Combined Heat and Power (CHP) projects represent 11% of total verified energy savings to date in PY5 and PY6, the second largest contributor to the portfolio to date after lighting, and has achieved 57% of the end-use goal for this phase. Therefore the SOS program is expected to be a large contributor to the final Phase II targets. Appliances, Motors and Drives, and

[10] This PY6 total includes the SUP PY6 program savings for consistency with the PY6 Plan spending targets. Since the program spent money and generated savings in PY6, the savings are reported at the PY level, but are not reported and counted toward the Phase II compliance targets.

[11] This total includes SUP PY5 and PY6 program savings for consistency with the PY5 plus PY6 aggregate Plan spending.

[12] This combined goal for PY5 and PY6 program savings includes zero savings for SUP in the Plan.

[13] The Phase II compliance savings total does not include SUP PY5 and PY6 program savings relative to Phase II compliance targets since SUP program savings will not be applied for Phase II compliance until PY7.

[14] This Phase II goal figure does not include Phase I carryover.

[15] Not including SUP program savings to date. SUP program savings will be applied in PY7.

Refrigeration are only at 56%, 48%, and 39% of their Phase II goals respectively, so there is an opportunity to address these end uses to fine tune the final savings relative to achieving the overall portfolio goal in a comprehensive and balanced manner.

PECO's portfolio had a TRC ratio of 1.66 in PY6, and thus the portfolio was cost-effective. This is a decline from the PY5 TRC of 1.51. Combined, Phase II programming yielded a TRC of 1.57.

Table 1-15 shows PY6 program savings compared to the energy and demand savings estimates filed in the EE&C plan.

Table 1-15: Comparison of PY6 Actual Program Savings to EE&C Plan for PY6

Program	PY6 MWh Savings Projected in EE&C Plan	Actual Reported PY6 MWh Savings	% Difference [(Planned – PY6 Actual)/PY Planned]	PY6 MW Savings Projected in EE&C Plan*	Actual Reported PY6 MW Savings*	% Difference [(PY6 Planned – PY6 Actual)PY6 /Planned]
Low-Income Energy Efficiency Program	19,704	18,971	4%	2.6	2.5	3%
Smart AC Saver-Residential	0	0	0%	78	54.4	30%
Smart Appliance Recycling (all sectors) [1]	10,823	10,133	6%	1.3	1.3	0%
Smart Builder Rebates	135	219	-62%	0.0	0.1	-240%
Smart Energy Saver	1,936	1,932	0%	0.2	0.2	6%
Smart Home Rebates (all sectors)	74,290	87,316	-18%	18.9	13.8	27%
Smart House Call	6,005	2,870	52%	0.7	0.4	37%
Smart Multi-Family Solutions - Residential	2,811	3,512	-25%	0.4	0.4	-12%
Smart Usage Profile [2]	0	16,891	0%	0	0	0%
Total Residential	**115,704**	**141,843**	**-23%**	**102**	**73**	**28%**

Smart AC Saver-C&I	0	0	0%	2.6	1.2	55%
Smart Business Solutions	12,513	15,603	-25%	2.7	2.9	-5%
Smart Construction Incentives	26,276	13,043	50%	6.3	2.1	67%
Smart Equipment Incentives - C&I	77,012	81,048	-5%	17.4	11.8	32%
Smart Multi-Family Solutions - Non-Residential	4,963	3,317	33%	0.9	0.4	57%
Smart On-Site	25,649	0	100%	3	0	100%
Total Commercial & Industrial	**146,413**	**113,011**	**23%**	**32.9**	**18.3**	**44%**
Smart Equipment Incentives - GNI	29,280	25,645	12%	9.8	2.8	71%
Total GNI	**29,280**	**25,645**	**12%**	**9.8**	**2.8**	**71%**
TOTAL PORTFOLIO	**291,397**	**280,500**	**4%**	**144.8**	**95.1**	**35%**

[1] Savings stated in Table 1 of the EE&C plan dated March 20, 2014 for SAR did not differentiate between sectors. For the purpose of comparing with the EE&C plan total, the total SAR PY6 Reported savings for all sectors is reported in the Residential sector.
[2] PECO will begin claiming Smart Usage Profile savings in PY7.
* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

1.9 PORTFOLIO LEVEL/CROSS-CUTTING PROCESS AND IMPACT EVALUATION SUMMARY FOR PROGRAM YEAR 6

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 one focus group with 15 participating and non-participating contractors. These various approaches help ensure both a thorough review of the PECO 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.

Table 1-16 shows overarching process and impact recommendations that affect multiple programs or the portfolio.

Table 1-16: Phase II Process and Impact Evaluation Recommendations from PY6 Evaluations

Applicability	Recommendations
Portfolio Level	PECO should mitigate the risk of under-delivering portfolio savings toward Phase II compliance targets due to non-performance of a small set of large custom projects (SOS and SEI) with a tightly managed deployment of predictable Residential deemed measures such as lighting and appliances. in PY7.
SCI and SEI	To ensure predictability of savings and increase control over program outcomes, the CSP should assure accurate data input and revision/reconciliation of placeholder values before developing reported savings
SHR and SHC	To fulfill planned program outcomes, PECO and the CSP should assure that programming is delivered to a comprehensive set of customers across the whole of the utility service territory
SHR, LEEP, SHC	In order to diversify its measure mix for Phase III, PECO should begin begin, in PY7, to reach out to manufactures, distributors, retailers and installation contractors in order to assure that conservation program incentives are aligned with trade ally goals.
SBR and SCI	To ensure predictability and meet portfolio savings targets, PECO should capitalize on strong Trade Ally relationships for smaller-scope energy efficiency projects, and not rely upon savings from programs driven by real estate market trends and timelines to achieve its Phase II savings goals.

1.10 SITE INSPECTIONS SUMMARY

Table 1-17: Summary of PY6 Site Visits

Program	Measure	Inspection Firm	Number of Inspections Planned	Number of Inspections Conducted	Number of Sites with Discrepancies from Reports	Resolution of Discrepancies
Low-Income Energy Efficiency Program	N/A	N/A	0	0	N/A	N/A
Smart AC Saver	N/A	N/A	0	0	N/A	N/A
Smart Appliance Recycling	N/A	N/A	0	0	N/A	N/A
Smart Builder Rebates	N/A	N/A	0	0	N/A	N/A
Smart Business Solutions	N/A	N/A	0	0	N/A	N/A
Smart Construction Incentives	Whole Building, HVAC, Lighting, Motors and Drives, Refrigeration	Navigant Consulting Inc., Mondre Energy, and Warren Energy Engineering	19	19	0	N/A
Smart Energy Saver	N/A	N/A	0	0	N/A	N/A
Smart Equipment Incentives - C&I	Lighting, Motors and Drives, HVAC, and Custom	Navigant, Mondre Energy, and Warren Energy Engineering	68	67	1	Site received much lower incentive check than should have, DNV GL is correcting this when the site completes another related project by providing an incentive check that accounts for the new project as well as the remainder from the first project.
Smart Equipment Incentives - GNI	Lighting, Motors and Drives, HVAC, and Custom	Navigant, Mondre Energy, and Warren Energy Engineering	42	41	0	N/A
Smart Home Rebates	N/A	N/A	0	0	N/A	N/A
Smart House Call	N/A	N/A	0	0	N/A	N/A
Smart Multi-Family Solutions	CFLs; Low-Flow Faucet Aerators; Low-	Mondre Energy	8	16	5	None

Program	Measure	Inspection Firm	Number of Inspections Planned	Number of Inspections Conducted	Number of Sites with Discrepancies from Reports	Resolution of Discrepancies
	Flow Showerheads					
Smart On-Site	N/A	N/A	0	0	N/A	N/A
Smart Usage Profile	N/A	N/A	0	0	N/A	N/A

Source: Navigant

2. SMART HOME REBATES

The objective of the Smart Home Rebates (SHR) program is to assist PECO residential customers in becoming consumers who are conscious about their energy use by encouraging and facilitating their adoption of energy-efficient products. The program achieves this goal by providing incentives to increase the market share of ENERGY STAR-qualified lighting (CFLs and LEDs) and appliances sold through retail and heating, ventilation, and air conditioning (HVAC) installer sales channels as well as by distributing educational materials that will increase customer awareness and acceptance.

2.1 PROGRAM UPDATES

The overall structure of the SHR program remained consistent in Phase II, with savings accruing from lighting, appliance, and HVAC measures. Within lighting measures, there was a transition over the course of PY6 from an emphasis on CFLs at the outset of this Phase to one on LEDs by the end of this program year.

2.1.1 Definition of Participant

For reporting purposes, a program participant is defined differently for lighting measures than for non-lighting measures. Because PECO delivers the lighting component of the program upstream at the manufacturer and retailer levels and customer identifying information is not collected at the time of purchase, no specific information is available to associate a given purchase with a specific individual. Because of this, a lighting participant is simply defined as a program bulb. For non-lighting measures, a participant is defined as each PECO customer purchase per detailed customer information from rebate applications and installer documentation.

2.2 IMPACT EVALUATION GROSS SAVINGS

In PY6, the SHR program continued to provide a significant portion of the total energy and demand savings within PECO's overall portfolio. Reported gross energy savings were 87,316 MWh and reported gross demand savings were 13.8 MW. Almost all 87,309 MWh) PY6 reported savings were in the residential sector with only 7 MWh reported in the non-residential sector. No reported energy and demand savings were attributed to low-income. Table 2-1 provides the Phase II totals at the close of PY6. Lighting measures continued to provide the large majority of reported energy (90 percent) and demand (81 percent) residential savings for the SHR program in PY6. HVAC and appliances provided the remaining 10 percent and 19 percent, respectively.

Table 2-1: 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	39,952	172,022	21.1	$20,618
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	60	7	0.0	$5
Large Commercial and Industrial				
Government, Non-Profit, and Institutional	5	1	0.0	$0
Phase II Total	**40,017**	**172,029**	**21.1**	**$20,623**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

2.2.1 Methods

For lighting measures, verification consisted of several steps. The evaluation team compared quarterly tracking data extracts against scanned manufacturer invoices for a census of all program bulbs to independently verify bulb counts in the tracking data. The evaluation team conducted a similar comparison of non-lighting program data to confirm compliance to Technical Reference Manual (TRM) requirements. Table 5-2 details the sampling strategy for the impact evaluation.

Table 2-2: SHR Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Electric HVAC	13,342	Census	13,342	13,342	Verification of TRM compliance for each record in the tracking system
Appliances	14,501	Census	14,501	14,501	Verification of TRM compliance for each record in the tracking system
Energy Star Lighting	1,986,139	Census	1,986,139	1,986,139	Verification of tracking data with scanned manufacturer invoices
Program Total	**2,013,982**		**2,013,982**	**2,013,982**	

Source: Navigant analysis

The evaluation team performed a comprehensive review of the program tracking data for lighting in PY6Q1 and catalogued a large number of incidences of internal inconsistency within the program tracking data. Specifically, references to bulb type such as standard spiral or reflector bulb showed different and conflicting information across various fields in the same record within the tracking data; this was observed for many records in the overall PY6Q1 dataset. The evaluation team also observed and catalogued this same type of inconsistency across fields with regard to the specific wattage of a given model. Additionally, looking across records in the PY6Q1 tracking data, inconsistent bulb specifications for characteristics such as wattage, lumens, and bulb lifetime were provided in different records for the same bulb model. This set of observations became the subject of a memo sent to PECO with supporting documentation. That memo and associated documentation provided structure for a re-examination by PECO and the program implementer to understand the sources of the observed discrepancies and to modify the tracking data development system to correct for the issues on both a backward-looking and forward-looking basis. Differences between Reported Gross Energy Savings and Adjusted Ex Ante Energy Savings in Table 2-3 reflect the results of these fixes to the tracking data system.

The evaluation team then performed savings calculations for each record in the program tracking data based on guidance from the Pennsylvania TRM dated June 2014. These independently calculated savings were compared to reported savings for each record. As part of this analysis, the evaluation team used TRM guidelines for baseline lamp wattage determination. The evaluation team followed TRM guidance in identifying baseline wattage using lumen bins defined by a combination of Energy Independence and Security Act (EISA) minimum efficacy requirements and ENERGY STAR qualification criteria for each lamp type in the program.

To attribute the proportion of program bulbs going into non-residential sockets, the evaluation team applied the cross-sector installation rate of 8.5 percent as determined from the PY5 in-store intercept surveys. Nonresidential savings parameter values for hours of use were applied to these cross-sector installations based on the proportions of cross-sector bulbs going into different nonresidential building types per the PY5 intercept data and the associated hours of use in the TRM for those building types. Also, the nonresidential lighting-HVAC interactive effects factor for energy, per the TRM, was applied to the cross-sector bulbs.

Verification of non-lighting measures followed a similar methodology with a review of each tracking system record for accurate and appropriate application of the relevant TRM methodology. This review found the ex ante savings to be generally accurate but did identify appreciable differences between reported savings and verified savings for three of the most common appliance measures: ENERGY STAR refrigerators and room air conditioners as well as variable speed pool pumps (realization rates of 0.73, 0.23, and 1.62, respectively).

There were no site inspections conducted for SHR.

2.2.2 Results

Because verified gross energy savings were based on a census of all program bulbs, there was no observed Coefficient of Variation (CV) in the sample design and, therefore, relative precision at the 85 percent confidence interval was zero.

Hours of use for lamps in nonresidential sockets (10.7 hours per day) are approximately four times that of the hours of use for lamps in residential sockets (2.8 hours per day). This difference yields magnified savings for bulbs installed in nonresidential sockets and drove the high energy realization rate of

approximately 1.3 for all lighting types in this analysis and the realization rate of 0.92 for residential installations (1.25 including installations at non-residential locations) for the program overall, as shown in Table 2-3.

For a subset of the PY6 rebated refrigerators (1,319 of 10,107), Navigant found that all of the units with lower-than-expected savings were manufactured in 2014. Most the unit configurations for sale in today's market did not exist before 2001 when the 2001 Federal Standard was enacted. The current 2011 Federal Standard includes many more configurations and accounts for the higher energy used by automatic ice makers and through-the-door water dispensers. The average size unit used in testing has also increased. The lack of appropriate baseline units in the 2001 Federal Standard explains why using the 2001 Federal Standard results in low or negative savings for 2014 manufactured refrigerator configurations that have newer features/larger sizes that were not addressed in the 2001 Federal Standard. While the 2014 TRM employed the 2001 standard, the 2015 TRM will use the 2011 standard.
For room air conditioners the 2014 TRM includes Federal Standard baseline combined energy efficiency ratios (CEER) effective as of June 1, 2014. However, the vast majority of units rebated in PY6 were manufactured prior to June 1, 2014. Navigant found that the manufacturer data for efficient units manufactured prior to June 1, 2014 provided energy efficiency ratios (EERs) instead of CEER. Providing the EER instead of the CEER was consistent with the previous Federal Standard (October 1, 2000) included in the 2013 PA TRM. During the review, Navigant found that the tracking system calculated the baseline for all units by using the previous standard in the 2013 PA TRM instead of the new standard in the 2014 PA TRM. This difference in baselines resulted in the lower realization rate for this measure.

Navigant found that the tracking system does not include the horsepower (HP) of efficient pool pump motors. The kilowatts (kW) for the single speed (baseline) pump (kWss) are included in the tracking data and appear to be sourced from the 2014 PA TRM. However, Navigant confirmed the pump HP and kW_{VFD} using the ENERGY STAR certified pool pump product list using the model number given in the tracking data and then used the verified HP to look up the average pump power (kWss) value in TRM Table 2-93. The kWss used in the tracking data was usually for a lower HP than for the corresponding average pump power for the rebated pump, resulting in significantly higher TRM-evaluated savings than reported savings. Navigant, therefore, adjusted savings for all 175 variable speed pool pumps.

Table 2-3 provides a summary of the energy savings impacts for both lighting and non-lighting measures.

Table 2-3: Program Year 6 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.
Electric HVAC	9,258	9,258	0.99	9,208	0.03	1.0%
Appliances	1,819	1,506	0.83	1,506	0.75	29.5%
Standard CFLs	16,495	16,496	1.29	21,234	0.00	0.0%
Specialty CFLs	6,716	6,717	1.29	8,647	0.00	0.0%
Standard LEDs	21,747	21,748	1.29	27,995	0.00	0.0%
Specialty LEDs	31,280	31,355	1.29	40,361	0.14	0.0%

Program Total	**87,316**	**87,079**	**1.25**	**108,953**	**N/A**	**0.6%**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant analysis

Of the savings in Table 2-3, nonresidential installation of SHR lighting measures amounted to 28,409 MWh of verified energy savings while nonresidential installation of HVAC and appliances accounted for 2 MWh and 6 MWh of energy savings, respectively.

For lighting measures, the evaluation team calculated verified gross demand savings using the same sequence of steps as for verified gross energy savings. The evaluation team verified the quarterly tracking data against manufacturer invoices for all bulbs and then calculated demand savings for each record based on guidance from the TRM. Fixes to the program tracking data system as discussed in the energy savings section above yielded differences between Reported Gross Demand Savings and Adjusted Ex Ante Demand Savings, as shown in Table 2-4. Nonresidential savings parameter values for peak load coincidence factor were applied to these cross-sector installations based on the proportions of cross-sector bulbs going into different nonresidential building types per the PY5 intercept data and the associated peak load coincidence factors for those building types. Also, the nonresidential lighting-HVAC interactive effects factor for demand per the TRM was applied to the cross-sector bulbs. Because verified gross demand savings were based on a census of all program bulbs, there was no observed CV in the sample design and, therefore, relative precision at the 85 percent confidence interval was zero percent.

Table 2-4: Program Year 6 SHR Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)*	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.
Electric HVAC	3.41	3.41	0.99	3.38	0.03	0.9%
Appliances	0.55	0.42	1.00	0.42	1.61	63.5%
Standard CFLs	2.13	2.13	1.68	3.58	0.00	0.0%
Specialty CFLs	0.87	0.87	1.68	1.46	0.00	0.0%
Standard LEDs	2.81	2.81	1.68	4.72	0.00	0.0%
Specialty LEDs	4.04	4.05	1.68	6.80	0.14	0.0%
Program Total n	**13.8**	**13.7**	**1.48**	**20.3**	**N/A**	**2.5%**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*						

Source: Navigant analysis

Of the savings in Table 2-4, nonresidential installation of SHR lighting measures amounted to 6.69 MW of verified demand savings, while nonresidential installation of HVAC and appliances accounted for less than one MW of demand savings each.

Table 2-5 shows the overall savings parameter values that yield final reported savings, ex ante adjusted savings, and evaluation-verified savings specifically for lighting measures for PY6.

Table 2-5. Lighting Savings Parameter Values

Gross Parameter and Savings Estimates	Program-Reported	Adjusted Ex Ante	Evaluation-Based
Program Bulb Sales	1,986,139	1,986,139	1,986,139
% Residential Installations	100%	100%	91.50%
% C&I Installations	0%	0%	8.5%
Average Displaced Watts	38.3	38.4	38.4
Res. Average Annual Hours of Use	1,022	1,022	1,022
Res. In-service Rate	0.97	0.97	0.97
Res. Energy Interactive Effects	1.01	1.01	1.01
Res. Demand Interactive Effects	1.23	1.23	1.23
Res. Peak Load Coincidence Factor	0.091	0.091	0.091
Res. Peak Line Loss Adjustment Factor	--	--	1.1916
C&I Average Annual Hours of Use	--	--	3915
C&I Realization Rate, Energy	--	--	1.0
C&I Realization Rate, Demand	--	--	1.0
C&I Energy Interactive Effects	--	--	1.12
C&I Demand Interactive Effects	--	--	1.34
C&I Peak Load Coincidence Factor	--	--	0.69
C&I Peak Line Loss Adjustment Factor	--	--	1.111
Total Installed First-Year Gross MWh Savings	**76,239**	**76,316**	**98,238**
Total Installed First-Year Gross Peak MW Savings	**9.9**	**9.9**	**15.7**
Values in tables may not reconcile as presented due to numerical precision.			

Source: Navigant analysis

2.2.3 Impact Finding and Recommendations

1. **Finding**: While corrections to the tracking data system for lighting were successful in fixing systemic issues with inconsistency in the data, these corrections were incorrectly applied in a small number of cases. This had a small impact on savings realization rates, with verified savings being 0.1 percent higher than reported savings on lighting measures for both energy and demand. The specific issue involved cases where records had been added to the program tracking data over the course of the year to negate or otherwise correct for small inaccuracies that had been found in the tracking data in the quarterly compliance reporting process. Then, in PY6Q4, when corrections were subsequently applied to the whole year's tracking data to address systematic data consistency issues, there was effectively a duplicate correcting process for the small number of sales that were already represented by erroneous and corrected records.
    a. **Recommendation**: Confirm internally that all internal data consistency issues have been resolved based on cross checks within and across records. If a program sales

record has been corrected or adjusted in some way by the addition of a modifying record, take note that any subsequent edits or corrections need to take both of these records into account. This type of situation must be examined carefully to ensure the accuracy of the final result.

2. **Finding:** In PY6, SHR overstated savings for room air conditioners and understated savings from variable speed pool pumps.
    a. **Recommendation:** Revise reported savings accounting to reflect appropriate inputs for non-lighting measures.

2.3 IMPACT EVALUATION NET SAVINGS

For lighting measures, the evaluation team developed five independent and complementary methods for estimating the program NTG ratio. These included the following:

- General population telephone survey
- Conjoint analysis via a web panel
- Price elasticity modeling based on detailed program tracking data
- Delphi Panel approach
- Long-term market effects modeling[16]

2.3.1 Results

Of these five methods, only the general population telephone survey and the conjoint analysis via web panel involved sampling. Details associated with the sampling strategy for these two approaches are shown in Table 2-6. For the general population telephone survey, computer-assisted telephone interviewing (CATI)-based telephone interviews were completed with 602 PECO residential customers from a sample of 12,000 drawn at random from the PECO residential customer database. Of these completed interviews, 100 were specifically based on a subsample of PECO residential customers that do not have a participating SHR retail store located in their ZIP code. This enabled the evaluation team's analysis to draw out any differences in program influence and program perceptions between the overall population and those PECO customers who can be considered underserved by the program in terms of geographic proximity to program stores.

[16] Details associated with this approach to NTG estimation over the PY1 to PY6 period are provided in Appendix E

The sample for the conjoint study was drawn from a random sample of adult residents of the Philadelphia Designated Market Area.[17] Qualified respondents were required to be 18 years of age or older and must have purchased a light bulb (any type) within the past 12 months. The sample included 400 respondents who purchased a reflector-style bulb in the past 12 months and at least 500 who purchased a standard-style bulb, for a total of 900 respondents across bulb types. The sample frame for the conjoint study was drawn from an online panel of respondents maintained by a professional research panel company.[18] The company employs participant quotas and data protocols to ensure quality respondents and an accurate representation of the population at the county level. This includes steps to verify the identity of the panelists via digital fingerprinting, IP verification, built-in quality control questions, and strict reward claims verification procedures. Individual panelists volunteered to participate in the conjoint study and received a small compensation for their participation.

Table 2-6: SHR Sampling Strategy for Program Year 6 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 [1] to Achieve Sample
Electric HVAC	N/A	13,342	0.50	85/10	100	100	79%
Appliances	N/A	14,501	0.50	85/10	100	100	99%
ENERGY STAR Lighting	N/A	1,986,139	1.00	85/10	600	602	60%
ENERGY STAR Lighting	N/A	1,986,139	1.00	85/5	900	900	100%
Program Total		**2,013,982**			**1,700**	**1,622**	

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

The price elasticity modeling approach to NTG estimation consisted of developing price elasticity curves for CFLs and LEDs based on detailed program tracking data and then approximating program impacts as the distance the program incentive amount for each bulb type moves participants along that curve. Specifically, the evaluation team obtained program tracking data from the program implementer at a monthly scale—i.e., more granular than the quarterly data extracts used in compliance reporting. The tracking data showed sales dates, incentive amounts, and expected final retail purchase price per package based on memorandums of understanding (MOUs) between PECO and participating retailers as well as frequent store visits and price checks on the part of implementation staff. The evaluation team also requested and received information from the implementer regarding dates of special endcap placements, extra deep discounts, other forms of special lighting promotions, and in-store tabling/education events for each participating retail store. The evaluation team developed a regression model based on this data, which yielded price elasticity curves separately for CFLs and LEDs. The evaluation team then applied the program incentive amounts to each curve to model the differences in rates of purchase for each bulb type at program-discounted prices and non-discounted prices. The

[17] Geographic area around a city in which the radio and television stations based in that city account for a greater proportion of the listening/viewing public than those based in the neighboring cities.

[18] Blackstone Group, 2015. http://www.bgglobal.com/.

change in sales between non-program prices and program prices divided by gross program sales yields the NTG ratio estimate using this method.

The fourth method used to estimate program NTG ratios was the Delphi Panel. The Navigant evaluation team for Duquesne Light, with support from the evaluation team for PECO, conducted a Delphi Panel with the following participants:

- Four manufacturers/retailers
- Two implementers
- Three industry experts
- Two market support professionals

In the first phase of the Delphi Panel process, panelists were provided with relevant contextual information regarding the service territories and program designs of the Duquesne and PECO residential lighting programs. Panelists were shown maps of the utility service territories and national data regarding trends in the sale of CFLs, LEDs, incandescent, and halogen lamps. Delphi Panel participants were then presented with methodological details of the evaluation approach to estimating program free ridership, such as overall estimation method, sampling approach, sample size, and timing of the evaluations. Panelists were then presented with free ridership findings from the Duquesne and PECO evaluations and were asked separately for standard CFLs, specialty CFLs, and LEDs, "How well do you think [calculated free ridership rate] reflects the actual percentage of customers who would have purchased the program-discounted ENERGY STAR [CFL] bulbs even without the discount and/or promotional materials provided by the program?" Using the collected data and methods as a reference point, panelists were then asked to provide their own estimates of free ridership by bulb type for each utility, along with an explanation of the basis for their estimates.

In the second phase of the process Delphi panelists were presented with the free ridership estimates and explanations provided by their fellow panelists. They were given the opportunity to either modify their own estimates as informed by the estimates and justifications of others or to keep their estimates unchanged. Final free ridership values were then calculated as averages by bulb type for each distinct group of market actors surveyed and across all panelists surveyed based on the final free ridership estimates at the end of the second round. Details associated with the methods and findings of this approach are included in 16.6Appendix E.

The fifth method of estimating overall program influence consisted of a long-term market effects modeling exercise. This method stands apart from the other methodologies in several important ways. In contrast with measuring program influence specifically for PY6, this method relied on national- and PECO-specific socket saturation data from PY1 through PY5 and modeled cumulative program influence on socket saturation of efficient bulbs in PECO service territory relative to a naturally occurring background adoption rate. Due to data availability, the analysis was limited to CFLs and did not differentiate between standard and specialty bulbs. The overall conclusion from the analysis wass that PECO's residential lighting program has had an average annual NTG of 45 percent for CFLs in the PY1-PY5 period, inclusive of overall market effects on customer awareness, expectations, and behavior regarding lighting purchases. Another conclusion from the analysis was that dramatic upward and downward swings in the size of PECO's residential lighting program in the PY1 to PY5 period may have had a negative effect on the market, essentially sending confusing signals to customers on prices and availability of efficient lighting options. The write-up from that analysis, including detailed methods and findings, is included in Appendix E.

Non-residential purchasers of SHR-incented or rebated equipment make purchasing decisions for their businesses in a different manner than those of residential consumers. NTG research for the SEI program is the most applicable source of information on this subject. For this reason, the evaluation team has applied the NTG values for the SEI program to non-residential installations. Table 1-11 details the NTG values for SHR installations by non-residential PECO customers.

2.3.2 Net Impact Findings and Recommendations

Attribution of program influence on customer decision-making is inherently imprecise, as it involves comparing actual purchase patterns to a hypothetical scenario—what would have happened in the absence of the program. For lighting measures, the research emphasis on the NTG ratio in PY6 yielded five separate estimates broken out by lamp type and for lighting measures overall. Each method can be seen as a facet or perspective with its own strengths and weaknesses in terms of how it captures program influence. One particular challenge in modeling customer decision-making in the absence of the program is to capture the full range of effects of the program on customer choices. Thus, a strength of the price elasticity modeling approach is that it is rooted in empirical data: customers purchased bulbs at different rates when the final purchase price they observed was higher or lower. However, a weakness of this approach is the implicit assumption that program influence can be characterized as a change in price on a given bulb model, all other things being equal. In reality, the absence of the program would almost certainly be accompanied by other changes that influence customer decision-making, including the relative prevalence and location of efficient and inefficient bulb types on store shelves, the incidence of promotional endcap placements, and the occurrence of educational and promotional signage. A strength of the Delphi Panel method of NTG estimation is the more holistic perspective on program influence that it brings, since experts in the lighting field reflect both qualitatively and quantitatively on what they have observed in the presence and absence of upstream incentives on lamp purchases. A weakness of the Delphi Panel approach is its inherent subjectivity, since panel participants who may have a vested interest in the continuance of lighting incentive programs are asked to offer their quantitative estimates of the program's influence. Due to the timing of coordinating the PY6 Delphi Panel effort with the Duquesne evaluation team, panelists were not presented with NTG findings from the PECO PY6 price elasticity modeling and conjoint survey approaches when they were asked to estimate program influence on customer decision-making. Rather, they reflected on data from the PY6 general population telephone survey and the PY5 in-store intercept data.

As shown in Table 2-7, NTG findings varied across methods and lamp types, with the overall average at approximately 0.4. The conjoint analysis and price elasticity modeling yielded the lowest overall NTG estimates, at 0.30 and 0.27, respectively. The Delphi Panel yielded the highest overall NTG estimate at 0.57, and the general population telephone survey and long-term market effects modeling yielded intermediate overall NTG estimates of 0.42 and 0.45, respectively. Notably, in the conjoint analysis in particular, NTG for standard CFLs and specialty CFLs hovered at approximately zero while NTG for LEDs was considerably higher. What this finding indicates is that some people who would have purchased CFLs at non-program prices chose instead to purchase LEDs at program prices, while some people who would have purchased incandescent-halogen bulbs at non-program prices chose to purchase CFLs at program prices. Indeed, the near-zero NTG indicates that the number of customers shifting from CFLs to LEDs under program prices is effectively equal to the number of customers shifting from incandescent-halogen to CFLs under program prices, yielding zero net change in CFL sales between program and non-program conditions (the modeled result for specialty CFLs yields a slightly negative NTG at -0.01, indicating that net sales of specialty CFLs might actually go down a small extent under program conditions, but this finding is most appropriately interpreted as zero net change). In this sense, CFLs may act as a bridge technology, or stepping stone, for some customers making a transition over time from baseline efficiency bulbs to LEDs. In support of this interpretation, the evaluation team noted that

efficient lamps (CFLs and LEDs) reach the highest total share of preference in the market when both of these bulb types are offered at program-discounted prices (72% total share of preference in the model) versus when only LEDs are discounted (68% total share of preference in the model).

The evaluation team made the determination that free ridership results from the PY6 general population telephone survey represent the most representative values for PY6 as well as for Phase III portfolio planning. The additional methods provide important perspectives that bind the overall NTG estimate. The general population telephone survey approach provides longitudinal consistency with the PY2 general population telephone survey approach as well as with the more general customer self-report approach of in-store intercept interviews conducted in PY2 and PY5. The conclusion that the PY6 general population survey yields, supported by the findings from the other approaches, is that program NTG ratio is relatively low at approximately 0.4. An alternative would have been to take the average NTG value across all of the methods employed, and this would have yielded a similar overall NTG value. Because the Delphi Panel was not able to consider the full range of PECO PY6 NTG research in its deliberations, the evaluation team made the determination that the general population telephone survey approach represented the most internally consistent and longitudinally consistent measurement of overall program influence. Table 2-7 shows NTG estimates by bulb type and overall for each method employed in PY6.

Table 2-7: 2015 Net-to-Gross Estimates

NTG Methodology	CFL - Standard	LED - Standard	CFL - Specialty	LED - Specialty	Total
General Population Survey	0.45	0.53	0.25	0.60	**0.42**
Conjoint Analysis	0.06	0.39	-0.01	0.42	**0.30**
Price Elasticity Model	0.15	0.38	0.08	0.30	**0.27**
Delphi Panel	0.56	0.65	0.57	0.65	**0.57**
Long-Term Market Effects, PY1–PY5	0.45	--	0.45	--	**0.45**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis

Because results from the long-term market effects modeling are specific to CFLs and cover the period from program inception in 2009 up through 2013, they are not directly comparable to the other PY6 NTG methods. However, the evaluation team notes here that the long-term market effects model yielded an overall CFL NTG of 0.45 for the period from PY1 to PY5. This serves as another estimate of overall program influence and corroborates the findings from the PY2 to PY6 self-report approaches.

The evaluation team recommends the application of the PY6 free ridership (FR) results from the general population survey and the PY5 spillover results from the in-store intercept survey for the appropriate NTG value for residential installations.

For non-lighting measures installed in the residential sector, the evaluation team relied on a telephone survey of participants. For both HVAC and appliance, 100 participants completed the survey and answered a series of free ridership and spillover questions, per the common NTG method prescribed by the SWE. The result was a 0.28 NTG ratio for HVAC customers, which is unchanged from PY6. While the free ridership for appliances also remained unchanged, the spillover from this measure category increased from 0.13 in PY5 to 0.41 in PY6. This drove the NTG ratio from 0.48 to 0.76. This change was driven by increased (self-reported) program influence on appliance purchases.

Telephone interviews and a Delphi Panel with HVAC trade allies corroborated the low NTG ratio for those measures. In the interviews, only three of 12 respondents reported using PECO market materials. HVAC contractors reported in the Delphi Panel that high efficiency products were "the easiest to sell" to what they described as their typical customer:

Upper/middle class, mid-high income, "educated" about benefits and ROI and long-term buyers

When asked how much of their business they would retain if without the current rebate, 10 out of 16 panelists estimated they would retain 70 percent of their high efficiency sales. Table 2-8 provides the NTG result for each measure category for residential installations.

Table 2-8: Program Year 6 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
Electric HVAC	0.73	0.02	0.28	1.50	21.3%
Appliances	0.64	0.41	0.76	2.16	31.0%
Standard CFLs	0.60	0.04	0.45	0.71	9.2%
Specialty CFLs	0.80	0.04	0.25	1.57	37.4%
Standard LEDs	0.56	0.09	0.53	0.54	8.9%
Specialty LEDs	0.48	0.09	0.60	0.44	14.7%
Program Total [1]	**0.58**	**0.07**	**0.49**	**0.31**	**7.1%**

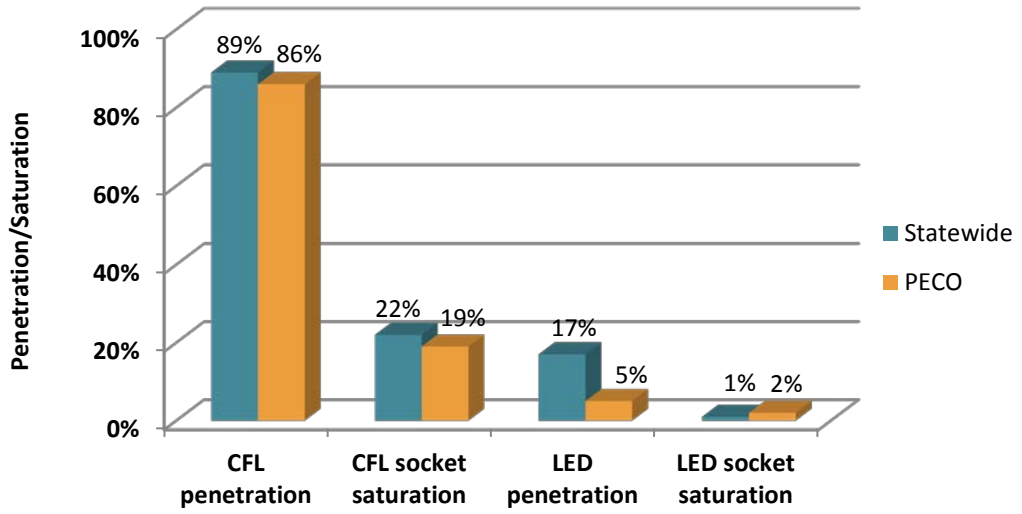
[1] NTG values are for residential installations. For non-residential installations, Navigant applied NTG values from the SEI program to reflect the purchasing approach of that sector.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

NTG is low to moderate for individual strata in the SHR program and for the program's residential installations. It is worth noting, however, that this finding does not appear to indicate that the efficient lighting market is necessarily saturated or transformed in the PECO service territory. Figure 2-1 shows the percentage of homes with one or more CFLs or LEDs installed (penetration), as well as efficient bulb socket saturation in PECO service territory compared with Pennsylvania overall. As indicated in the figure, CFL and LED penetration and CFL socket saturation are below the statewide average.

Figure 2-1: CFL and LED Penetration and Socket Saturation



Source: 2014 Pennsylvania Statewide Act 129 Residential Baseline Study. GDS Associates, Inc.

Key NTG findings for lighting measures include the following:

- **EISA-compliant halogens have seen a big spike in sales, higher than recent predictions.**[19] As the lowest upfront cost option, Halogen A-line lamps constitute a significant threat to the LED and CFL markets between now and 2020. While self-reported FR is high, as halogens gain market share, the need for program interventions increases.
- **Penetration and saturation for PECO do not indicate market transformation**. The SWE contends that the market may be transformed for residential lighting measures and incentives for CFLs and LEDs may not be needed. However, while market penetration for CFLs is high, actual socket saturation is low. The penetration and socket saturation for LEDs is even lower. As market transformation indicators, penetration and saturation levels do not indicate that market actors (in this case residential consumers) have changed their purchasing or installation practices sufficiently enough to indicate that program interventions are no longer necessary.
- **Recommended NTG values for Phase III design.** The evaluation team recommends the application of the PY6 FR results from the general population survey and the PY5 results from the in-store intercept survey.
- **Overall NTG has remained fairly low over time.** While these NTG levels are low to moderate, these levels have been consistent over the life of PECO residential lighting programming.

[19] See http://www.nema.org/news/Pages/First-Quarter-Proves-to-be-a-Mixed-Bag-for-Consumer-Lamp-Indexes.aspx, which shows halogen A-line lamps at 44 percent of national A-line lamp shipments as of Q1 2015.

2.4 PROCESS EVALUATION

For lighting measures, the evaluation team employed several data collection methods that collectively informed the process evaluation. These included the general population telephone survey, the conjoint web panel, program manager and implementer interviews, and a program marketing materials review. In addition, manufacturer in-depth interviews conducted on a statewide basis provided additional insights from a process perspective. The methodology and sampling approaches associated with the general population telephone survey and conjoint web panel are discussed in Section 2.3 of this report. The program manager and implementer interviews were conducted as single interviews with the program leads on the PECO and implementation sides, and the program marketing materials review was based on a representative sampling of different types of program marketing materials sent as digital files by the program manager and implementer. Lighting manufacturer in-depth interviews were conducted with eight manufacturers on a statewide basis by the Pennsylvania Power and Light (PPL) evaluation team, and the results were shared with evaluators for all upstream lighting programs administered by Pennsylvania EDCs. The sample for the manufacturer interviews was made up of all lighting manufacturers whose products are incentivized through one or more upstream lighting programs by the EDCs in Pennsylvania; those who were willing to participate in the interview dictated the achieved sample. The evaluation team also conducted shelf surveys at six participating retail stores.

For non-lighting measures, the evaluation team pursued input from both trade allies and participants. The evaluation team conducted 11 in-depth interviews and an online Delphi Panel with 16 HVAC installers as well as a set 150 of mystery shops at 83 participating retail locations. The evaluation team also surveyed 200 participants by telephone and completed an online focus group with 17 PECO customers who purchased qualifying HVAC equipment.

Table 2-9 shows target sample sizes and achieved sample sizes for each data collection method where sampling was employed.

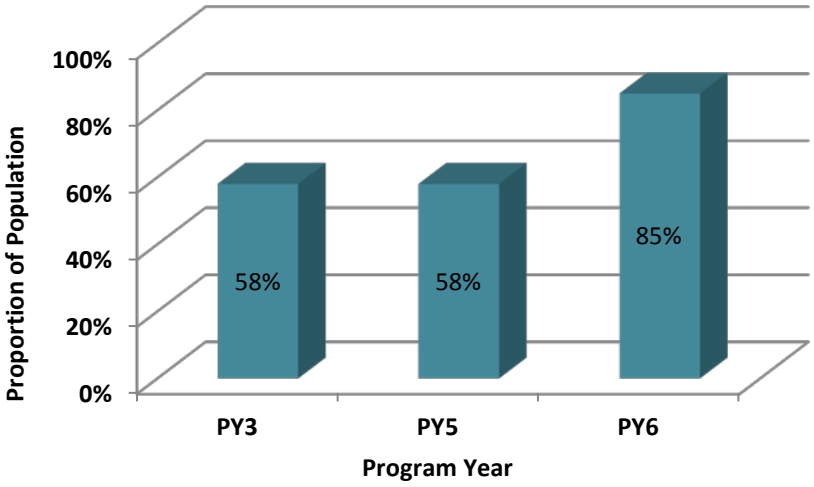
Table 2-9: SHR Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confi-dence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
HVAC Installers (Delphi Panel)	N/A	1,782	N/A	N/A	16	16	100%	Process
HVAC Installers (Telephone Interviews)	N/A	1,782	N/A	N/A	12	11	100%	Process, NTG
Residential HVAC Customers	N/A	22,798	N/A	N/A	17	17	60%	Focus Group
Retail Staff (Lighting Mystery Shop)	N/A	462	N/A	N/A	50	50	71%	Process
Retail Staff (Non-Lighting Mystery Shop)	N/A	462	N/A	N/A	100	100	83%	Process
Residential Lighting Customers (Web Panel)	N/A	90,367	0.625	90/10	900	898	54%	Process, NTG
Residential Lighting Customers (Telephone Survey)	N/A	1,986,139	1	85/10	600	602	60%	Process, NTG
SHR Participants (Telephone Survey-Appliance)	N/A	12,329	0.5	85/10	100	100	99%	Process, NTG
SHR Participants (Telephone Survey HVAC)	N/A	10,469	0.5	85/10	100	100	79%	Process, NTG
Program Manager (Telephone Interview)	N/A	1	N/A	N/A	1	1	100%	Process
Program Total		**2,126,591**			**1,896**	**1,862**		
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant analysis

The principle data collection activity for lighting participants was a telephone survey of 602 PECO customers. As shown in Figure 2-2, PECO customer awareness of LED measures increased from 58 percent in PY2 and PY5 to 85 percent in PY6.

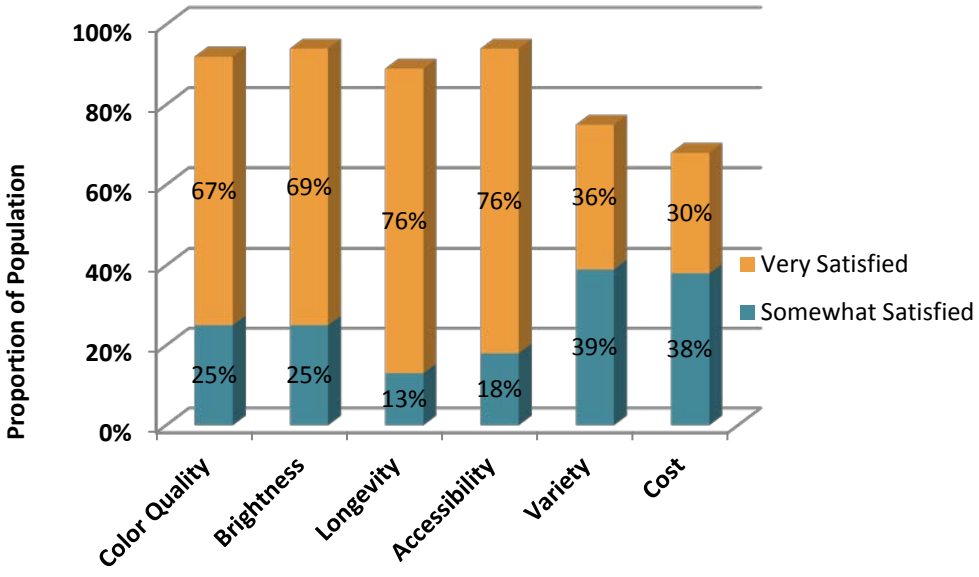
Figure 2-2: Awareness of LEDs in General Population



Source: General Population Telephone Survey

PECO customers indicated that their satisfaction with the various features of LEDs is generally high. As shown in Figure 2-3, the majority of customers describe themselves as highly satisfied or somewhat satisfied with all features about which they were asked. Customers expressed particularly high levels of satisfaction with color quality, brightness, longevity, and accessibility of LED bulbs.

Figure 2-3: Customer Satisfaction with Features of LED Lamps

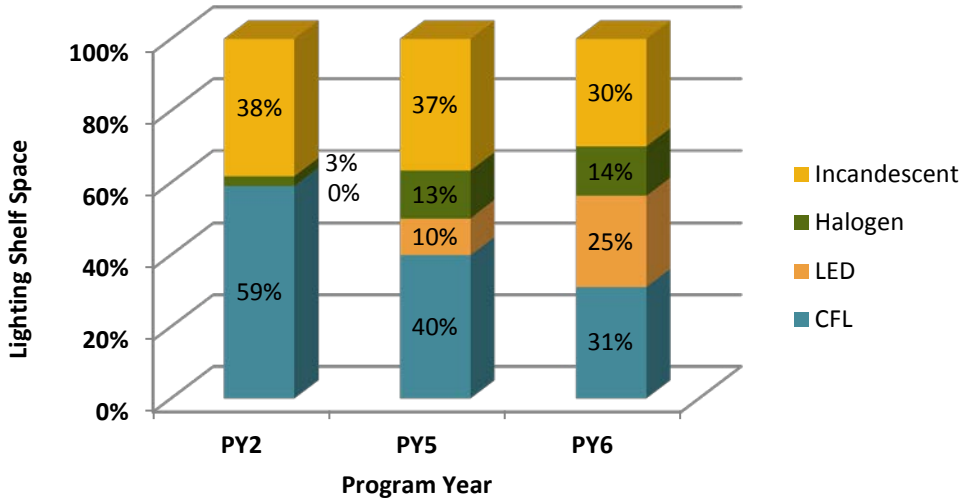


Source: General Population Telephone Survey

While customers expressed high levels of satisfaction with the availability and variety of LED lamp options, the shelf surveys conducted in participating program retail stores over the course of the program indicated that increasing shelf space occupied by LEDs has corresponded with decreasing shelf space occupied by CFLs. As a result, the total proportion of lighting shelf space dedicated to efficient

lamps has remained virtually unchanged over the past five years of the lighting program, as shown in Figure 2-4.

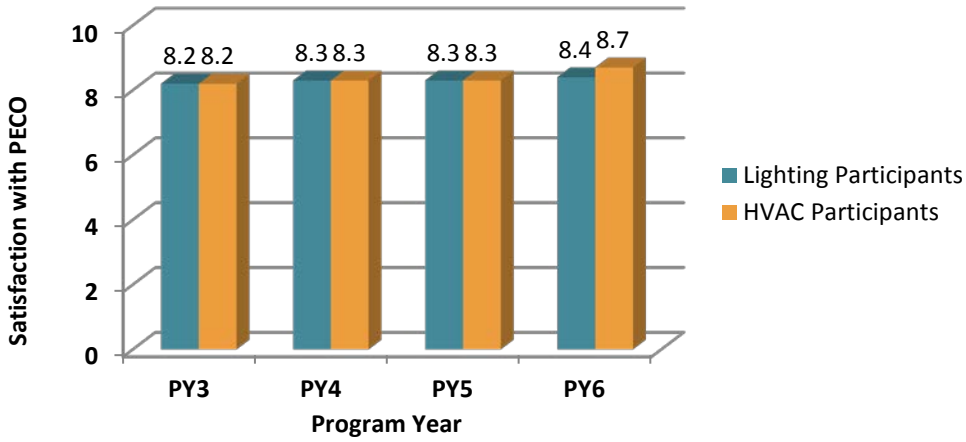
Figure 2-4: Lighting Shelf Space by Lamp Type, PY2–PY6



Source: Lighting shelf surveys at participating retailers, PY2–PY6

Based on the general population telephone survey results for lighting measures, satisfaction with PECO overall has remained relatively high and relatively steady across program years. Navigant also conducted a telephone survey of PECO customers who purchased rebated HVAC and appliance measures. Figure 2-5 shows that satisfaction with PECO on a scale from 0 to 10 has risen slightly over the past four program years among both of these audiences.

Figure 2-5: Overall Satisfaction with PECO



Source: Lighting General Population Telephone Survey, HVAC Participant Telephone Survey
Notes: Five-point scale converted to 10-point scale for comparison to past years.
N=200 in all years.

Participating in the SHR program has an effect on overall satisfaction with PECO for some customers. Specifically, in PY6, participation in the program increased satisfaction with PECO in 33 percent of

respondents. As shown in Table 2-10, this is less than reported in PY5 but greater than that reported in PY3 or PY4.

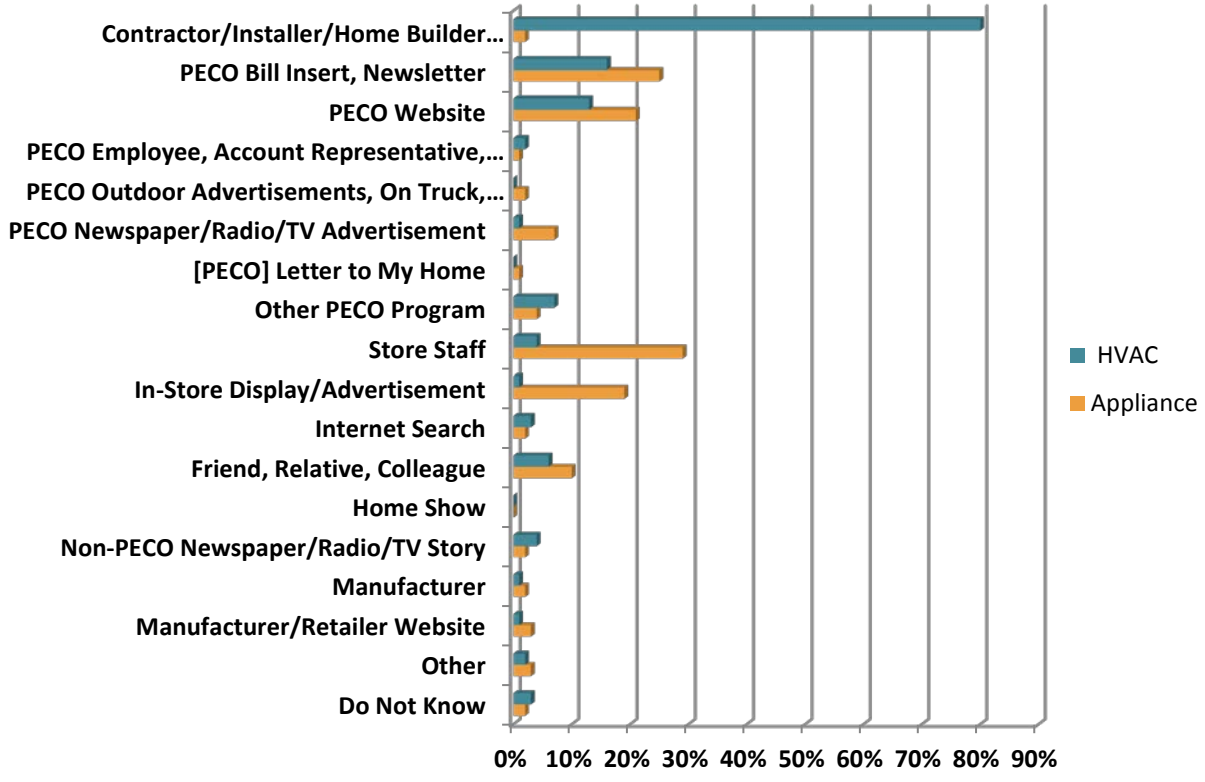
Table 2-10: Change in Satisfaction with PECO after Participation

Change in Satisfaction	PY3	PY4	PY5	PY6
Higher	23%	23%	40%	33%
About the Same	74%	75%	58%	64%
Lower	3%	1%	2%	2%
Too Early to Tell	1%	2%	-	-
Don't Know	0%	0%	1%	0%
N = 200 all years				

Source: HVAC Participant Telephone Survey

As in previous years, trade allies (contractors, installers, and builders) remained critical sources of information to these participants (see Figure 8-1). HVAC participants learn about the program differently than appliance customers. Trade allies account for about 80 percent of HVAC customer awareness, whereas 80 percent of appliance customers learn about SHR rebates through retail store staff, in-store displays, PECO mailers, and the PECO website.

Figure 2-6: Non-Lighting Participant Awareness—HVAC vs. Appliance



Source: HVAC Participant Telephone Survey

However, as mentioned earlier regarding NTG and shown in Table 2-11, the majority of trade allies are not using SHR materials. For installers with higher levels of rebate activity, their sales process may be

effectively established without the need for additional SHR materials. Installers with lower levels of activity reported they did not have materials—in one case, the trade ally did not receive the materials requested from PECO. Only three of the 2015 trade allies reported any regular use of PECO marketing collateral.

Table 2-11: HVAC Trade Allies' Use of Marketing Materials

Strata	Do not use materials	Do not have materials	Use materials
Distributors (n=2)	2	0	0
High-level participants (n=4)	3	0	1
Mid-level participants (n=3)	0	2	1
Low-level participants (n=1)	1	0	0
Non-participants (n=2)	0	1	1

Source: Navigant analysis

The evaluation team's panelists predict that less than 50 percent of the market has adopted high efficiency equipment for most equipment types. This suggests the penetration of high efficiency equipment is incomplete. Trade allies estimated an even lower penetration of high efficiency equipment among low-income segments (see Table 2-12).

Table 2-12: HVAC Trade Ally Estimated Market Penetration of High Efficiency Equipment

High Efficiency Equipment	Total Market	Low-Income
AC SEER 15 or higher	45%	20%
ASHP SEER 15 or higher	44%	17%
GSHP ENERGY STAR tier 3	44%	5%
Natural Gas Replacement Furnaces AFUE 95%+	53%	17%
Furnace Fan Motors <= 2% efficiency	48%	10%

Source: Navigant analysis

These estimates indicate that the SHR program is limited in participation by the demographics that participating trade allies choose to serve. As shown in a GIS analysis located in 16.6Appendix E, this limitation is expressed by distinct geographies receiving rebated installations.

Navigant also found that participating retailer enthusiasm for energy efficiency is declining. With HVAC measures, the SHR program relies upon trade allies, in this case retail sales staff, to promote and sell program equipment. The evaluation team conducted 100 mystery shops of participating retailers and found a decline in all but one category, ,as shown in Table 2-13.

Table 2-13: Participating Retailer Knowledge and Courtesy

Category	PY5	PY6	Percent Change
Knowledge of rebate	5.79	6.16	+6%
Enthusiasm toward energy efficiency	8.46	7.15	-15%
Friendliness	8.87	8.50	-4%
Knowledge of product	8.17	7.75	-5%
Easy to find	8.56	8.49	-1%
Average rating	7.97	7.61	-5%

Source: Navigant analysis of mystery shopping data

The erosion of enthusiasm scores marks the slippage of critical knowledge for driving the sale of energy-efficient appliances through the SHR program. Only 41 percent of sales associates could direct customers to a SHR-qualified mode, while 91 percent of sales associates could in PY5. Sales associates could only explain the rebate process (prompted and unprompted) in 48 percent of visits; last year 65 percent mentioned the process without prompting. This year 72 percent of sales associates said applying for the rebate was easy compared to 92 percent last year.

While the ability of store staff to locate SHR-qualified models has decreased, the number of unprompted mentions increased from 16 percent of visits to 31 percent of visits between PY5 and PY6. No correlation between big box or specialty appliance stores explains the incongruous result. One plausible explanation is that due to ongoing turnover of sales staff, the presence of SHR may increase in the sales approach of senior staff while junior staff members are being less effectively informed or trained by SHR retail outreach.

The presence of point-of-purchase materials has not diminished. PECO SHR materials were on display at half of the stores, mostly stickers on the appliances. This occurred equally at big box stores and appliance stores. Last year, the presence of point-of-purchase material was 51 percent. Likewise, when asked whether they would recommend another, non-rebated model to shoppers, sales staff stuck with the SHR-qualified model at the same frequency as PY5—73 percent of the time.

2.4.1 Process Evaluation Findings and Recommendations

1. **Finding:** Based on the general population survey and the SWE Residential Baseline Survey, it appears that PECO customers have a high level of awareness of CFLs and LEDs. While this has translated into broad market penetration for CFLs, overall adoption of LEDs has been slow. Among those who have purchased LEDs, satisfaction is high for all features; however, satisfaction with price is limited with low-income customers. In this context, awareness and satisfaction do not appear to be barriers to adoption.
    a. **Recommendation:** PECO should focus its promotional messaging on increasing the understanding of an LED's useful life and product quality.

2. **Finding:** The primary opportunity for residential customers to purchase lighting products is from the shelves at retail locations. PECO's programming has focused on upstream buy-downs that flow into larger chain stores that target the mid- to upper-income market segment. An exception to this focus are the stores of Goodwill Industries, a non-profit that primarily serves low-income customers. Manufacturers and retailers stated, in interviews and the online Delphi Panel, that national and local programs—primarily incentives—mitigated risks related to the introduction of new lighting technologies and reduced retail prices sufficiently enough to secure

early adoption of CFLs and LEDs. However, LED prices are in decline and this decline will continue with or without program subsidy. It would seem that price was not a barrier. However, short-lived (non-ENERGY STAR) LEDs are among the products currently entering the market. These are not program measures and could displace SHR participation. For this reason, incentives to keep program bulbs competitive with lower-quality products may be vital to the success of the program. Since PY2, the shelf share of efficient lighting products has not changed significantly, in spite of residential programs across North America. As EISA phases out traditional incandescent options, consumers will be tempted to purchase lower-priced halogens. This shift in volume would affect the overall lighting supply chain to the disadvantage of efficient lighting options. The SHR program may have succeeded in holding the line on retail shelves against less efficient lighting choices but, absent programmatic intervention, availability of LEDs and CFLs may decline. In this context, availability appears to remaina barrier.

   a. **Recommendation:** PECO should develop outreach and promotion efforts to retailers to prevent non-qualifying lighting products from expanding market share.

3. **Finding:** From the start of the SHR program, PECO has promoted energy efficiency to installation contractors and distributors. These trade allies have served the more affluent and educated segments of PECO's residential customers. The less affluent and less educated customers have not benefited as much from program rebates. The result is high free ridership among current customers, as described by both participants and trade allies. PECO now has the opportunity to address underserved market segments rather than maintain a continued focus on the same market segments and geographies.
   a. **Recommendation:** Recruit installation contractors that serve under-represented areas in the PECO service territory.

4. **Finding:** As shown from the mystery shopping activity and participant surveys, the current program design relies upon retail sales staff promoting qualifying equipment to residential customers. This does not appear to be a reliable link in the program theory.
   a. **Recommendation:** Increase outreach to and training for retail store sales staff.

2.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 2-14 provides a summary of PY6 recommendations for process and impact evaluations.

Table 2-14: SHR Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Confirm that all internal data consistency issues identified and addressed in PY6 have been resolved based on cross-checks within and across records.	Implemented – the source of the data inconsistencies was identified and new processes were put in place to ensure that when product attributes change the system has a mechanism to change with them.
Recommendation 2: Revise reported savings accounting to reflect appropriate inputs for non-lighting measures.	Implemented
Recommendation 3: PECO should employ the NTG ratio detailed in Section 2.3.2.	Implemented for Phase III planning
Recommendation 4: PECO should focus its promotional messaging on increasing the understanding of LED useful life and product quality.	Being Considered – We are currently working on incorporating this into our future promotional messages
Recommendation 5: PECO should develop outreach and promotion efforts to retailers to prevent non-qualifying lighting products from expanding market share.	Being Considered – We are currently working on incorporating this into our future promotional messages
Recommendation 6: Recruit installation contractors that serve under-represented areas in the PECO service territory.	Being Considered – We will be working closely with our evaluator, CSP, and marketing experts to design a plan to reach under-served markets.
Recommendation 7: Increase outreach to and training for (retail) store sales staff.	Being Considered – We will be working closely with our evaluator, CSP, and marketing experts to design a plan to reach under-served markets.

Source: Navigant analysis

2.6 FINANCIAL REPORTING

For the second year of Phase II, the SHR program exceeded its expected TRC of 1.3. This is due primarily to the low cost and wide adoption of lighting measures. A breakdown of SHR program finances is presented in Table 2-15.

Table 2-15: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	51,318	80,752
2	EDC Incentives to Participants	13,731	20,623
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	37,587	60,129
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	3,790	7,305
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	3,432	6,918
8	Marketing[2]	358	387
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5, and 11)	55,108	88,057
13	Total NPV Lifetime Energy Benefits	77,183	137,449
14	Total NPV Lifetime Capacity Benefits	6,647	10,687
15	Total NPV TRC Benefits[4]	91,141	165,123
16	TRC Benefit-Cost Ratio[5]	1.65	1.88

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

3. SMART HOUSE CALL

PECO's Smart House Call (SHC) program is a new program in Act 129 Phase II. The program is built around direct install (DI) measures for all participants and additional, contractor-installed major measures for electric heat rate customers. DI measures include: ENERGY STAR CFL bulbs, ENERGY STAR LEDs, LED nightlight, low-flow faucet aerators, low-flow showerheads, and smart strip plug outlets. Contractor-installed major measures include: Air source heat pump (ASHP) duct sealing, ASHP maintenance, air sealing, attic insulation, and wall insulation.

PECO customers living in single-family homes or in multi-family dwellings with three or fewer units are eligible for the program. Customers who participate at the assessment level pay $50 and receive a walk-through of their home during which an energy advisor installs appropriate DI measures as needed and provides a set of additional recommendations for the homeowner to consider on an unincentivized basis. Customers who are on PECO's electric heat billing rate are eligible for the audit level of program participation (in PY7, eligibility for the audit level will expand to include customers with central air conditioning). At this level the customer pays $100 and receives a more in-depth review of their home, which includes a blower door test and combustion safety test as well as the walk-through and installation of appropriate DI measures. They are also eligible for incentives on the program's contractor-installed major measures. They receive an audit report that provides the full cost, incentive amount, and discounted cost on recommended contractor-installed measures as well as recommendations to consider on an unincentivized basis.

3.1 PROGRAM UPDATES

PY6 marked the second year of the program since its introduction. The overall structure of the program remained consistent in PY6. Qualification criteria for the different levels of program participation remained consistent, as did the set of DI measures and contractor-installed measures incentivized through the program. Based on the program's growth over the course of PY6, the program implementer hired additional energy advisors. The program maintained the same group of PECO-approved contractors that perform the program-incentivized major measures with the exception of one contractor that went out of business. A significant change in PY6 was the increased emphasis on program marketing via diverse channels, with a particular emphasis on direct mail to PECO customers. Marketing channels included co-branding with PECO-approved contractors, multimedia with television commercials and video spots, contractor referrals, an online sign-up form for customer call bakcs, presentations at home owners' association meetings, and others.

3.1.1 Definition of Participant

For the SHC program, a participant is defined as a dwelling with a unique address including a unit number. Hence, if separate units in a multi-family building of three or fewer units participate in the program these are considered unique participants. Equivalently, if one person owns multiple dwellings, each unique address for which an assessment or audit is conducted is considered a separate participant.

3.2 IMPACT EVALUATION GROSS SAVINGS

As shown in Table 3-1, all Phase II reported savings for the SHC program have been in the Residential sector. Total reported energy savings for Phase II were 3,825 MWh, with the majority of these reported energy savings coming in PY6 at 2,870 MWh. Reported gross demand savings for Phase II were 0.56 MW, with 0.44 MW of that total coming in PY6. PECO paid out $321,333 in customer incentives in Phase II, with $248,822 of that in PY6. Energy savings, demand savings, and incentives paid all increased 200%

or more from PY5 to PY6. Reported savings were based on TRM algorithms for all program measures, including an Interim Measure Protocol (IMP) in the case of air sealing.

Table 3-1: 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	5,622	3,825	0.6	$321
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**5,622**	**3,825**	**0.6**	**$321**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*				

Source: Navigant

3.2.1 Methods

The evaluation team employed several methods in the impact evaluation. These served to measure the level of agreement between program tracking data and available independent documentation and to gauge the proportion of program measures still in place relative to what was reported in the tracking data.

The first impact evaluation method was a comprehensive review of implementer invoices against the quarterly program tracking data. In this review the evaluation team compared the number and date of assessments and audits performed and the program costs associated with that work between the two data sources.

The next component of the impact evaluation was a comprehensive re-creation of program savings calculations for all measures. As shown in Table 3-2, this activity was based on all records in the tracking data. For both energy and demand savings, the evaluation team applied algorithms as specified in the TRM and parameter values from a combination of TRM default inputs and customer-specific values as provided in the tracking data. The evaluation team compared reported savings and TRM-verified savings for each record, each measure, and for the program overall.

The evaluation team also conducted phone interviews with a stratified random sample of 32 program participants to verify whether or not program-incentivized measures as recorded in the program tracking data were installed and functioning. Stratification was based on whether customers had participated at the assessment level or audit level and, within the audit level, whether the program tracking data indicated they had installed one or more of the contractor-installed major measures. Final targeted and achieved sample sizes are shown in Table 3-2. For each measure type where the tracking data indicated the participant had one or more measures installed, the respondent was asked to verify the number of program measures that remained installed and whether they remained functioning. In cases where participants reported having uninstalled measures they were asked the reason for having done so.

Finally, the evaluation team reviewed all program files for a stratified random sample of 40 program participants. As with the installation verification interviews, stratification was based on whether customers had participated at the assessment level or audit level and, within the audit level, whether the program tracking data indicated they had installed one or more of the contractor-installed major measures. Final targeted and achieved sample sizes are shown in Table 3-2. The evaluation team compared all materials in a participant's file against the tracking data and documented any discrepancies observed.

Table 3-2: Smart House Call Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Assessment	3,185	85/0	3,185	3,185	TRM verification of savings calcs
Audit Only	922	85/0	922	922	TRM verification of savings calcs
Audit + Install Major Measures	412	85/0	412	412	TRM verification of savings calcs
Assessment	3,185	85/13	13	15	Install verification phone interviews
Audit Only	922	85/13	10	10	Install verification phone interviews
Audit + Install Major Measures	412	85/13	7	7	Install verification phone interviews
Assessment	3,185	85/7.5	18	18	Customer file review
Audit Only	922	85/7.5	13	13	Customer file review
Audit + Install Major Measures	412	85/7.5	9	9	Customer file review
Program Total	**4,519**		**4,589**	**4,591**	
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant

As a small program evaluated at the basic rigor level, this evaluation uses telephone-based measure installation verification and file review to verify savings. Consistent with the evaluation plan, no onsite inspections were conducted for this program..

3.2.2 Results

The evaluation team calculated verified savings based on the combined realization rate from the impact evaluation activities described above. Hence, each of these activities is described below as yielding partial realization rates (i.e., a realization rate from that specific evaluation activity), and the combination of these partial realization rates yields the overall program level realization rate. Realization rates are calculated by project type and overall.

Looking at energy savings, the TRM-based recreation of savings calculations matched to within one percent of reported savings for all program measures except air sealing and insulation. For air sealing, verified energy savings were approximately 25 percent higher than reported savings. This is because reported savings were based on erroneous coefficients that had been in a draft of the IMP for this measure. This error, having been identified during the evaluation, was subsequently corrected in an updated draft of the IMP and used to inform both the PY6 verified savings calculation and the 2016 TRM

looking forward. Verified energy savings for insulation were also approximately 5 percent higher than reported savings. This was due to a persistent calculation error in reported savings specifically for the 88 records in which the final insulation R-value was 49.

The measure installation verification telephone interviews yielded partial realization rates for assessments, audits, and audit major measures of 0.94, 1.00, and 0.98, respectively. These were driven by reports from customers in the sample that had uninstalled a total of six CFLs, three LEDs, one smart power strip, one low flow shower head, and one low flow faucet aerator. Reasons cited for the disinstallations, which were mostly by assessment participants, included dissatisfaction with bulb light quality, disruption of normal appliance functioning by the power strips, and inadequate water flow with low flow devices in place. Also, one participant in the sample described home renovations for reasons other than energy efficiency that resulted in replacing a low flow faucet aerator with a new standard faucet.

The participant file review yielded partial realization rates for assessments, audits, and major measures of 1.00, 1.01, and 1.17, respectively. These were driven by 100 percent verification of DI measures in this sample as well as the verified installation of several program-incentivized measures that were not captured in the program tracking data. For one audit participant with major measures installed, the tracking data erroneously reported this participant as having pursued ASHP maintenance, whereas that participant's file contained a paid invoice for ASHP duct sealing, attic insulation, and air sealing, including program incentives for these measures and not for ASHP maintenance. The program implementer reconfirmed that the invoice represented completed work. In another case a customer's file noted that two smart power strips had been installed whereas the tracking data reported only one.

As mentioned above, the evaluation team calculated the full realization rate for verified energy savings as the combination of the partial realization rates by evaluation activity. Table 3-3 shows verified energy savings and final realization rates by project type and overall. Achieved relative precision for the overall program was 6.9 percent at the 85 percent confidence interval.

Table 3-3: Program Year 6 SHC 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.
Assessment	1,305	N/A	0.94	1,228	0.13	4.5%
Audit	976	N/A	1.01	986	0.04	1.5%
Audit_Install	589	N/A	1.23	725	0.35	16.0%
Program Total	**2,870**	**N/A**	1.02	**2,939**	**0.30**	**6.9%**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant

3.2.2.1 Verified Demand Savings

Similar to energy savings, the TRM-based recreation of demand savings calculations matched to within one percent of reported savings for all program measures except air sealing and insulation. Note, however, that in the case of air sealing, verified demand savings were approximately 58 percent lower than reported savings (whereas energy savings were 25 percent higher than reported). This is rooted in

the same issue of erroneous coefficients in a draft of the IMP for this measure. Also, verified demand savings for insulation were approximately three percent higher than reported savings, again due to a persistent calculation error in reported savings specifically for the 88 records in which the final insulation R-value was 49.

The measure installation verification telephone interviews yielded partial demand realization rates for assessments, audits, and audit major measures of 0.94, 1.00, and 0.99, respectively, driven by the disinstallation of some measures as noted above. The participant file review yielded partial demand realization rates for assessments, audits, and major measures of 1.00, 1.01, and 1.08, respectively, driven by 100 percent verification of DI measures in this sample as well as the verified installation of several measures that were not captured in the program tracking data, as noted above.

The evaluation team calculated the full realization rate for verified demand savings as the combination of the partial realization rates by evaluation activity. Table 3-4 shows verified demand savings and the final demand realization rate by project type and overall. Achieved relative precision for the overall program was 4.6 percent at the 85 percent confidence interval.

Table 3-4: Program Year 6 Smart House Call Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	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.
Assessment	0.17	N/A	0.94	0.16	0.14	4.7%
Audit	0.11	N/A	1.01	0.12	0.04	1.6%
Audit_Install	0.16	N/A	0.95	0.15	0.22	9.9%
Program Total	**0.44**	**N/A**	0.96	**0.42**	**0.20**	**4.6%**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

3.2.3 Impact Findings and Recommendations

Below are specific recommendations and the associated impact evaluation findings on which the recommendations are based.

1. **Finding:** Looking at energy savings, the TRM-based recreation of savings calculations matched to within one percent of reported savings for all program measures except air sealing and insulation.
    a. **Recommendation:** Ensure TRM savings algorithms are updated and applied consistently in reported savings.

3.3 IMPACT EVALUATION NET SAVINGS

A major finding of the PY5 SHC program evaluation was the incidence of significant program spillover via the installation of unincentivized measures by contractors. In response to this observation, the evaluation team focused the PY6 net savings evaluation specifically on spillover and combined these findings with the PY5 free ridership rate to yield the overall PY6 NTG value. The evaluation team used

the SWE Common Method for Downstream Programs when developing the free ridership estimate in PY5 and the SWE Common Approach for Measuring Spillover for Downstream Programs when estimating program spillover in PY6.

The sample frame for the spillover assessment file reviews was the entire SHC PY6Q1 to PY6Q3 program population. The sample design was focused on achieving 85 percent confidence at 15 percent precision for the overall NTG estimate. To develop the sample, the evaluation team noted the achieved relative precision of 6.0 percent for the free ridership estimate in PY5. The evaluation team calculated that relative precision of 13.7 percent on the spillover estimate would be expected to achieve 85 percent confidence at 15 percent precision for the overall NTG estimate. The sample consisted of three strata representing assessment participants, audit participants with no major program measures installed, and audit participants who have undertaken one or more major program measures according to the program tracking data.

Having developed the sample using the guidelines above, the evaluation team requested and received the scanned program files for 132 program participants, including contractor receipts and other program documentation. The evaluation team reviewed the program files and documented all recommendations made to customers as noted on the intake forms, the audit reports, the incentive applications, and contractor invoices. This included making note of any apparent cases of spillover where the participant appeared to have undertaken unincentivized energy efficiency improvements on the basis of program recommendations. The evaluation team then attempted to contact all 132 participants in the spillover sample to inquire about potential program spillover (whether or not it was observed in the documentation) and the possible influence of the program on their decision-making in cases where unincentivized measures were installed. For each participant Navigant reached, the evaluation team asked the participant whether or not they had installed any unincentivized measures and whether or not they expected to receive a rebate on these measure(s) through any other program. The evaluation team also asked them to rate the influence of the SHC program on their decision to install the measure(s) on a zero to five scale as well as to rate the likelihood they would have taken the same actions in the absence of the program. Ultimately, the evaluation team was able to speak with 45 customers in the 132-point sample, 37 of whom provided enough information where the evaluation team was able to make a clear determination on the presence or absence and magnitude of spillover. As shown in Table 3-5, the responses and files from these 37 customers formed the basis for the spillover estimate.

Table 3-5: SHC Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Assessment	N/A	3,185	1.10	85/13.7	59	17	100%
Audit Only	N/A	922	1.10	85/13.7	43	9	100%
Audit + Install Major Measures	N/A	412	1.10	85/13.7	30	11	100%
Program Total		**4,519**			**132**	**37**	

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

The evaluation team calculated estimated spillover on a case-by-case basis. The engineers used TRM algorithms and TRM default inputs as appropriate, depending on the information available. As shown in Table 3-6, the overall program level PY6 NTG value was 1.15, driven by low free ridership at 0.19 and high spillover at 0.34. Low free ridership was observed consistently across project types in the PY5 customer interviews. By contrast, the estimated spillover rate was high for audit participants in the final sample and relatively low for assessment participants and those audit participants with major measure installations shown in the tracking data. The evaluation team notes that the sample was designed to achieve 85/15 confidence/precision in the NTG estimate at the program level and not at the stratum level; hence, the spillover findings are most illustrative at the program level.

Out of 55 participants interviewed specifically regarding spillover, 37 provided clear enough responses where a determination of the presence or absence of spillover could be made. Of these, 17 participants provided clear and documentable evidence of program spillover. Among participants who implemented spillover measures, the average attribution score for program influence on their actions was 93 percent.

The most common spillover measures consisted of additional air sealing and insulation actions that went beyond those actions that were eligible for program incentives. Examples included insulating basement rim joists and other basement or knee wall air sealing and insulation measures. Other examples included insulating attic access hatches or pull-down stairs, garage ceilings, or second story overhangs. Some participants pursued fan replacement or new central air conditioning system measures not covered by the program. Some participants bought new appliances such as a washer/dryer without receiving incentives from other programs. Several assessment participants pursued insulation, air sealing, HVAC maintenance, or duct sealing measures that would have been incentivized if they had been audit level participants.

Table 3-6: Program Year 6 Smart House Call 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
Assessment	0.17	0.10	0.93	N/A	N/A
Audit Only	0.20	1.15	1.94	N/A	N/A
Audit + Install Major Measures	0.20	0.04	0.84	N/A	N/A
Program Total[1]	**0.19**	**0.34**	**1.15**	**1.18**	**16.3%**

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

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

3.4 PROCESS EVALUATION

The PY6 process evaluation involved in-depth interviews with a number of program stakeholders as well as a review of program materials. The evaluation team conducted in-depth interviews with the program manager and the program implementer, as well as with a sample of energy advisors and PECO-approved program contractors. The program materials review was based on a representative sampling of various kinds of program marketing materials and weekly internal program reports that were made available to the evaluation team by the program manager and the program implementer.

Both the program manager and the program implementer went through personnel changes over the course of PY6. To keep abreast of program changes through this transition, the evaluation team interviewed both individuals who served as program manager over the course of PY6 and both individuals who served as program lead for the implementation contractor during PY6. For the energy advisor and contractor interviews, the evaluation team made the qualitative determination that six completed interviews among each of these groups would provide adequate depth and breadth to characterize the program. The evaluation team contacted the whole population in each of these groups and continued to seek contact until six interviews were completed with members of each group.

Table 3-7: SHC Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Program Manager	N/A	2	N/A	N/A	2	2	100%	Process
Program Implementer	N/A	2	N/A	N/A	2	2	100%	Process
Contractors	N/A	10	N/A	N/A	6	6	100%	Process
Energy Advisors	N/A	17	N/A	N/A	6	6	100%	Process
Program Total		**31**			**16**	**16**		
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant

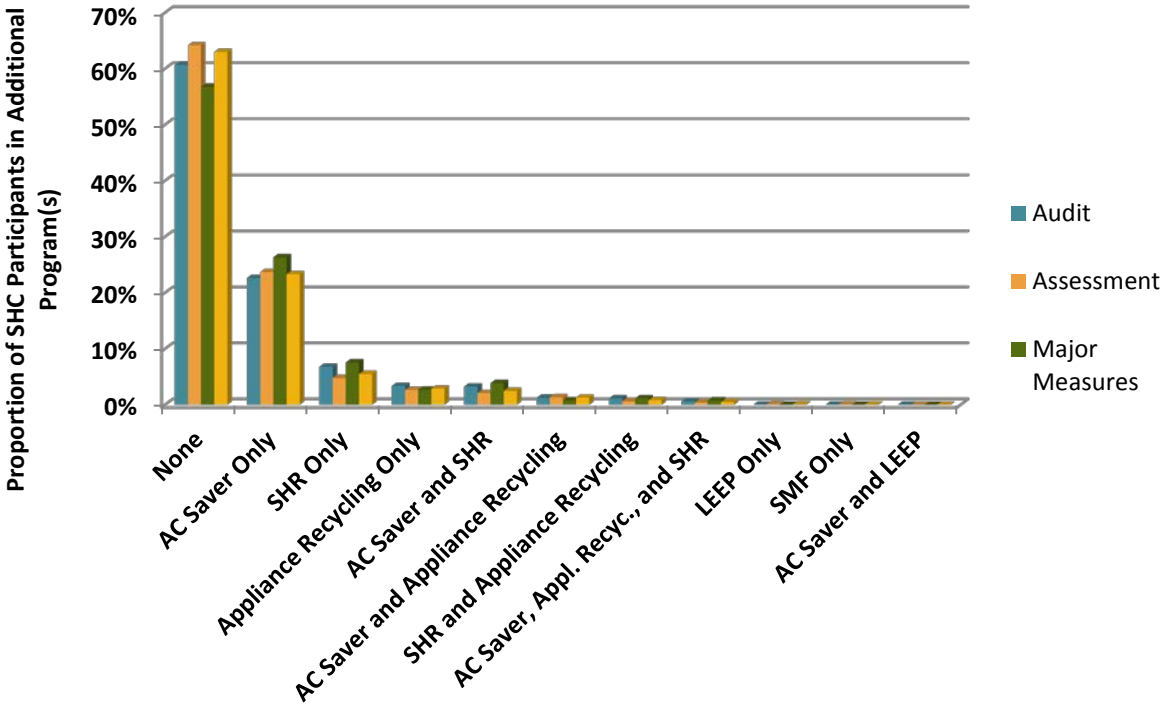
3.4.1 Results

Program marketing improved dramatically over the course of PY6. Successes and innovations in the areas of marketing, program design, and delivery occurred continually throughout the year. There was a considerable marketing drive in PY6 across a wide variety of channels, and these peaked with a large direct mail campaign near the end of the program year. Customers report hearing of the program mainly through mailers (31 percent), cross program (27 percent), and bill inserts (19 percent)

The program also experienced success from a marketing perspective from building its relationships with participating contractors. Improved contractor communications allowed contractors to become major advocates for the program. Sharing lead generation responsibilities with contractors is proving successful thus far. Interestingly, the full set of PECO-approved contractors for the SHC program has almost no overlap with the set of trade allies for the SHR program. Almost all of the contractors reported that they used the program marketing materials to promote the program with their customers. Contractors generally expressed satisfaction with the market and print program materials that they received for the program and did not suggest any improvements or changes.

The SHC program plays a role in influencing participation in additional Smart Ideas programs. As shown in Figure 3-1, approximately 25 percent of participants in the SHC program also participate in the Smart AC Saver program , while five to ten percent of SHC participants also participate in the SHR report.

Figure 3-1: Cross-Program Participation by PY6 SHC Participants



Source: Query of PY6 integrated portfolio tracking database

Energy advisors note that there is room in the program to expand the list of measures that qualify for program incentives. Part of this unexplored capacity is captured in the array of non-program-qualifying recommendations that energy advisors give to participants. Energy advisors note that approximately 45 percent of participants express an intent to pursue additional measures that go beyond what is incentivized under the program. Contractors estimate that 20 percent of the participants they serve choose to install additional, non-incentivized measures beyond what they install through the program.

In terms of offering the optimal measure mix, the program faces the continuing challenge of requests for expanded customer eligibility and measure mix with a low program TRC. Customers are pleased that those without electric heating but with central air conditioning are eligible for the audit level of participation as of the end of PY6.

It is common for program participants to receive one or more recommendations for unincentivized measures that go beyond what is covered by the program. Out of the 132 program files reviewed in the spillover analysis, 70 percent showed at least one unincentivized measure recommendation. For assessment participants, in particular, the incidence of unincentivized measure recommendations was almost universal at 95 percent. Assessment participants tend to receive a significantly higher number of unincentivized measure recommendations (average 4.0 recommendations) compared with audit participants (average 0.75 recommendations). The most common unincentivized measure recommendations are as follows:

- Assessment participants:
  - Air seal rim joist
  - Insulate attic
  - Air seal attic
  - Caulk windows
  - Mastic ducts in basement
  - Weatherstrip doors
  - Insulate attic access door
  - Chimney balloon
- Audit participants:
  - Insulate attic access door
  - Insulate whole house fan box
  - Insulate garage ceiling and/or second story overhangs
  - Install bathroom exhaust fan
  - Upgrade to higher efficiency HVAC system
  - Consider high efficiency appliances

Energy advisors receive training on building science, the required software, how to work with clients, program details, and what is offered by the program. As part of their training energy advisors also shadow peers in the field for a few days. Energy advisors generally experience the initial training they receive for their role and ongoing updates as effective and relevant; energy advisors collectively rate the overall effectiveness of training at a 4.4 on a scale of 1 to 5. Energy advisors value the variety of modalities in their training, and they note that peer-to-peer training is the best mode for customer engagement training and using equipment in the field. They note that more formal training in the classroom and using online materials is better for learning the technical aspects of the job.

Energy advisors believed that by and large the communication and logistics for implementing the program run smoothly. However, they mentioned that frequent changes to the program structure, changes to program protocols and requirements, and changes to the software tools that are used to implement the program can lead to confusion and the need to frequent re-trainings and information updates.

Contractors say the high rate of program staff turnover, the inevitable learning curve of a new program, and the large number of program roles led to some confusion about program logistics, program requirements, and changes in eligibility. Contractors cast a somewhat critical eye on the program's training, communication, and logistics. Contractors rate the overall effectiveness of their training instructors at 2.75 on a 1 to 5 scale and overall effectiveness of the training at 3.33. Contractors requested the opportunity for live training to supplement the webinar offerings. Of contractors, 40 percent said they were not aware of the change in program design at the end of PY6 that makes people with central air conditioning eligible for the audit level of participation.

Both energy advisors and contractors stated that they were not well oriented to the specific additional Smart Ideas programs for which SHC participants may be eligible. Energy advisors specifically noted that they would like to be able to model energy savings and monetary savings from those other opportunities as part of encouraging participants to consider them.

Contractors generally note that they are actively promoting the SHC program with their own customer base. They cite their own websites and pamphlets, as well as Conservation Services Group (CSG) handouts and word-of-mouth, as the predominant tools they use in spreading the word about the

program. Contractors note a generally steady flow of calls from customers, which picked up in PY6 relative to PY5 as well as over the course of PY6 itself.

Energy advisors indicated that the program did not allow them to build sufficient personal rapport and trust with participating customers. The structure of the program is such that the energy advisor comes to be seen as a trusted and independent advisor rather than someone who is trying to sell something. This dynamic also allows energy advisors to educate customers about energy use in their homes. Energy advisors noted that they were not encouraged to adequately follow up with customers who received an audit to encourage them to pursue contractor-installed measures. Energy advisors mentioned that nothing can replace face-to-face time with customers, which is a strength of the program. At the same time, being able to refer customers to YouTube videos could enhance the customers' ability to understand how and why certain steps are taken.

Contractors note that there may be a disconnect in some of the messaging and encouragement the customers receive from them versus what they are hearing from the energy advisors. Specifically, contractors may point out to participants particular ways in which the customer may improve the energy efficiency of their home that are overlapping but inconsistent with the advice given by the energy advisors. Contractors vary in the degree to which they make a conscious point of trying to convey a unified message with the energy advisor.

3.4.2 Process Findings and Recommendations

The process evaluation yielded several findings that point the way toward program improvements. Below are specific recommendations and the associated process evaluation findings on which the recommendations are based.

1. **Finding:** Program marketing improved dramatically over the course of PY6. Successes and innovations in the areas of marketing, program design, and delivery occurred continually throughout the year.
    a. **Recommendation:** Continue the successful marketing message focused on saving money and parse out the direct mailings to promote a manageable rate of program uptake.

2. **Finding:** The program plays a role in influencing participation in additional Smart Ideas programs.
    a. **Recommendation:** Engage more effectively in cross-program promotion by improving the ability of energy advisors to educate the customer in this regard.

3. **Finding:** Both energy advisors and contractors stated that they were not well oriented to the specific additional Smart Ideas programs for which SHC participants may be eligible.
    a. **Recommendation:** Promote a smoother customer experience by improving the quantity and integrated structure of energy advisor and contractor training.
    b. **Recommendation:** Create a higher degree of teamwork and co-ownership of the program's success for contractors via a more consistent and overarching structure of communicating program updates and logistics.

4. **Finding:** Energy advisors indicated that the program did not allow them to build sufficient personal rapport and trust with participating customers. The structure of the program is such that the energy advisor comes to be seen as a trusted and independent advisor rather than someone who is trying to sell something. This dynamic also allows energy advisors to educate

customers about energy use in their homes. Energy advisors noted that they were not encouraged to adequately follow up with customers who have received an audit to encourage them to pursue contractor-installed measures.

   a. **Recommendation:** Provide consistent follow up by energy advisors to encourage measure adoption.

5. **Finding:** Energy advisors note that there is room in the program to expand the list of measures that qualify for program incentives. Part of this unexplored capacity is captured in the array of non-program-qualifying recommendations that energy advisors give to participants.
   a. **Recommendation:** Consider adding measures based on currently unincentivized recommendations that customers are following.
   b. **Recommendation:** The CSP should determine their influence on spillover and encourage this behavior among participants.

3.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 3-8: Smart House Call Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Ensure TRM savings algorithms are updated and applied consistently in reported savings.	Implemented. Changes were made mid-year in PY6 to correct the issue when it was identified on incoming data submissions.
Recommendation 2: Continue the successful marketing message focused on saving money and parse out the direct mailings to promote a manageable rate of program uptake.	Implemented. This message continues to be used in our campaign, but we are analyzing the shelf life of this message through incoming data.
Recommendation 3: Engage more effectively in cross-program promotion by improving the ability of energy advisors to educate the customer in this regard.	Being Considered. Effective marketing for cross-promotions is in the design phase in expectancy of implementation.
Recommendation 4a: Promote a smoother customer experience by improving the quantity and integrated structure of energy advisor and contractor training.	Being Considered. Design and structure review is underway regarding incorporation into the program in other methods than what is used now.
Recommendation 4b: Create a higher degree of teamwork and co-ownership of the program's success for contractors via a more consistent and overarching structure of communicating program updates and logistics.	Implemented. A monthly contractor email from management is sent informing contractors of program updates. Design and offering of co-branded opportunities continue to encourage contractor collaboration.
Recommendation 5: Provide consistent follow up by energy advisors to encourage measure adoption.	Being Implemented. Measure adoption encouragement has been re-emphasized to the Energy Advisors and automated reminders are sent by the Energy Advisors promoting moving forward with recommendations.
Recommendation 6a: Consider adding measures based on currently unincentivized recommendations that customers are following.	Rejected. Although these measures are encouraged by our Energy Advisors to the customer, there is no plan to add measures into the program.
Recommendation 6b: The CSP should determine their influence on spillover and encourage this behavior among participants.	Rejected. Although these measures are encouraged by our Energy Advisors to the customer, there is no plan to add measures into the program.

Source: Navigant analysis and PECO

3.6 FINANCIAL REPORTING

The SHC program continues to underspend its budget allocation, but program savings are further below plan than spending. This yields a higher savings acquisition cost than plan. Based on total budget expenditures for the program, approximately six percent of the program budget is spent on incentives

to customers, with 64 percent and 30 percent going to program administration and marketing, respectively. Whereas the Phase II planned overall acquisition cost is $1.28/kWh, realized acquisition cost in Phase II to date has been $1.86. The program's rapid growth at the end of PY6 yielded favorable acquisition costs. Specifically, the acquisition cost in PY6Q4 was less than half the Phase II average and below the overall Phase II plan average at $1.13/kWh.

In PY5, the program had a low TRC of 0.38 due in part to first-year startup costs paired with a three-month delay in the program's start relative to plan. In PY6, the program had an improved yet still relatively low TRC of 0.56, yielding a Phase II TRC to date of 0.51. This is below the goal of 0.61 as laid out in the March 2014 revision of the Phase II Energy Efficiency and Conservation Plan. A breakdown of the program finances (by program) is presented in Table 3-9.

Table 3-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	1,072	1,322
2	EDC Incentives to Participants	249	321
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	823	1,001
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	3,972	5,861
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	2,710	4,449
8	Marketing[2]	1,262	1,412
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	5,044	7,183
13	Total NPV Lifetime Energy Benefits	2,532	3,256
14	Total NPV Lifetime Capacity Benefits	190	245
15	Total NPV TRC Benefits[4]	2,853	3,667
16	TRC Benefit-Cost Ratio[5]	0.57	0.51

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

4. SMART APPLIANCE RECYCLING

The Smart Appliance Recycling (SAR) program provides PECO's residential and non-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 of 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.

4.1 PROGRAM UPDATES

In PY6, the residential component of the SAR program experienced strong participation. PY6 Q4 had the highest number of appliances recycled in a single quarter since the inception of the program. In Q2, the program increased the available incentive from $35 to $50 and increased the amount of customer outreach done on behalf of the program, which led to the increase in participation. Of PY6 savings, 85 percent came from refrigerator retirement or replacement; ENERGY STAR refrigerator replacement accounted for 51 percent of total energy savings. SAR implementer JACO collected 10,356 refrigerators and 1,807 freezers in PY5. Additionally, 110 refrigerators and 11 freezers were collected from nonresidential customers.

4.1.1 Definition of Participant

For the purposes of this report, a participant in the SAR program is considered to be the appliance recycled. The summary tables in the EDC tracking database count participation as a pickup by JACO, which is less than the number of units recycled.

4.2 IMPACT EVALUATION GROSS SAVINGS

Table 4-1 presents the gross reported energy and demand savings for the SAR program distributed across customer sectors. As the table demonstrates, more than 99 percent of reported program activity through PY6 was in the residential sector, with the remainder in the C&I and GNI sectors.

Table 4-1: Phase II Smart Appliance Recycling Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential	18,724	16,370	2.4	$796
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	121	130	0.0	$5
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	12	12	0.0	$1
Phase II Total	**18,857**	**16,512**	**2.4**	**$802**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: PECO tracking data

4.2.1 Methods

Navigant conducted two activities in its impact evaluation of PY6 program activity. The first activity was a comprehensive engineering review of all measure-specific records in the tracking database to verify proper application of TRM algorithms in reported savings values. Gross energy savings are expressed in terms of full-year unit energy consumption (UEC) values estimated using the 2014 TRM appliance recycling regression model. The 2014 Pennsylvania TRM also has replacement energy consumption values that are subtracted from the UEC of the recycled unit depending on whether the unit was replaced with an ENERGY STAR unit or a non-ENERGY STAR unit. A set of regression equations for refrigerators and freezers is applied to the specific characteristics of units collected by PECO's program during PY6 in order to estimate the UECs. This method applies the regression equation coefficients from the 2014 TRM in order to estimate refrigerator and freezer UECs. This 2014 TRM regression model was developed as part of the national Uniform Methods Project.[20]

Navigant's second evaluation activity was a telephone survey for a sample of PY6 participants. Navigant designed a stratified random sample from the population of program participants in the PY6 tracking database at the measure level.

Full-year UEC values from each method were then adjusted for partial use based on self-reported findings from the completed telephone surveys. This adjustment prorates the full-year value for the proportion of the year that the unit would have operated in the program's absence. The value of this adjustment was calculated directly from phone survey responses regarding the number of months during the year that the participant indicated the appliance would have operated if the program had not picked it up. Average part-use factors were calculated across all respondents, separately for refrigerators and freezers.

Navigant completed telephone surveys of 100 out of 125 participants in the sample (25 customers refused or had missing data). Both of these evaluation activities provided information on the types and quantities of the appliances recycled. 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. The participant sample was a stratified random sample from the population of residential program participants in the PY6 tracking database at the measure level. Once the strata breakpoints were determined and each project was assigned to one of the strata, each project was assigned a random number. The projects were sorted first by stratum and then by random number. The number of projects identified in Table 4-2 was then selected from within each stratum to form the sample.

[20] Uniform Methods Project for Determining Energy Efficiency Program Savings, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. The principal objective for the project was to establish easy-to-follow protocols based on commonly accepted engineering and statistical methods for a core set of commonly deployed energy efficiency measures.

Table 4-2: Smart Appliance Recycling Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Refrigerators n		85%/15%	75	63	Telephone survey
Freezers n		85%/15%	50	37	Telephone survey
Program Total	**5,176**	**85%/15%**	**125**	**100**	
Values in tables may not reconcile as presented due to numerical precision.					

Source: PECO tracking data, Navigant analysis

4.2.1.1 Onsite Inspections

No onsite inspections to confirm measure installation were performed for the SAR impact evaluation. Onsite inspections were not indicated in the evaluation plan.

4.2.2 Results

As Table 4-3Table 16-3 presents, Navigant's analysis resulted in an energy realization rate of 0.90 and verified gross energy savings for PY6 of 8,982 MWh. This is 83 percent of the PY6 SAR target of 10,823 MWh.[21] The realization rate of 0.90 for this program is primarily due to the discrepancy between reported recycling type (retirement versus replacement with ENERGY STAR/non-ENERGY STAR) and telephone survey results. The discrepancy is most likely caused by participants changing their replacement status after the participant submits their program application and before the phone survey. It is possible that some participants were not initially intending to replace the removed refrigerator or freezer, but they later changed their mind. At pickup, customers indicated that 49 percent of refrigerators and 76 percent of freezers would be retired. However, the telephone survey found that only 28 percent of refrigerators and 68 percent of freezers were retired. The differences between the default TRM full-year UEC values that were based on units recycled in PY4 and the values estimated using the regression model equations from the TRM for the PY6 units recycled also contributed to lowering the realization rates.

[21] *PECO Energy Efficiency and Conservation Plan (EE&C)*, p.107, March 2014.

Table 4-3: Program Year 6 Smart Appliance Recycling 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.
Refrigerator Retired	5,258	N/A	0.53	2,780	0.26	4.0%
Freezer Retired	1,348	N/A	0.75	1,010	0.18	4.0%
Refrigerator Replacement, Non-ES	659	N/A	0.52	340	0.26	4.0%
Refrigerator Replacement, ES	2,647	N/A	1.78	4,716	0.26	4.0%
Freezer Replacement, Non-ES	61	N/A	0.22	14	0.18	4.0%
Freezer Replacement, ES	159	N/A	1.25	198	0.18	4.0%
Program Total	**10,133**	N/A	**0.89**	**9,058**	**N/A**	**2.4%**

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis, tracking data

Table 4-4 presents evaluation results for demand reduction with similar realization rates as energy savings.

Table 4-4: Program Year 6 Smart Appliance Recyling Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MWh/yr)	Adjusted Ex-Ante Demand Savings (MWh/yr)	Demand Realization Rate (%)	Verified Gross Demand Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Refrigerator Retired	0.8	N/A	0.53	0.4	0.26	4.0%
Freezer Retired	0.2	N/A	0.75	0.2	0.18	4.0%
Refrigerator Replacement, Non-ES	0.1	N/A	0.51	0.1	0.26	4.0%
Refrigerator Replacement, ES	0.4	N/A	1.78	0.7	0.26	4.0%
Freezer Replacement, Non-ES	0.0	N/A	0.22	0.0	0.18	4.0%
Freezer Replacement, ES	0.0	N/A	1.25	0.0	0.18	4.0%
Program Total	**1.5**	N/A	**0.89**	**1.4**	**N/A**	**2.4%**

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis, tracking data

4.3 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 one 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.

4.3.1 Methods

In late 2013, the SWE initiated a Common Approach to estimating free ridership for all EDCs operating appliance recycling programs.[22] 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. Table 4-5 outlines the PY6 sampling strategy for the SAR program NTG research.

Table 4-5: Smart Appliance Recycling Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Refrigerators	N/A	10,356	0.5	85/15	75	63	52%
Freezers	N/A	1,807	0.5	85/15	50	37	52%
Program Total		**12,163**			**125**	**100**	

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis, tracking data

4.3.2 Results

The NTG ratios calculated for both refrigerators and freezers increased in PY6 compared to PY5 (the first year that the common approach was used). This may be due to the increase in the incentive in PY6. The incentive increase may have motivated participants who otherwise would not have recycled their units to participate in the program. These participants would have had low free ridership rates, thus increasing the overall NTG ratio. Table 4-6 summarizes the evaluation results for the PY6 NTG research.

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

Table 4-6: Program Year 6 Smart Appliance Recycling 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	0.66	N/A	0.34	0.26	3.7%
Freezers	0.59	N/A	0.41	0.18	3.7%
Program Total[1]	**0.65**	**N/A**	**0.35**	**N/A**	**N/A**

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

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of phone survey results

4.3.3 Impact Findings and Recommendations

1. **Finding:** There were some discrepancies between reported recycling type (retirement versus replacement with ENERGY STAR/non-ENERGY STAR) and the telephone survey results, causing a decrease in the realization rate.
    a. **Recommendation:** Navigant recommends that at the point of pickup JACO attempts to confirm the participant's replacement intentions indicated at the point of application. Alternatively, the evaluation team recommends 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.

4.4 PROCESS EVALUATION

Navigant performed the process evaluation using the following methods:

- Interviews of the PECO and implementation program managers
- In-depth interviews with five secondary market actors
- A participant survey of a total of 125 program participants, segmented by refrigerator and freezer replacement

The evaluation team conducted a participant survey for both verification (impact) and process purposes. As described below in Table 4-7, a sample was drawn representing each of the program measures.

Table 4-7: Smart Appliance Recycling Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Refrigerators	N/A	10,356	0.5	85/15	75	75	52%	Impact, NTG, Process
Freezers	N/A	1,807	0.5	85/15	50	50	52%	Impact, NTG, Process
Program Manager	N/A	1	N/A	N/A	1	1	100%	Process
Program Total	**N/A**	**12,164**	**N/A**	**N/A**	**126**	**131 [1]**	**N/A**	**Impact, NTG, Process**

[1] Includes secondary market interviews

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of program tracking data

Overall, the program implementation and administrative processes have not changed greatly in Phase II, with the exception of the increased incentive level in the second quarter of the program year—from $35 to $50. Through the program manager interview, the evaluation team learned that PECO also increased the amount of advertising in PY6. PECO increased the number of bill inserts by 40 percent, increased the SAR media presence through television and radio advertisements, and sent a direct mailing to 400,000 customers. The combination of the increased rebate level and increased marketing contributed to an overall increase in SAR participation in PY6. The increase in participation was especially prevalent in refrigerator and freezer removals, which both experienced a demonstrable increase in the number of participating units after the rebate level was increased.

Program satisfaction remains high for all aspects of the program delivery to participants, and 91 percent of the 125 participants surveyed stated that they were "very likely" to recommend the program to a friend, relative, or colleague.

As part of the PY6 evaluation, Navigant conducted interviews with five secondary market actors, including used appliance dealers and junk removal services. According to the appliance dealers, the SAR program, including the increased rebate, have had a limited effect on the secondary retail market. None of the refrigerators recycled by the program were less than nine years old, and according to the appliance dealers, they would not have considered these units for their inventories and would have recommended other means of disposal. This is consistent with previous research done in the PECO territory.

The SAR program has, however, had an effect on the disposal market for refrigerators and freezers. Navigant interviewed two of the larger junk hauling services in PECO territory, and they reported that the number of refrigerators that they picked up has decreased over the past year, which is when PECO increased the rebate and increased program marketing. Those units would have been recycled by the service since reselling appliances is not part of their business. One of the companies the evaluation team spoke to will actually refer people to the PECO program if they call to have a refrigerator picked up.

4.4.1 Process Findings and Recommendations

1. **Finding:** Program marketing and the program incentive increased in PY6, leading to increased participation and savings.
    a. **Recommendation:** Navigant recommends that the incentive level remain at the $50 level throughout PY7 to maintain the current participation levels. Navigant also recommends that PECO continue to send bill inserts and direct mailings at the more frequent rate adopted in PY6.

4.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 4-8 summarizes Navigant's recommendations and their current status.

Table 4-8: Smart Appliance Recycling Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
Recommendation 1: Navigant recommends that at the point of pickup JACO attempts to confirm the participant's replacement intentions indicated at the point of application. Alternatively, the evaluation team recommends 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.	Implemented. At the time of pick up the CSP confirms the participant's replacement intentions which were initially indicated during the appointment
Recommendation 2: Navigant recommends that the incentive level remain at the $50 level throughout PY7 to maintain the current participation levels. Navigant also recommends that PECO continue to send bill inserts and direct mailings at the more frequent rate adopted in PY6.	Implemented. The incentive level will remain at $50 throughout PY7 with bill inserts continuing to be the primary method of promotion.

Source: Navigant and PECO

4.6 FINANCIAL REPORTING

A breakdown of the program finances by program is presented in Table 4-9.

Table 4-9: Smart Appliance Recycling Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	1,773	2,721
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	1,056	1,718
8	Marketing[2]	717	1,003
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	1,773	2,721
13	Total NPV Lifetime Energy Benefits	5,906	10,094
14	Total NPV Lifetime Capacity Benefits	457	772
15	Total NPV TRC Benefits[4]	6,362	10,866
16	TRC Benefit-Cost Ratio[5]	3.59	3.99

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

5. SMART USAGE PROFILE

The primary goal of the Smart Usage Profile (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 energy efficiency 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 a home energy report (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 participants' circumstances.

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. The abbreviated email reports present the customers' energy usage from the previous month and compare 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 are the primary metric for gauging program success and are determined via a regression analysis performed on the billing records of participant households. Savings from behavioral programs, such as the SUP program, are typically considered to have a one-year lifetime for as long as the reports are being delivered. 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 toward PECO's compliance goals for Phase II, while program savings in PY5 and PY6 will not count toward the compliance goals. Navigant estimates program impacts in this section of the PY6 Annual Report for informational purposes only. The results outlined in this section are not included in the portfolio results seen in Section 1.

5.1 PROGRAM UPDATES

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

5.1.1 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. 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 target SUP program customers as high-use residential customers that receive electricity from PECO.[23] Additionally, as of this evaluation report, eight percent of the SUP program target

[23] PECO defines high usage as greater than or equal to 14,000 kWh per household per year.

population includes low-income customers to result in a target population that is representative of PECO's aggregate low-income customer base.[24]

Prior to the launch of each program year participant wave, 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.[25] Customers assigned to the participant group must opt out if they no longer want to receive the HERs. The evaluation, measurement, and verification industry considers this RCT strategy to be the best way to enable accurate evaluation of the impacts of behavioral programs. [26] The RCT strategy also aids the implementer in monitoring progress toward program goals.

In August 2013, the implementer enrolled 44,796 PECO customers in the first wave treatment group (Wave 1). In June 2014, the implementer enrolled an additional 49,989 customers in a second wave treatment group for PY6 (Wave 2) for a total of 49,785 enrolled participants during the PY6 program year. In June 2015, the implementer also enrolled a third wave of 69,300 participants for PY7 (Wave 3). These participant numbers are higher than PECO's planned participation of 40,000 per wave because the implementer enrolled a higher number of target participants in anticipation of lost savings from attrition and because PECO increased the program's PY7 enrollment to leverage the SUP program's savings predictability across the portfolio.[27]

5.2 IMPACT EVALUATION GROSS SAVINGS

[24] 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.

[25] 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.

[26] 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.

[27] PECO revised its internal Phase II energy savings goal for this program from 20,000 MWh to 27,000 MWh in PY7. However, this evaluation report presents progress against the 20,000 MWh goal to align with the Phase II filed plan.

As mentioned earlier, 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 from the SUP program in PY7 will count toward PECO's compliance goals for Phase II, while program savings in PY5 and PY6 will not count toward the compliance goals. The results outlined in this section are not included in the portfolio results seen in Section 1. Navigant estimates program impacts in this section of the PY6 Annual Report for informational purposes only.

Table 5-1: Phase II Smart Usage Profile Reported Results by Customer Sector [1]

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential	0	0	0.0	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**0**	**0**	**0.0**	**$0**

[1] SUP savings toward Phase II compliance targets will be reported in PY7.

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of program tracking data

5.2.1 Methods

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 eliminated 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 Post, 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, Post Treatment

This is referred to as a one-way fixed-effects model because it includes a household-specific fixed-effects term. Equation 5-1 formally[28] presents the equation for this model.

Equation 5-1. 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).
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. The calculation of the fixed-effect term does not require knowledge of which characteristics at each household are unchanged. The regression model uses billing data to implicitly estimate the aggregate impact upon energy use of all characteristics that are unchanged over time. The particular characteristics that are incorporated into this fixed-effect term for each household will vary and are unknown, but some possible examples include square footage of the dwelling, number of occupants, and indoor temperature preferences. 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 (DID) in average daily kWh use between the participants and non-participants across the pre-program and treatment periods. Consequently, the DID statistic is considered the best indicator of program effects in a program evaluation. The evaluation team generated average savings for PY6 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 PY6.

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 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

[28] 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.

for household-level variation in energy use. Navigant refers 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 shown in Equation 5-2.

Equation 5-2. 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 the course of the program (PY5 or PY6) were omitted from the regression analysis to estimate program effects but were included in the estimate of total program savings for the time prior to when they moved away from PECO territory. 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 the program duration. Table 5-2 summarizes the sampling strategy for the PY6 evaluation.

Table 5-2: Smart Usage Profile Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Wave 1	44,796	N/A	Program census	Program census	Billing analysis of program census
Wave 2	44,989	N/A	Program census	Program census	Billing analysis of program census
Program Total	**89,785**	**N/A**	**Program census**	**Program census**	**N/A**

Source: Navigant analysis of program tracking data

This evaluation uses billing analysis to verify savings; therefore, onsite inspections are not conducted for this program.

5.2.2 Results

5.2.2.1 Double Counted Savings and Channeling Effects

One of the ways the SUP program encourages participants to reduce energy consumption is by channeling them into other energy efficiency programs offered by PECO, notably the SAR, SHC, SHR, Smart Multi-Family (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), as well as to understand the SUP's ability to channel participants into other programs.

For each wave of customers enrolled in the SUP program, Navigant compared the change in the rate of participation for the treatment group and the control group in the 12 months prior to program enrollment and PY6 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 Multi-Family programs did not exist prior to the start of the SUP program in PY5. Therefore, the rate of participation in the pre-program year is set to zero for the DID calculation for HER participant and control households enrolled during PY5. The evaluation team then multiplied the DID statistic by the number of treatment households to get the change in participation in 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 energy efficiency programs since the savings would not have occurred in the absence of either program. The 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,[29] if the 85 percent confidence interval around the estimated uplift includes zero, Navigant concluded there is no evidence of uplift for a given program and did not adjust for DCS.

From a channeling perspective, Navigant concluded that, at this point in time, the SUP program does not appear to be an efficient direct mail marketing channel for other PECO programs, with the exception of LEEP as explained below. Table 5-3 provides the channeling summary, shown as the percent of participants channeled of all SUP participants. The programs included here are those that showed statistical significance in the double counting analysis. Compared to PECO's typical direct mail return rate of one percent, these rates imply that the SUP reports are less effective at channeling participants into other programs than typical direct mail campaigns. To explore whether SUP participants make up a different target market than is typical for the SHC program, Navigant compared responses to the demographics questions in the SUP and SHC surveys; however, response distributions were similar across income, building type, and square footage.

Table 5-3: Share of SUP Participants Channeled into other PECO Programs

Other PECO Program	Share of Wave 1 SUP Participants Channeled into Program (n=44,796)	Share of Wave 2 SUP Participants Channeled into Program (n=44,989)
Smart House Call	0.23%	0.82%
Smart Appliance Recycling	N/A (not statistically different than zero)	0.24%
Smart Home Rebates	0.27%	N/A (not statistically different than zero)

Source: Navigant analysis of program tracking data

Taking a closer look at low-income customers in Wave 1, the SUP program appears to be more successful at channeling participants into the LEEP program. In total, the SUP program channeled 75 participants into LEEP, accounting for 0.17 percent of all participants. Assuming eight percent of participants are low-income customers, the channeling calculates to a two percent response rate, higher than the typical one percent response rate for PECO direct mail campaigns.

5.2.2.2 Opt-Out Rate

The SUP program allows participants to opt out of receiving HERs. Participants that opt out are part of the original RCT design and, therefore, are not excluded from the regression analysis. Navigant's analysis showed that 130 customers opted out of the SUP program during PY6, or approximately 0.2 percent. This rate is low compared to the evaluation team's experience evaluating other opt-out programs. After a participant opts out of receiving the HERs, they may continue to be influenced by their initial exposure

[29] The Statewide Evaluation Team, "Evaluation Framework: For Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs," June 30, 2013.

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.[30] 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 the industry standard.

5.2.2.3 Verified Savings

The verified ex post energy savings in PY6 were 16,891 MWh. A summary of verified ex post SUP program savings is shown in Table 5-4 and Table 5-5.

Table 5-4: Program Year 6 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.
Wave 1	N/A	N/A	6,150	N/A	0.0%
Wave 2	N/A	N/A	10,741	N/A	0.0%
Program Total	**16,555**	**1.02**	**16,891**	**N/A**	**0.0%**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis of program tracking data

Table 5-5: Program Year 6 Smart Usage Profile 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.
Wave 1	0.00	N/A	0.00	N/A	N/A
Wave 2	0.00	N/A	0.00	N/A	N/A
Program Total	**0.00**	**N/A**	**0.00**	**N/A**	**N/A**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis of program tracking data

5.2.3 Impact Findings and Recommendations

[30] The SEE Action protocol refers to this estimate of average savings as the intent to treat estimate.

1. **Finding:** The verified ex post energy savings in PY6 were 16,891 MWh.
    a. **Recommendation:** PECO should continue to monitor SUP channeling effects in PY7 to determine SUP's role in the Phase III plan.

2. **Finding:** From a channeling perspective, Navigant concluded that, at this point in time, the SUP program does not appear to be an efficient direct mail marketing channel for other PECO programs, with the exception of LEEP.
    a. **Recommendation:** PECO should consider adjusting PY7 savings goals for other energy efficiency programs to account for the increased expected savings from the SUP program, as necessary. Because the PY7 wave is in full effect, there are limited adjustments PECO can make to the SUP program before the end of Phase II. To account for the increased savings expected from SUP in PY7, PECO can adjust savings goals and implementation tactics for other programs to ensure alignment with the overall portfolio goal.

5.3 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:

> [Non-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 5-6 and Table 5-7 are not applicable to this program. As a result, the net and gross savings estimates are the same for the SUP program.

Table 5-6: Smart Usage Profile Sampling Strategy for Program Year 6 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
Wave 1	N/A	44,796	N/A	N/A	N/A	N/A	N/A
Wave 2	N/A	44,989	N/A	N/A	N/A	N/A	N/A
Program Total		**89,785**			**0**	**0**	
Values in tables may not reconcile as presented due to numerical precision.							

Source: Navigant analysis of program tracking data

Table 5-7: Program Year 6 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
Wave 1	0	0	1.00	N/A	N/A
Wave 2	0	0	1.00	N/A	N/A
Program Total[1]	**0**	**0**	**1.00**	**N/A**	**N/A**
[1] NTG ratio at the program level should be developed using stratum weight and stratum NTG ratios. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis of program tracking data

5.4 PROCESS EVALUATION

Navigant conducted an in-depth process evaluation in PY6. The process evaluation included interviews with program managers and Opower, as well as a phone survey of a representative sample of participants and non-participants from the control group. The process evaluation explored the following research objectives as noted in the evaluation plan:

- Analyze areas of program success and challenges
- Assess barriers to the program achieving its goals
- Examine opportunities for program improvement
- Understand participant satisfaction and engagement with the program
- Assess any gaps between the program logic and actual performance

5.4.1 Program Theory and Logic Model

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, provide call center support to handle customer inquiries about the program, and provide information technology (IT) resources to assist in managing program data. In addition, PECO corporate communications staff provide 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 energy efficiency, 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 potential with tips. The SUP program's intended outputs 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. The SUP program's 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 energy efficiency partner.

5.4.2 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 PY6 program year as well as the 12 months prior to when each wave of participants began receiving HERs. 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.

5.4.3 Verification and Due Diligence

Navigant conducted participant phone surveys as part of the PY6 evaluation of the SUP program and confirmed that the majority (89 percent, n=472) of the participating households contacted recalled receiving the mailed HERs. Another methodology to confirm 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 where the SUP program was not being executed as designed. As described below, 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 a total of 17,256 customers that had opted out of the SUP

program, moved out of PECO territory, or otherwise became inactive during PY5 and PY6. Data from these households was included in the evaluation for analytical purposes.

5.4.4 Phone Surveys and Staff Interviews

Through a qualified survey house, Navigant conducted a phone survey of SUP treatment and control group customers. 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 completed 450 surveys with contacts within this population (see Table 5-8). In addition to customer phone surveys, Navigant conducted phone interviews with the PECO program manager and the Opower 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.

Table 5-8: Smart Usage Profile Process Sampling Strategy for Program Year 6

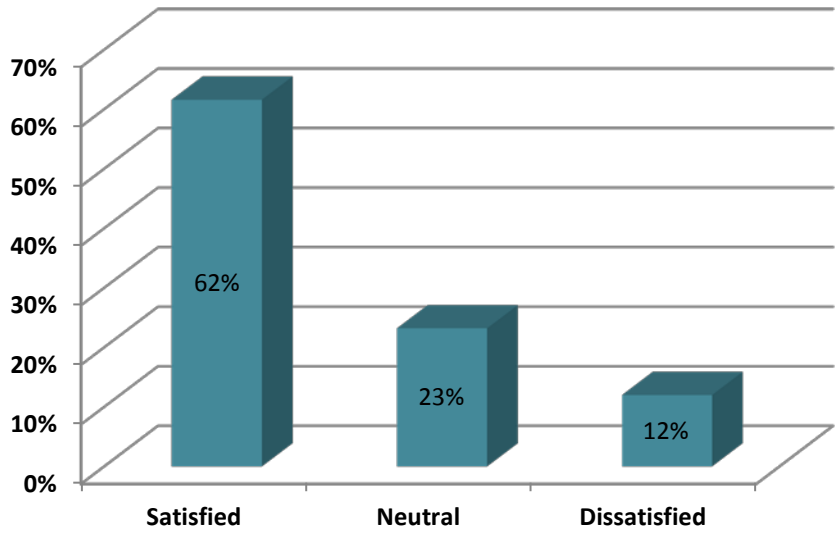
Target Group or Stratum	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Treatment Group	89,785	0.50	85/15	250	250	4%	Phone survey
Control Group	46,749	0.50	85/15	200	200	4%	Phone survey
Program Staff	1	N/A	N/A	1	1	100%	Staff/implementer interviews
Implementer Staff	1	N/A	N/A	1	1	100%	Staff/implementer interviews
Program Total	**136,536**			**452**	**452**		
Values in tables may not reconcile as presented due to numerical precision.							

Source: Navigant analysis of program tracking data

5.4.4.1 Customer Satisfaction and Similar Home Comparisons

The evaluation team found a satisfaction rating of 62 percent based on respondents who rated their satisfaction with the mailed HERs at a four or higher, on a scale from one to five. Figure 5-1 provides a summary of these findings.

Figure 5-1: Participant Satisfaction with Mailed Reports

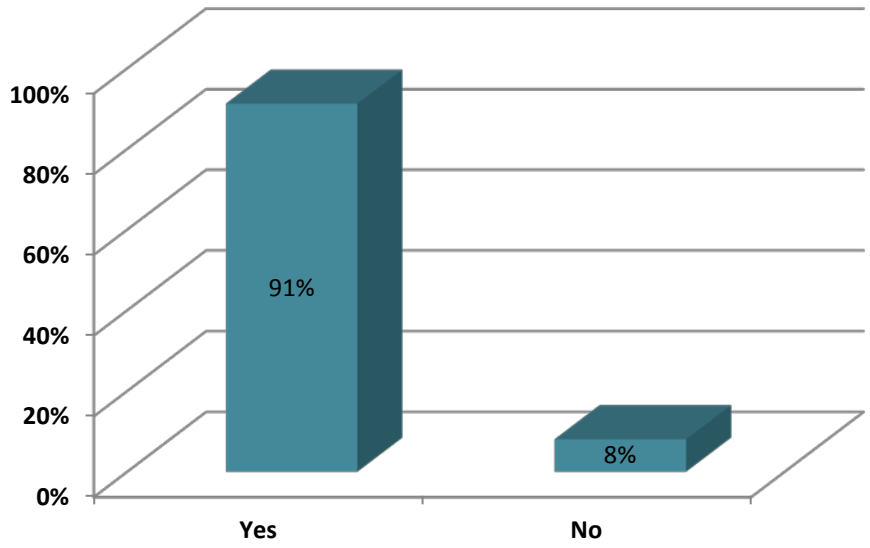


Source: Navigant analysis of survey data

Compared to other HER program evaluations conducted by Navigant, participant satisfaction with the mailed reports was lower than the typical range of 68 percent to 70 percent. This appears to be the exception, as for most of the customer engagement metrics explored in the participant survey, including recall rates and time spent reading the reports, the SUP program is performing within typical ranges expected for this program type. Dissatisfied respondents most frequently commented on their distrust or dissatisfaction with the similar home comparisons and of the information in the reports in general.

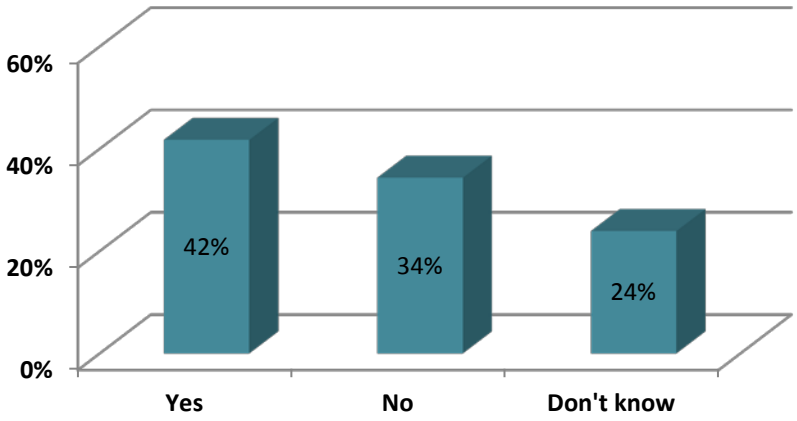
The majority of respondents could recall the neighbor comparison section of the reports, but less than half of them believed the comparison was accurate. Figure 5-2 and Figure 5-3 show that while 91 percent of respondents recalled the home comparison, only 42 percent of that subset believed that their home was being accurately compared in the reports. Of the respondents who said “No” when asked whether they trusted the comparison to a similar home, many indicated that they did not feel their home was comparable to similar homes or did not trust the source of information. A number of respondents made the claim that PECO does not have an accurate record of the square footage of their home or the number of full-time residents, while others commented on the fact that their home has higher or lower than average daily occupancy. This is a typical complaint for HER programs based on similar Navigant evaluations.

Figure 5-2: Recall of Similar Home Comparison



Source: Navigant analysis of survey data

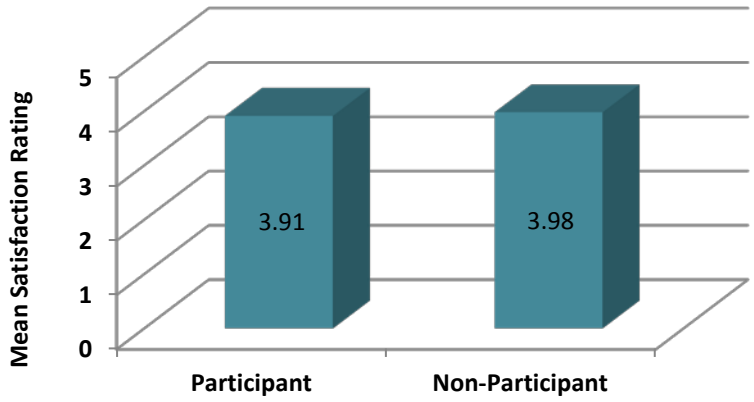
Figure 5-3: Belief in Accuracy of Home Comparison



Source: Navigant analysis of survey data

Respondents reported a similar level of satisfaction with PECO as a company overall, regardless of whether they received the HERs. Although participant satisfaction with the program itself was slightly below the typical range seen for HER programs, respondents still reported a similar level of satisfaction with PECO regardless of participant status. Figure 5-4 shows the mean satisfaction rating given by both participants and non-participants, on a scale from one to five. The differences shown in the figure are not statistically significant. This similarity in satisfaction indicates that the home energy reports have little, if any, impact on customer satisfaction with PECO as a company in either a positive or negative way.

Figure 5-4. Respondent Satisfaction with PECO Overall

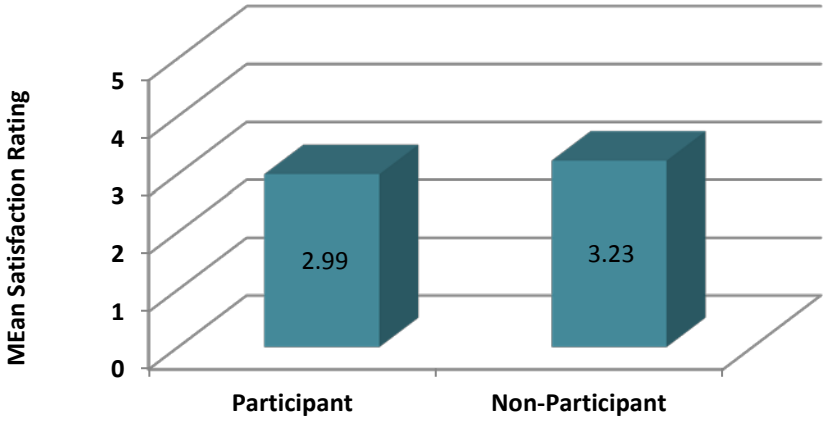


Source: Navigant analysis of survey data

5.4.4.2 Motivation and Engagement with the Program

To test assumptions made in the Program Theory and Logic Model, the evaluation team asked a series of questions about their energy usage. Both participants and non-participants had comparable answers, except for the topic of satisfaction with the amount of energy used in their homes. When asked to rate their level of satisfaction with their home's energy consumption on a scale from one to five, participants expressed a significantly lower level of satisfaction, as shown by Figure 5-5. Participants reported an average satisfaction rating of 2.99, compared to an average rating of 3.23 for non-participants, resulting in a statistically significant difference.

Figure 5-5: Satisfaction with Home Energy Consumption

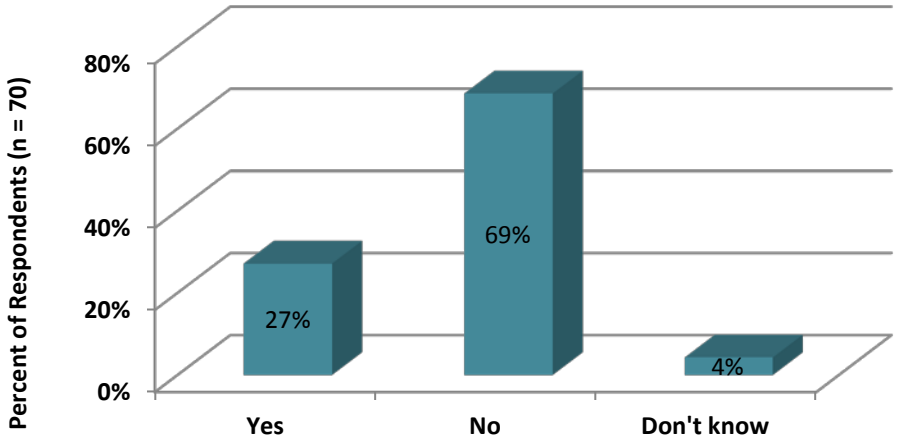


Source: Navigant analysis of survey data

This correlation between participation in the program and satisfaction with energy use suggests that participants are more aware of their usage after receiving the HERs and are, in turn, more likely to be motivated to lower their consumption. This finding shows that participants are well-positioned to engage with PECO on their energy usage based on a desire to lower their overall home energy consumption.

The majority of email recipients did not recall receiving the email reports from PECO. Figure 5-6 shows that of the 70 survey respondents currently receiving the electronic home energy reports, only 27 percent recalled receiving these emails. This finding calls into question the importance of the emails and their larger role in program processes.

Figure 5-6: Recall of Home Energy Report emails



Source: Navigant analysis of survey data

Overall, non-participants reported accessing the PECO web portal more often than participants. PECO offers a web portal at www.PECO.com that allows customers to see a full summary of their bill, including their historical usage data and comparisons to similar homes. According to the SUP Program Theory and Logic Model, the "My Usage" section of the PECO web portal is intended to extend the SUP program information to participants as well as to non-participants. A significantly lower proportion of participant customers reported visiting the portal—56 percent compared to 75 percent of non-participants. This finding suggests that participants feel they are already getting what they need from the printed reports and do not feel the need to turn to the portal for additional information or resources, which goes against the current understanding of program logic.

5.4.5 Process Findings and Recommendations

1. **Finding:** Compared to other HER program evaluations conducted by Navigant, participant satisfaction with the mailed reports was lower than the typical range of 68 percent to 70 percent. Dissatisfied respondents most frequently commented on their distrust or dissatisfaction with the similar home comparisons and of the information in the reports in general. The majority of respondents could recall the neighbor comparison section of the reports, but less than half of them believed the comparison was accurate.
    a. **Recommendation:** PECO should consider requiring the implementer to increase transparency around how they generate information in the reports. Increased transparency would facilitate communication with participants to better build trust in the HERs.

2. **Finding:** The majority of email recipients did not recall receiving the email reports from PECO. A significantly lower proportion of participant customers reported visiting the portal—56 percent compared to 75 percent of non-participants.

a. **Recommendation:** PECO should document clear intentions and metrics for the email and web portal components of the program, especially for Phase III, and set and track goals accordingly.

5.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The recommendations for the SUP program are listed in Table 5-9 along with the PECO status for each recommendation.

Table 5-9: Smart Usage Profile Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Adjust savings goals for other energy efficiency programs to account for the increased expected savings from the SUP program, as necessary. Because the PY7 wave is in full effect, there are limited adjustments PECO can make to the SUP program before the end of Phase II. To account for the increased savings expected from SUP in PY7, PECO can adjust savings goals and implementation tactics for other programs to ensure alignment with the overall portfolio goal.	Being considered. As noted here, the participant pool and goals for the Smart Ideas programs are already set for PY7. These thoughts will be considered for Phase III.
Recommendation 2: PECO should continue to monitor SUP channeling effects in PY7 to determine SUP's role in the Phase III plan.	Implemented. PECO is looking at ways to enhance SUP's channeling ability.
Recommendation 3: PECO should consider requiring the implementer to increase transparency around how they generate information in the HERs. Increased transparency would facilitate communication with participants to better build trust in the reports.	Being considered. We will work with the vendor to attempt to find meaningful ways to increase transparency.
Recommendation 4: PECO should document clear intentions and metrics for the email and web portal components of the program, especially for Phase III, and set and track goals accordingly.	Being considered. PECO is currently working on the Phase III program and will explore better web portal tracking.

Source: Navigant

5.6 FINANCIAL REPORTING

As Table 5-10 demonstrates, the SUP program was slightly cost effective in PY6, with a TRC ratio of 1.00. Throughout all of Phase II, the program is not cost effective yet, with an aggregate TRC ratio of 0.89.

Table 5-10: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	1,779	2,362
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	1,779	2,362
8	Marketing[2]	1	1
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	1,779	2,362
13	Total NPV Lifetime Energy Benefits	1,772	2,091
14	Total NPV Lifetime Capacity Benefits	0	0
15	Total NPV TRC Benefits[4]	1,772	2,091
16	TRC Benefit-Cost Ratio[5]	1.00	0.89

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

6. SMART ENERGY SAVER

The PECO Smart Energy Saver (SES) program seeks to educate fifth through eighth grade students about the benefits of energy efficiency through engaging information and fun, energy-saving activities both in their classrooms and homes. 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, the program to offer educational opportunities about energy efficiency to parents and guardians through their student's participation in the program and that this education will affect their decision-making and energy usage behaviors, causing them to engage with other PECO programs in the future.

The SES program also encourages energy efficiency through the installation of several types of low-cost, energy-efficient measures that are provided to each student through the PECO SES kits. These measures offer simple, direct ways to save energy in each household. 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 likely install the measures.

Overall, the PECO SES program goals include the following:

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

PECO hired a CSP, Research Action Programs (RAP), to implement the program and distribute kits to participating teachers in schools throughout the PECO service territory.[31] RAP worked with PECO to identify and recruit fifth grade teachers into the program and then distribute curriculum materials and take-home kits to the teachers, free of charge. RAP also supplied a slimmed down version of the kits and materials via the PECO Energizing Education Program (PEEP) to sixth through eighth grade classrooms within PECO territory.[32]

To achieve the program goals of energy education, the SES program offers materials for an energy-based classroom curriculum where participating teachers instruct fifth grade students on energy-saving approaches that they can implement in their homes.[33] Each participating student is provided with a take-home kit that includes low-cost, energy-efficient measures and materials designed to raise awareness about how individual actions 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 that explain how to install measures from the take-home kits as well as a list of kid-friendly energy-related

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

[32] Navigant's evaluation included analysis of a student installation survey as well as parent/guardian and teacher survey data from both full (SES) and slimmed down (PEEP) kit recipient households. Navigant also included PEEP teachers in the phone survey completed with a sample of teachers.

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

websites that provide students with additional activities and information. The outside of the kits are branded to promote other PECO energy efficiency programs such as the PECO Smart Home E-Audit and the PECO SAR program. Other utilities, including DTE Energy and ComEd, across the country employ a similar program.

In PY6, the program, through the implementer RAP, distributed full SES take-home kits that included four CFLs (two 13W, one 18W, and one 23W), a low flow showerhead, a faucet aerator, and one LED night light. The program also distributed slimmed-down PEEP kits, which included two 13W CFLs and two LED night lights. The full take-home materials include the following:

- LED Night Light (one for SES kit, two for PEEP kit)
- 13W CFL Bulbs (two for both the SES kit and PEEP kit)
- 18W CFL Bulbs (one, SES kit only)
- 23W CFL Bulb (one, SES kit only)
- Kitchen Aerator (SES kit only)
- Low Flow Showerhead (SES kit only)
- Flow Rate Test Bag (SES kit only)
- Electrical Tape (SES kit only)
- Digital Thermometer (SES 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 energy efficiency program

Each of the kit measures corresponds with a deemed value in the 2014 PA TRM, and the program achieves energy savings from the installation of the items included in the take-home kit. The SES program does not claim savings from behavioral changes that result from program activities.

The program materials, and subsequently the teachers, encourage students to install the measures included in the take-home kits and complete an installation survey noting which measures they installed. Teachers who returned at least 80 percent of their students' installation survey data received a grant for $50 to use for materials or activities in their classrooms. The take-home kits also include information about PECO's energy efficiency 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 program feedback, as well as household contact information for follow-up surveys.

6.1 PROGRAM UPDATES

PECO launched the SES progam in PY5. Slight changes were made to the program as a result of the PY5 evaluation, including offering an incentive to encourage parents to return surveys in the kits, changes to the questions asked in the student installation surveys, and updates to the inputs used in the ex ante calculations. None of these changes resulted in notable divergence from the program offering outlined in the Phase II plan.

6.1.1 Definition of Participant

PECO defines participation based on the number of take-home kits distributed. One kit is equal to one participant. For the full SES kit distribution, the 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 energy efficiency.[34] The program also targets sixth through eighth grade students with the slimmed-down PEEP kits. By sending efficiency measures and information home with students, the program is, by extension, targeting the parents and guardians of these students as an additional audience.

6.2 IMPACT EVALUATION GROSS SAVINGS

During Phase II, the SES program has served 25,503 participants and reported residential sector savings of 6,232 MWh/yr and 0.5 MW, as reported in Table 6-1.

Table 6-1: Phase II Smart Energy Saver Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential	25,503	6,232	0.5	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**25,503**	**6,232**	**0.5**	**$0**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of program tracking data

6.2.1 Methods

Navigant verified that in PY6 RAP distributed 7,951 SES (full) kits and 4,968 PEEP (slimmed down) kits. These 12,919 kits were distributed to 269 teachers across 129 schools. Of the 12,919 take-home kits that were distributed, the program received 4,197 (32 percent) of the student installation surveys back from participating teachers. In comparison, the overall survey return rate in PY5 was 42 percent. The installation survey return rate by kit type is indicated in Table 5-2, in the column titled "Achieved Sample Size."

Table 6-2: Smart Energy Saver Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
PEEP Participants	4,968	85/15	4,968	873	Gross impact evaluation
SES Participants	7,951	85/15	7,951	3,324	Gross impact evaluation
Program Total	**12,919**		**12,919**	**4,197**	

Values in tables may not reconcile as presented due to numerical precision.

[34] Based on the implementer interview with RAP.

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 2014 PA TRM. Through the installation surveys, the students provided information about how many and which of the take-home kit measures were 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 2014 PA TRM.

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 the TRM dictates that data collection can be used to update values and when the evaluation team was confident in the data supplied by the installation survey.

No onsite inspections to confirm measure installation were performed for the SES impact evaluation. Onsite inspections were not indicated in the evaluation plan and would only be able to be performed for the households where a parent or guardian returned the parent/guardian survey providing contact information. Only 206 parents/guardians returned these surveys, which would have led to a very limited sample.

6.2.2 Results

Navigant verified PY6 gross savings for the SES program as 2,611 MWh/year and 0.25 MW, as shown in Table 6-3 and Table 6-4. The energy realization rate attributed to this program was 1.35, as indicated in Table 6-3, and the peak demand realization rate attributed to this program was 1.52, as indicated in Table 6-4. The high realization rate for the SES program was attributable to the following factors:

- A change between the ex ante calculations and the ex post calculations in how the In Service Rate (ISR) for CFLs is defined. In the PY5 evaluation, Navigant recommended that PECO use the student installation survey installation rates as a replacement for the ISR; the 2014 PA TRM no longer allows for this adjustment. Therefore, the ISR used in the ex post calculations was higher than the installation rates used to calculate the ex ante savings and resulted in a higher energy savings per measure for the CFL measures.
- The determination through this year's survey that the kit-provided LED night lights were, in 61 percent of cases, not replacing existing night lights. This finding caused an adjustment to the baseline wattage used in the energy savings calculation from 7W to 2.7W and a reduction in the energy savings possible through the LED night light measure.
- A change in the TRM that allowed for user-defined data to replace the number of persons per household for the low flow showerhead and faucet aerator measures. Through the student installation surveys it was determined that the SES population has an average of 4.7 persons/home for single family and 5.0 persons/home for multi-family as compared to the TRM-default values of 2.7 persons/home for single family and 2.6 persons/home for multi-family. It makes sense that the SES program population has a significantly higher average person to home ratio because this population was made up of homes with at least one school age child. The higher number of persons per home in the SES population increased the savings achievable through the low flow showerhead and faucet aerator measures.

Table 6-3: Program Year 6 Smart Energy Saver Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Adjusted ExAnte 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.
13W CFL	478	478	1.75	838	0.71	1.2%
18W CFL	111	111	1.47	163	0.95	2.5%
23W CFL	151	151	1.40	211	1.03	2.7%
LED Night Light	381	381	0.35	132	0.55	1.2%
Low Flow Showerhead	493	493	1.81	893	1.18	3.1%
Faucet Aerator	318	318	1.17	373	1.10	2.9%
Program Total	**1,932**	**1,932**	**1.35**	**2,611**	**N/A**	**1.0%**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant analysis of program tracking data

Table 6-4: Program Year 6 Smart Energy Saver Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	Adjusted ExAnte Demand Savings (MW) [OPTIONAL COLUMN]	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.
13W CFL	0.05	0.05	1.23	0.06	N/A	1.2%
18W CFL	0.01	0.01	1.36	0.02	N/A	2.5%
23W CFL	0.02	0.02	1.34	0.02	N/A	2.7%
LED Night Light	0.00	0.00	N/A	0.00	N/A	0.0%
Low Flow Showerhead	0.04	0.04	2.14	0.09	N/A	3.1%
Faucet Aerator	0.04	0.04	1.42	0.06	N/A	2.9%
Program Total	**0.16**	**0.16**	**1.52**	**0.25**	**N/A**	**1.2%**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*						

Source: Navigant analysis of program tracking data

6.2.3 Impact Findings and Recommendations

1. **Finding:** The high realization rate for the SES program was attributable to the following factors: the ISR used in the ex post CFL calculations was higher than the installation rates used to calculate the ex ante savings and resulted in a higher energy savings per measure for the CFL measures; the determination through this year's survey that the kit-provided LED night

lights were, in 61 percent of cases, not replacing existing night lights; and a change in the TRM that allowed for user-defined data to replace the number of persons per household for the low flow showerhead and faucet aerator measures.

a. **Recommendation:** RAP should adjust inputs to the ex ante calculations based on the impact evaluation findings. The ex ante calculation inputs should be adjusted to better align with the requirements of the 2014 PA TRM and take into account the PY6 survey findings. The ex ante calculations should be adjusted for CFL ISRs, for LED night light base wattage, and for the number of persons per household for low flow showerheads and faucet aerators. Adjustments to the ex ante calculation inputs will help to better estimate the PY7 ex post results and achieve a realization rate in PY7 that is closer to 1.0.

b. **Recommendation:** PECO program managers should decide whether LED night lights belong in the distribution kit when the majority have been installed where no night light had previously been installed. The LED night light measure is the one with the lowest savings per unit. While the savings on this measure were always low, the savings were significantly reduced by the PY6 survey finding that the majority of the LED night light measures were not replacing existing night lights. Removing the LED night light measure could increase the cost-effectiveness of the kits.

6.3 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.

Net impacts were not stated as an evaluation goal for the PY6 evaluation cycle. As such, no estimates can be made as to the estimated program free ridership or spillover and no NTG value was calculated, as reflected in Table 6-5 and Table 6-6. However, a concluding question in the student installation survey does point to whether families changed the way that they used energy as a result of their child's participation in the SES program. This should be treated as anecdotal evidence that does not point to a finding of either free ridership or spillover, but 72 percent of the students indicated that the SES program helped their family change the way that they used energy.

Table 6-5: Smart Energy Saver Sampling Strategy for Program Year 6 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
Program Total	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant

Table 6-6: Program Year 6 Smart Energy 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
Program Total	N/A	N/A	N/A	N/A	N/A

Source: Navigant

6.4 PROCESS EVALUATION

The SES program process evaluation included a review of program materials (returned student installation surveys, teacher surveys, and parent surveys), interviews with program managers and RAP, and interviews with participating teachers, as shown in Table 6-7. The broad goals of the process evaluation included identifying qualitative trends among customer satisfaction and experience with the program.

Table 6-7: Smart Energy Saver Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Teachers	Above 80% student survey return rate	79	0.5	85/15	3	5	23%	Teacher interviews
Teachers	1%-79% student survey return rate	34	0.5	85/15	3	7	29%	Teacher interviews
Teachers	0% student survey return rate	156	0.5	85/15	4	3	11%	Teacher interviews
Program Staff	N/A	2	N/A	N/A	2	2	100%	Staff/implementer interviews
Implementer Staff	N/A	1	N/A	N/A	1	1	100%	Staff/implementer interviews
Program Total	**N/A**		**N/A**	**N/A**	**13**	**18**		
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant

The process evaluation activities, including the review of program materials and the interviews with the program implementer, program staff, and the participating teachers led to a few significant findings. These findings generally fall into two categories: program design and participant engagement. These two topic areas will be explored in greater detail below.

6.4.1 Program Design

Through the 15 interviews completed with participating teachers, it was clear that the teachers were engaged with and grateful for the SES program. It is important to note that Navigant attempted to reach

teachers with greater and lesser levels of program participation through the phone surveys. Using the student installation survey return rate as a metric to measure engagement, the evaluation team attempted to contact teachers who had returned more than 80 percent of the student surveys from the kits they had received, those that returned one percent to 79 percent, and those who returned zero percent of the student surveys, as indicated in Table 6-7.

Navigant was able to interview a greater number of teachers than what was targeted within each of the strata where teachers had returned some of the student installation surveys but was unable to meet the targeted number of four within the group of teachers who showed up in the program documentation as returning no student installation surveys. The three teachers who were reached in this group also indicated that they had returned student installation surveys, which means they may have done so after the sample was pulled. Therefore, the process evaluation team was not able to talk to any teacher who indicated they did not return any student surveys in order to understand why. Though the teacher phone interviews were not able to approach quite as diverse of a group of teachers as hoped, the interviews did lead to some interesting findings on program design issues, including English comprehension, parental consent, and the methodology for completing student installation surveys.

6.4.1.1 English Comprehension

Multiple teachers indicated that many of the students in their classrooms have parents with low levels of English comprehension. These teachers struggle to get any homework assignment back, so one that requires a parent to understand and support the child's efforts is particularly challenging.

6.4.1.2 Parental Consent

Of the 15 teachers reached in the phone survey, two indicated that they required some type of parental consent before the students were sent home with the kits. By requiring parental consent teachers are building an additional barrier to program participation. The teachers who indicated that they had required some level of parental consent also indicated that they had kits left over at the end of the program. These teachers had concerns over sending the kits back to the program because they felt it may reflect poorly on them and their schools and may limit their ability to receive kits in the future. Additionally, one of these teachers indicated that they asked all of the students, even those who had not brought kits home, to complete the installation survey as a class activity, which leads to the inclusion of bad data on installation rates in the program data.

6.4.1.3 Methodology for Completing Student Installation Surveys

The one teacher who indicated that they had asked all students to fill out the student installation surveys, even those who had not taken kits home, was particularly troubling because these surveys being included in the program data could result in bad savings assumptions. Additionally, a few teachers indicated that they had their students complete the installation surveys in the classroom rather than at home with their parents, as the program is designed. While this is not necessarily troubling, it is an indication that the SES program functions differently in practice than the assumed design. Since no data on how the installation survey is completed is currently collected on a broader scale, the evaluation could not explore whether the difference in methodologies for survey completion has any impact on the data being collected.

6.4.2 Participant Engagement

Participant engagement was not directly measured through the SES program; however, in order to understand participant engagement, Navigant used the surveys returned through each of the various channels. Navigant made the assumption that if program participants returned surveys through program

channels then they were seen as engaged in program activities. However, the PY6 SES program saw low levels of participant engagement, including a 32 percent return rate on student surveys, a 25 percent return rate on teacher satisfaction surveys, and a two percent return rate on parent satisfaction surveys. If the main goal of the program was energy savings, these low return rates would be insignificant because they are large enough to provide statistical significance. The evaluation team believes, however, that they are indicative of a larger problem with participant engagement in the SES program.

The 32 percent return rate for student installation surveys is lower than any other similar program reviewed by Navigant. The assumption used for all program evaluation activities is that the other 68 percent of the population that did not return student installation surveys is representative of the 32 percent that did return surveys. While this has been proven by the Navigant team for similar programs, the analysis was always completed where more than 50 percent of the student installation surveys were returned for the program. There is some hesitation that the 32 percent of the student program participants who returned surveys for this program were representative of the other 68 percent of program participants. Either way, it is clear to the Navigant team that participant engagement is a missing link in the PECO SES program. While program activities indicate that energy savings are taking place, there are concerns around whether these energy savings equate to participant engagement that may link to other PECO program activity.

6.4.3 Process Findings and Recommendations

1. **Finding:** Multiple teachers indicated that many of the students in their classrooms have parents with low levels of English comprehension. These teachers struggle to get any homework assignments back, so one that requires a parent to understand and support the child's efforts is particularly challenging.
    a. **Recommendation:** RAP should work to increase student installation survey comprehension via graphics and vocabulary lists. Every effort should be made to ensure that the English comprehension skills of the parent do not limit the ability to complete the assignment. Navigant recommends building graphics and vocabulary lists that support an understanding of program activities rather than just using the graphics as colorful additions to the page.

2. **Finding:** The teachers who indicated that they required some level of parental consent also indicated that they had kits left over at the end of the program. These teachers had concerns about sending the kits back to the program because they felt it may reflect poorly on them and their schools and may limit their ability to receive kits in the future.
    a. **Recommendation:** RAP should encourage teachers to send back any unused kits at any time throughout the program so that the program can accurately track what is installed in student homes. In order for the program to accurately track savings, it is imperative that the program fully understand which kits are making it into student's homes and which are not. RAP should be clear with teachers that sending back unused kits will not reflect poorly on them; rather, it will allow the program to more accurately collect data to understand the program's impacts.

3. **Finding:** Since no data on how the installation survey is completed is currently collected on a broader scale, the evaluation could not explore whether the difference in methodologies for survey completion had any impact on the data that was collected.
    a. **Recommendation:** RAP should add a few questions to the teacher satisfaction survey in order to gather additional data on the methodology used to collect data through the student installation surveys. These changes will help the evaluation team understand

where the student surveys are completed: in the classroom or at home. This change has been made, and the evaluation team will have data in PY7 to evaluate whether the way that the student installation survey data is collected has an impact on the overall quality of the data.

4. **Finding:** While program activities indicate that energy savings are taking place, there are concerns around whether these energy savings equate to participant engagement that may link to other PECO program activity.
    a. **Recommendation:** PECO program managers should adopt changes to program activities and activity tracking if the benefit of channeling needs to be quantified. The evaluation team recognizes that program participants illustrate low levels of program engagement through their interaction with the SES program. As such, the SES program should not be recognized as a program that channels participants to other PECO programs. If PECO would like to understand how effective the program is at channeling, the program managers will have to consider adopting changes to program activities and activity tracking to quantify activities through verifiable means.

6.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The recommendations for the program are listed in Table 6-8 along with the PECO status for each recommendation.

Table 6-8: Smart Energy Saver Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1a: Adjust inputs to the ex ante calculations based on the impact evaluation findings.	Implemented.
Recommendation 1b: Decide whether LED night lights belong in the distribution kit when the majority are installed where no night light had previously been installed.	Being considered. Measures already set for PY7.
Recommendation 2: Increase student installation survey comprehension via graphics and vocabulary lists.	Being considered. Curriculum and surveys already set for PY7.
Recommendation 3: Encourage teachers to send back any unused kits at any time throughout the program so that the program can accurately track what is installed in student's homes.	Implemented. Vendor has increased communications to teachers regarding the return of unused kits.
Recommendation 4: Gather additional data on the methodology used to collect data through the student installation surveys.	Implemented
Recommendation 5: Adopt changes to program activity tracking and activities if the benefit of channeling needs to be quantified.	Being considered. Will look into adopting changes to program activity tracking.

Source: Navigant and PECO

6.6 FINANCIAL REPORTING

As Table 6-9 demonstrates, the SES program continued to be cost-effective in PY6 and for Phase II, with a TRC ratio of 4.16 for PY6 and 3.90 for Phase II overall.

Table 6-9: Summary of SES Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	0	0
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	483	901
8	Marketing[2]	0	0
9	EDC Evaluation Costs	**0**	**0**
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	**0**	**0**
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	483	901
13	Total NPV Lifetime Energy Benefits	1,768	3,098
14	Total NPV Lifetime Capacity Benefits	104	165
15	Total NPV TRC Benefits[4]	2,009	3,517
16	TRC Benefit-Cost Ratio[5]	4.16	3.90

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

7. 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, including a base rebate of $400 per home, plus $0.10 per kWh of savings achieved.

7.1 PROGRAM UPDATES

After difficulties recruiting builders willing to build electrically heated, ENERGY STAR-certified homes in PY5, the program was expanded to allow gas-heated homes in PY6. Gas-heated homes contribute less electric savings from HVAC and shell measures, though significant energy savings still exist from cooling, lighting, and domestic hot water measures. This change represents a divergence from the program offering outlined in the Phase II plan in order to meet Phase II savings targets, which appears likely at the current pace.

7.1.1 Definition of Participant

The target market for participation in the SBR program is primarily residential builders and Home Energy Raters. All newly constructed, residentially metered single-family homes in PECO's service territory are eligible to participate. A participant in the SBR program is defined as a home achieving ENERGY STAR certification through the program.

7.2 IMPACT EVALUATION GROSS SAVINGS

During Phase II, the SBR program served 90 participants and has reported residential sector savings of 225 MWh/yr and 0.1 MW, as reported in Table 7-1.

Table 7-1: Phase II Smart Builder Rebates Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential	90	225	0.1	$59
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**90**	**225**	**0.1**	**$59**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of program tracking data

7.2.1 Methods

The impact evaluation consisted of desk reviews of project REM/Rate files and building simulation modeling. The impact evaluation sampling strategy is shown in Table 7-2. Navigant used two main approaches for evaluating projects:

1. **Desk review**. Navigant reviewed REM/Rate models and prescriptive measures (lighting and domestic hot water) for compliance with the 2014 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 a sample of 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.

Table 7-2: Smart Energy Saver Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Custom (HVAC and Shell) Savings	88	85/15	10	10	Gross impact evaluation
Prescriptive (Lighting and Appliance) Savings	88	85/15	88	88	Gross impact evaluation
Program Total	**176**		**98**	**98**	
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis of program tracking data

Navigant reviewed REM/Rate models, tracking data, prescriptive measure savings calculations (lighting and domestic hot water heating, or DHW), and supporting files for compliance with the 2014 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. Navigant found, however, 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. The difference between the TRM verified savings and ICF's standard protocol savings is reflected in the program realization rate.

No onsite inspections were conducted.

7.2.2 Results

The verified PY6 gross savings for the SBR program were 224 MWh/year and 0.1 MW. The energy savings realization rate attributed to this program was 102%, as indicated in Table 7-3. The high

realization rate for the SBR program is attributed to the fact that ex ante and ex post savings estimates were both calculated using DOE-2-based modeling software with identical inputs.

Table 7-3: Program Year 6 Smart Builder Rebates 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.
Custom	140	103%	145	0.10	4.8%
Prescriptive	79	100%	79	0.00	0.0%
Program Total	**219**	**102%**	**224**	**N/A**	**3.1%**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis of program tracking data

The peak demand savings realization rate attributed to this program was 92%, as indicated in Table 7-4. The lower realization rate for the SBR program is attributed to the fact that ex ante peak demand savings were not calculated using TRM methods. The TRM protocol specifies the use of a coincidence factor to derive coincident peak demand savings from non-coincident savings generated from REM/Rate models. However, ICF calculates savings using a proprietary building simulation model that provides 8,760 hourly simulation, from which peak demand savings can be extracted directly for the PJM peak period. While ICF's method provides a more accurate result, the TRM protocol does not currently allow for this method.

Table 7-4: Program Year 6 Smart Builder Rebates 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.
Custom	0.1	91%	0.1	0.33	15.7%
Prescriptive	0.0	100%	0.0	0.00	0.0%
Program Total	**0.1**	**92%**	**0.1**	**N/A**	**13.9%**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis of program tracking data

7.2.3 Impact Findings and Recommendations

1. **Finding:** The lower realization rate for SBR program demand savings is attributed to the fact that ex ante peak demand savings were not calculated using TRM methods. ICF calculates savings using a proprietary building simulation model that provides a more accurate result; however, the TRM protocol does not currently allow for this method.
   a. **Recommendation:** ICF needs to incorporate PA TRM savings calculations for domestic hot water heaters into their tracking system in PY7.

b. **Recommendation:** ICF needs to follow PA TRM protocols for modeled demand savings, using the deemed coincidence factor, until an errata correction can be made to TRM protocols.

7.3 IMPACT EVALUATION NET SAVINGS

The three residential builders that participated in PY6 did not provide a sufficiently large sample for meaningful NTG analysis. Navigant will conduct an NTG evaluation in PY7 when the program will likely have between 20 and 40 participants and will offer a sample large enough for a robust NTG analysis.

7.4 PROCESS EVALUATION

Navigant conducted a limited process evaluation in PY6 because there were no significant changes to program processes and not enough program participants to justify participant surveys. The following section describes the activities conducted as part of the PY6 process evaluation of the SBR program.

The principal data source contributing to the process evaluation was 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, program management, and identified areas for program improvement.

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 used by the evaluation team to collect all necessary data regarding program implementation in PY6, as well as to discuss research areas of particular interest to program and implementation staff. Table 7-5 provides the detail for the process evaluation activities.

Table 7-5: Smart Builder Rebates Sampling Strategy for Program Year 6

Target Group or Stratum	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	Used For Evaluation Activities (Impact, Process, NTG)
Program Staff	1	N/A	N/A	1	1	100%	Staff/implementer interviews
Implementer Staff	1	N/A	N/A	1	1	100%	Staff/implementer interviews
Program Total	**2**	**N/A**	**N/A**	**2**	**2**		
Values in tables may not reconcile as presented due to numerical precision.							

Source: Navigant

7.4.1 Process Findings and Recommendations

There were no significant changes to SBR program processes in PY6, aside from the introduction of gas-heated homes. Marketing activities primarily focused on direct outreach to recruit new builders through in-person meetings and builder events. The program was only able to recruit three new builders in PY6.

Program staff have had limited success overcoming builders' barriers to entry into the efficient new home building market. The main barrier is that few builders have experience building to ENERGY STAR standards in PECO's service territory. In addition, most builders are reluctant to bear the financial risk of

adjusting building practices to meet program standards and gain experience at the current incentive levels. The largest participant in the program decided to stop building ENERGY STAR homes because the incentives were insufficient.

The expansion of program eligibility requirements to allow gas-heated homes generated significant additional participation in PY6. This additional participation primarily consisted of small townhomes and multi-single developments, for which the incentive offset a greater portion of the incremental participant cost. It is likely that this program change will allow the program to meet its Phase II savings targets.

1. **Finding:** Current incentive levels are insufficient to attract new builders to the program. Considering local builders' inexperience building to ENERGY STAR standards, higher incentives will be necessary stimulate market development in these early years of the program.
    a. **Recommendation:** PECO should increase the base incentive amount from $400/home to at least $750/home, while retaining the additional $0.10/kWh.
    b. **Recommendation:** PECO should offer a variable incentive structure based on building type with lower base incentives for multifamily units, and higher base incentives for multi-single and single-family homes.

7.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The recommendations for the SBR program are listed in Table 7-6 along with the PECO status for each recommendation.

Table 7-6: Smart Builder Rebates Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1a: Use the PA TRM algorithm for DHW savings calculations in PY7.	This recommendation has been implemented.
Recommendation 1b: Use the PA TRM algorithm for modeled demand savings until an errata correction can be made to TRM protocols.	In progress. PECO is following this recommendation.
Recommendation 2a: PECO should increase the base incentive amount from $400/home to at least $750/home, while retaining the additional $0.10/kWh.	PECO recommends increasing the base incentive amount from $400/home to at least $750/for single homes, while retaining the additional kWh of$0.10 with the flexibility to increase to $0.20 per Kwh savings as the budget allows.
Recommendation 2b: PECO should offer a variable incentive structure based on building type with lower base incentives for multifamily units, and higher base incentives for multi-single and single-family homes.	PECO agrees we should offer additional tiered incentives. PECO will investigate this recommendation of a less stringent pathway to allow builders to participate who are not yet willing or able to build to ENERGY STAR standards.

Source: Navigant and PECO

7.6 FINANCIAL REPORTING

As Table 7-7 demonstrates, the SBR program achieved a TRC ratio of 0.43 in PY6. The primary driver of this low TRC in PY6 was high program overhead, due in part to the higher outreach burden while gaining traction in a difficult market. Participant costs are also high relative to savings for gas-heated homes. In Phase III, gas benefits will be included in the TRC test, which should significantly improve the result.

Table 7-7: Smart Builder Rebates Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$239	$245
2	EDC Incentives to Participants	$0	$0
3	EDC Incentives to Trade Allies	$57	$59
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$182	$186
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$367	$651
6	Design & Development	$0	$0
7	Administration, Management, and Technical Assistance[1]	$282	$529
8	Marketing[2]	$85	$122
9	EDC Evaluation Costs	$0	$0
10	SWE Audit Costs	$0	$0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$607	$895

13	Total NPV Lifetime Energy Benefits	$213	$218
14	Total NPV Lifetime Capacity Benefits	$38	$38
15	Total NPV TRC Benefits[4]	$258	$265
16	TRC Benefit-Cost Ratio[5]	0.43	0.30

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile due to numerical precision.

Source: Navigant analysis

8. LOW INCOME ENERGY EFFICIENCY PROGRAM

In PY6, the Low Income Energy Efficiency Program (LEEP) continued operating much as it has since the program's inception, while continuing to explore ways to broaden and deepen the program's impacts. The number of participants increased from PY5 to PY6 as did CFL distribution and refrigerator replacements.

8.1 PROGRAM UPDATES

- The LEEP surpassed the savings from PY5 and achieved 18,971 MWh/year.
- CFLs continued to account for the majority of savings in PY6. CFL bulb distribution accounted for 56 percent of the overall energy savings per year.
- Components 2, 3, and 4 saw an increase in savings from PY5 to PY6. There was also a slight increase in the number of participants from PY5 to PY6.

8.1.1 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 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. The LEEP components and their target markets are described in Table 8-1 and in the text below.

Table 8-1: Low-Income Energy Efficiency Program Components

Component	Target Market	Measures
1	PECO residential customers with a household income at or below 150 percent of the Federal poverty level.* Household usage levels must exceed 600 kWh per month for electric baseload customers (500 kWh for Customer Assistance Program, or 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 Low Income Usage Reduction Program (LIURP) during PY1- to PY6.	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 replacements
*For the purposes of meeting PECO's 4.5 percent low-income savings requirement, PECO will only count savings generated by households at or below 150 percent of the Federal Poverty Income Guidelines. *Values in tables may not reconcile as presented due to numerical precision.*		

Source: PECO LEEP program documentation

Market for Component 1: PECO residential customers with a household income at or below 150 percent of the Federal poverty level (FPL),[35] plus the LEEP requirement of household usage levels that exceed

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

monthly average usage of 600 kWh per month for electric baseload (500 kWh for CAP low-income discount rate customers) for non-electric heating customers and 1,400 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 to PY7.

Market for Component 3: PECO residential electric customers with a household income at or below 150 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 150 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.

8.2 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 8-2.

Table 8-2: Phase II Low-Income Energy Efficiency Program 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	$0
Low-Income	19,539	33,098	3.6	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**19,539**	**33,098**	**3.6**	**$0**

*Included participants and savings from all LEEP components

** All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of PECO LEEP PY6 tracking database

8.2.1 Methods

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. Telephone survey verifications were conducted on a sample of participants, as seen in Table 8-3.

Table 8-3: Low-Income Energy Efficiency Program Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Component 1	10,429	85/15	50	50	Telephone survey
Component 3	16,683	85/15	50	50	Telephone survey
Component 4	3,613	85/15	25	25	Telephone survey
Program Manager Interview	1	N/A	1	1	Telephone survey
Program Total	**30,726**	**85/15**	**126**	**126**	
Values in tables may not reconcile as presented due to numerical precision.					

Source: Naviant Analysis

8.2.1.1 Onsite Inspections

No onsite inspections to confirm measure installation were performed for the LEEP impact evaluation. Onsite inspections were not indicated in the evaluation plan.

8.2.2 Results

Table 8-4 and Table 8-5 show the verified energy and demand savings, respectively, by component and component type. Component 3 contributed the largest portion of gross and verified program savings in PY6. Component 3 also had a realization rate of 1.00. Component 1 contributed the next largest portion of gross and verified program savings. The overall program realization rate was 0.99.

Table 8-4: Program Year 6 Low-Income Energy Efficiency Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Adjusted ExAnte 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 Baseload	3,867	N/A	0.96	3,696	0.17	4.0%
Electric Heat	1,62	N/A	0.97	1,127	0.17	4.0%
Component 2	962	N/A	0.95	912	N/A	N/A
Component 3	10,609	N/A	1.00	10,609	0.30	7.0%
Component 4	2,372	N/A	1.00	2,372	0.40	0.0%
Program Total	**18,971**	**N/A**	**0.99**	**18,716**	**N/A**	**4.0%**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant analysis of PECO LEEP PY6 tracking database

Table 8-5: Program Year 6 Low-Income Energy Efficiency Program Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	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.
Electric Baseload	0.54	N/A	0.96	0.52	0.17	4.0%
Electric Heat	0.13	N/A	0.97	0.13	0.17	4.0%
Component 2	0.12	N/A	0.95	0.12	N/A	N/A
Component 3	1.37	N/A	1.00	1.37	0.30	7.0%
Component 4	0.36	N/A	1.00	0.36	0.4	0.0%
Program Total	2.52	N/A	0.99	2.49	N/A	4.0%

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of PECO LEEP PY6 tracking database

8.3 IMPACT EVALUATION NET SAVINGS

Navigant assumed an NTG ratio of 1.0, as in prior years, because low-income customers typically do not have the resources to install energy efficiency measures.

Table 8-6: Low-Income Energy Efficiency Program Sampling Strategy for Program Year 6 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
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

Table 8-7: Program Year 6 Low-Income Energy Efficiency Program 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

8.4 PROCESS EVALUATION

Navigant performed the LEEP process evaluation using the following methods:

- Interviews with the PECO and implementation program managers
- Ride-along observations of 24 homes receiving Component 1 audit/education visits
- A participant survey of a total of 125 program participants from Components 1, 3 ,and 4

The evaluation team conducted a participant survey for both verification (impact) and process purposes. As described in Table 8-8, a sample was drawn representing each of the program components, with the exception of Component 2. As in previous evaluations, Component 2 was not included in the participant survey sample because the participants are considered primarily LIURP participants and would have no knowledge of the LEEP program. The Component 1 realization rate was used for Component 2 participants. 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-install measures, the survey established an ISR through questions determining first whether CFLs, faucet aerators, and showerheads were installed as reported and second whether the participants removed any measures; if so, questions were asked about the reasons for removal. Table 8-8 summarizes the sampling strategy for these phone surveys.

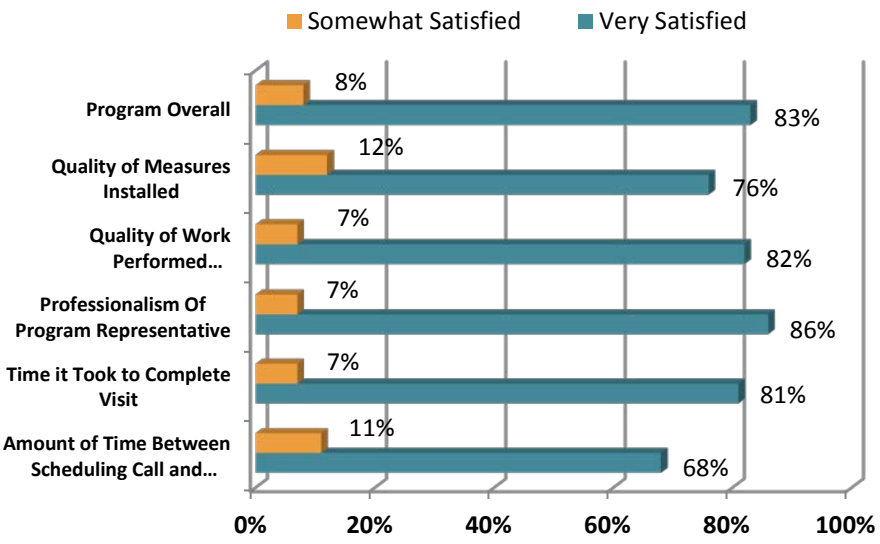
Table 8-8: Low-Income Energy Efficiency Program Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Component 1	N/A	10,429	0.8	85/15	50	50	42%	Impact, process
Component 3	N/A	16,683	0.5	85/15	50	50	83%	Impact, process
Component 4	N/A	3,613	0.9	85/15	25	25	34%	Impact, process
Program Total	**N/A**	**30,725**	**N/A**	**N/A**	**125**	**125**	**63%**	**Impact, process**
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant

Participants were asked about several topics, including satisfaction with various program components and if any additional actions were taken after participating in the LEEP. The participant surveys revealed that LEEP participants continue to be very satisfied with the program, both overall and with the individual components. Of participants, 83 percent stated that they were “extremely satisfied” with the program overall. Figure 8-1 presents the satisfaction results for the LEEP program overall and the various program components.

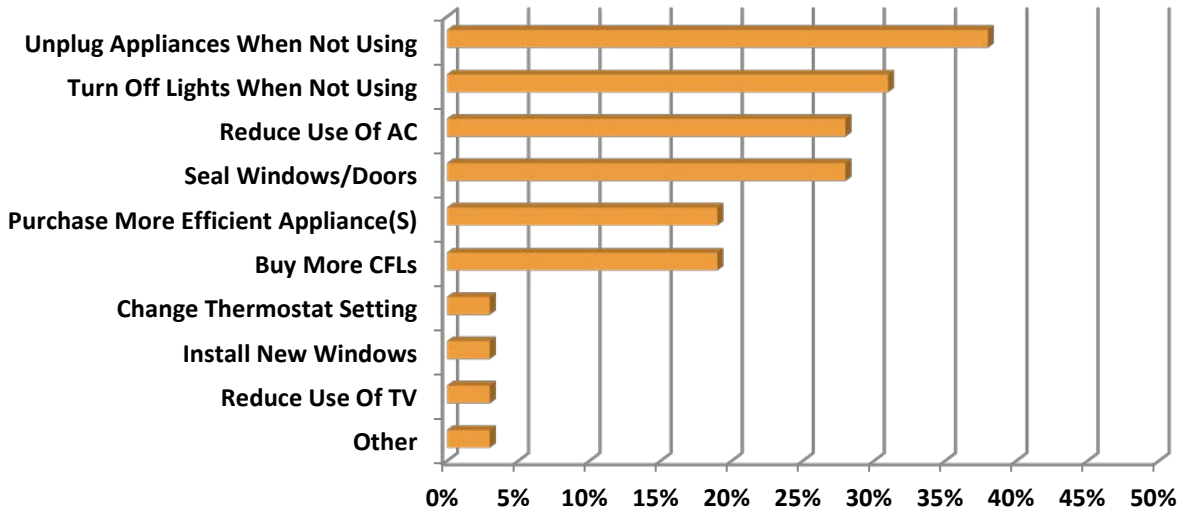
Figure 8-1: Low-Income Energy Efficiency Program Participant Satisfaction



Source: Navigant analysis of customer phone survey

During the participant survey, program participants were also asked if they had taken any additional energy-saving actions after participating in the LEEP that were not recommended by their LEEP representative. Slightly more than one-quarter (26 percent) of participants said that they had taken additional actions, which included unplugging appliances that were not being used, turning off lights that were not being used, and reducing the use of air conditioning. Almost all of the actions taken were either no-cost behavioral actions or low-cost energy-saving measure purchases. Figure 8-2 presents the actions taken by the LEEP participants who reported that they took additional actions.

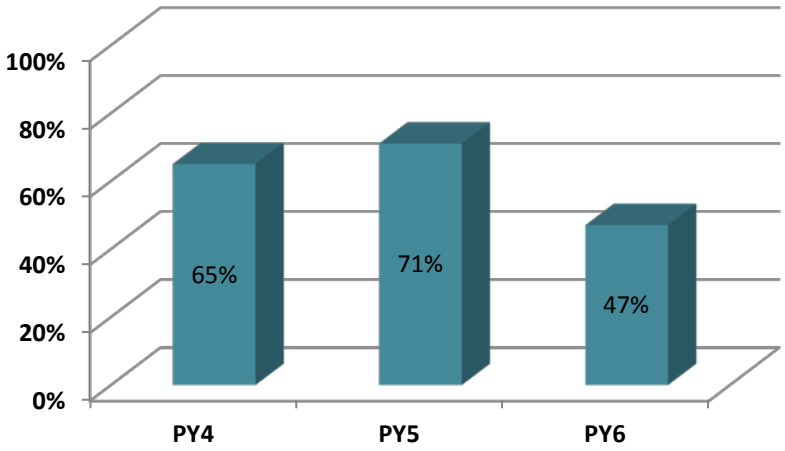
Figure 8-2: Additional Actions Taken Not Recommend by the LEEP Representative



Source: Navigant analysis of customer phone survey, n=32

As shown in Figure 8-3, the participant surveys also revealed that the first-year CFL ISR for Component 3 participants fell in PY6, compared to PY4 and PY5. The participants with uninstalled bulbs replied that they were in storage or the participants were waiting for other bulbs to burn out. This was consistent with the responses given in previous years. This finding does not affect the program savings because the program uses a deemed three-year ISR. However, this finding may indicate that, within the low-income community, CFL socket saturation is increasing. Further research will be done by Navigant staff in PY7 to determine whether in ISR will remain low or will return to the previous levels, as well as the reasoning behind the decrease.

Figure 8-3: Component 3 First-Year CFL In-Service Rate



Source: Navigant analysis of customer phone survey

The 24 ride-along surveys revealed a variety of information about the customers. The audits conducted by the implementer found that heating accounted for over half of the average electric bill. This was true even for participants who had gas space heating (28 percent of the surveyed houses). Participants who officially have gas space heating are still heavily reliant on electric space heating, possibly due to reasons such as having their gas service turned off due to lack of payment or inefficient gas heating systems that do not effectively heat all the floors or rooms of the house. During the ride-along surveys, Navigant staff also found that 75 percent of participant homes had unfinished basements but did not have any floor insulation, causing heat loss between the basement and the finished living space of the house. The program does not currently include floor insulation. The evaluation team also found that one-quarter of the homes included in the ride-along surveys had windows that did not close properly, either because they were not installed properly or were old and worn out. Navigant staff also found that 21 percent of the homes visited had windows that were broken. Both the non-closing and broken windows were a source of drafts, increasing the heating load of participant houses. The program also does not currently include window replacement. If the program were expanded to include these additional shell measures, the LEEP would address the primary contributor to energy usage in participating household: electric space heating. The program staff also noted that during the audits, 13 percent of participants declined the CFLs, primarily for aesthetic reasons.

8.4.1 Process Findings and Recommendations

1. **Finding:** Of LEEP survey participants, 26 percent reported that they had undertaken additional actions that were not recommended by a program representative after participating in the LEEP. Most of the actions taken were no- or low-cost actions, including unplugging appliances, turning off lights, or reducing the use of air conditioning. These actions show that LEEP participants may

be open to taking additional behavioral actions. Participants also reported that they purchased additional CFLs after participating in the program.

   a. **Recommendation 1a:** Encourage auditors to spend more time during the audits discussing phantom energy usage and explaining the difference between turning off and unplugging appliances.
   b. **Recommendation 1b:** Consider leaving additional spare energy efficient lighting for participants so that they can replace on burnout.

2. **Finding:** Of homes visited during the ride-along surveys, 75 percent had unfinished basements but did not have floor insulation, allowing for a heat exchange between the basement and the living space and increasing the amount of heating used.
   a. **Recommendation:** For Phase III, expand the measures offered to include floor insulation.

3. **Finding:** Of the homes visited during the ride-along surveys, 21 percent had broken windows, and 25 percent of homes visited during the ride along surveys had windows that did not shut properly. Broken windows and windows that do not shut properly create drafts, increasing heating use.
   a. **Recommendation:** For Phase III, expand the measures offered to include window replacement.

4. **Finding:** The first-year ISR for Component 3 CFLs fell to 47 percent in PY6, down from 71 percent in PY5. Of participants whose homes were visited during the ride-along surveys, 13 percent declined the offered CFLs.
   a. **Recommendation:** For Phase III, consider including LEDs in the program in addition to CFLs. Including LEDs in the program plan will give the program staff the ability to adapt the program to the rapidly changing lighting market.

8.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 8-9 summarizes Navigant's recommendations and their current status.

Table 8-9: Low-Income Energy Efficiency Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1a: Encourage auditors to spend more time during the audits discussing usage and explaining the difference between turning off and unplugging appliances.	In process. Working with outreach and ESO to ensure we are involved in every project in the earliest stage possible.
Recommendation 1b: Consider leaving additional spare energy-efficient lighting for participants so that they can replace on burnout.	Being Considered. This may pose budget and evaluation issues.
Recommendation 2: For Phase III, expand the measures offered to include floor insulation.	Being Considered. Budget and evaluation impacts are being evaluated.
Recommendation 3: For Phase III, expand the measures offered to include window replacement.	Being Considered. Budget and evaluation impacts are being evaluated.
Recommendation 4: For Phase III, include LEDs in the program in addition to CFLs. Including LEDs in the program plan will give the program staff the ability to adapt the program to the rapidly changing lighting market.	Being Considered. Budget and evaluation impacts are being evaluated.

Source: Navigant and PECO

8.6 FINANCIAL REPORTING

A breakdown of the program finances is presented in Table 8-10.

Table 8-10: Low-Income Energy Efficiency Program Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	9,394	15,365
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	9,158	15,054
8	Marketing[2]	235	310
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	9,394	15,365
13	Total NPV Lifetime Energy Benefits	10,289	21,039
14	Total NPV Lifetime Capacity Benefits	691	1,222
15	Total NPV TRC Benefits[4]	11,873	23,892
16	TRC Benefit-Cost Ratio[5]	1.26	1.56

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

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 customer moves, requests from customers to drop from the program, etc. During PY6, PECO maintained a list of customers seeking to join the program and continually backfilled as participants who left the program. As of the end of PY6, PECO had 80,575 active DCUs representing 69,192 participating homes.

Total verified gross savings were 55.0 MW for the residential Smart AC Saver program, which was 71 percent of the PY6 target of 78.0 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 PY6 totaled $6.9 million, approximately 72 percent of the PY6 budget of $9.6 million. Navigant calculated the TRC benefit-cost ratio of the residential Smart AC Saver program at 2.16. The residential Smart AC Saver program was cost-effective in PY6.

9.1 PROGRAM UPDATES

PECO designed the Phase II Smart AC Saver program to call conservation events for fewer hours than in Phase I. In PY6, PECO called two conservation events that totaled less than four hours. Additionally, 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.

The Smart AC Saver program experienced a drop in participation in PY6, however, due to its efforts to backfill participants from a list of customers who had requested to join the program; PECO limited this drop-in participation to approximately 5.4 percent.

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

This section includes a discussion of the gross impact evaluation approach, gross impact evaluation results, and onsite inspections. In PY4, Navigant applied a deemed savings value to determine residential Smart AC Saver program impacts during event hours.

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[36] to validate the results of the PJM test event that PECO conducted on July 23, 2014. Table 9-1Table 10-1 shows the total residential Smart AC Saver results reported for Phase II.

Table 9-1: 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	69,192	0	126.1	$13,776
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**69,192**	**0**	**126.1**	**$13,776**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

9.2.1 Methods

For the PY6 evaluation, the Navigant team utilized the deemed approach to savings for the residential sector and compared those results to the results that Comverge calculated for the PY6 curtailment season. In PY4, Navigant utilized the base per-participant impacts contained in the "Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region" report to calculate program savings. In PY6, the Navigant team utilized the PY4 per participant demand reductions to validate the total load reduction claimed in PECO's PJM test event on July 23, 2014.

The Navigant team applied the PY4 evaluation findings to verify the results of the PJM test event performed by the program CSP, Comverge, in PY6. The team verified the residential results by applying the findings of the Navigant PY4 evaluation utilizing the "Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region" report. The PY4 deemed savings research utilized a sample of 85 participants. The results achieved the 90 percent confidence and 10 percent precision targets.

For PY6, Comverge conducted a PJM-compliant test event to determine the performance of the residential Smart AC Saver population.

[36] *Navigant PECO Act 129 – Phase I Research Report: Program Year 4.*

Table 9-2: Residential Smart AC Saver Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Program Manager	1	N/A	1	1	Phone in-depth interview
Program Total	**1**	**N/A**	**1**	**1**	

Source: Navigant

9.2.1.1 Onsite Inspections

In previous program years, Navigant conducted onsite verification visits as part of the verification and due diligence process. Because PECO obtained a switch operability study from Comverge in October 2013, which is suitable for load research studies submitted to PJM for five years, the team did not conduct any onsite verification visits in PY6.

9.2.2 Results

In its test event on July 23, 2014, Comverge reported a maximum hourly average reduction of 0.58 kW for the residential segment. For the residential segment, a total savings of 45.66 MW (54.41 MW adjusted for line losses) was calculated, with 79,276 active DCUs participating.

Navigant verified the number of active DCUs on the date of the PJM test event and applied the switch operability study rate of 100 percent and calculated the number of participating DCUs to be 80,102. The Navigant team then sought to validate Comverge's findings by utilizing the deemed approach to savings from PY4. The results of the residential population are illustrated in Table 9-3.

Table 9-3: PY5 Residential Average Impact (kW)

Event Date	Hour Beginning	Average Impact (kW)	# of Participating Switches	Total Load Reduction (MW)
July 23, 2014	14	0.873	80,102	69.9
Average	**N/A**	**0.873**	**80,102**	**69.9**
Values in tables may not reconcile as presented due to numerical precision.				

Source: Navigant analysis

Program impacts were calculated by applying kW reduction values to all event hours. The PY4 Navigant analysis calculated average impacts at Weighted Temperature Humidity Index (WTHI) = 83.2 and the hour from 4:00 p.m. to 5:00 p.m. As illustrated in Table 9-4, 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 9-4: Comparison of Impact Results after Line Loss Adjustment

Savings Analysis	Average Impact (kW)	Total Load Reduction (MW)
Navigant Commercial Analysis	1.04	83.3
Comverge Commercial Analysis	0.686	54.4
Values in tables may not reconcile as presented due to numerical precision.		

Source: Navigant

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.

Table 9-5 and Table 9-6 show the Navigant evaluation results for energy and demand savings, respectively.

Table 9-5: Program Year 6 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	0	1.00	0	N/A	N/A
Program Total	**0**	**1.00**	**0**	**N/A**	**N/A**

Source: Navigant analysis

Table 9-6: Program Year 6 Residential and 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.
Residential	54.98	1.00	54.98	N/A	N/A
Program Total	**54.98**	**1.00**	**54.98**	**N/A**	**N/A**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

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 10-6 and Table 9-8 are not applicable to this program.

Table 9-7: Residential Smart AC Saver Sampling Strategy for Program Year 6 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
Program Manager	1	1	N/A	N/A	1	1	100%
Program Total		**1**			**1**	**1**	

Source: Navigant analysis

Table 9-8: Program Year 6 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	N/A	N/A	N/A	N/A	N/A

Source: Navigant analysis

9.4 PROCESS EVALUATION

For PY6, the evaluation team proposed a scaled-down process evaluation similar to that of PY5 for the Smart AC Saver program given that there are no demand goals as part of Act 129 in Phase II. For the PY6 process evaluation Navigant employed the following methods:

- In-depth interview with PECO program manager
- Review of Smart AC Saver program marketing materials
- Review of the program tracking database and program finances

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 wanted to maintain the population of active load control devices by replacing customers that exited the Smart AC Saver program during the course of Phase II.

9.4.1 Program Management and Staff Interviews

The Navigant team conducted one in-depth interview with PECO program staff (as indicated in Table 9-9) to understand the dates and durations of conservation events as well as PECO's efforts to recruit new customers and utilize its backstock of hardware for these new installations. Further, the team sought to understand the plan for the Smart AC Saver program in PY7 as well as potential design modifications to the program in Phase III of Act 129.

Table 9-9: Residential Smart AC Saver Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Program Manager	N/A	1	N/A	N/A	1	1	100%	Phone in-depth interview
Program Total	**N/A**	**1**	**N/A**	**N/A**	**1**	**1**	**100%**	

Source: Navigant

9.4.2 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, brief explanations of how the Smart AC Saver program works, and an easy-to-follow link to receive email conservation event notices.

9.4.3 Conservation Events

Discussions with PECO program staff indicated conservation events in PY6 were anticipated to be similar to those of PY5, and, in fact, only two conservation events were called in PY6 compared to three events in PY5. PECO called one two-hour event in Bucks County Pennsylvania only and a second one and one-half-hour system-wide PJM test event in PY6. The PJM test event resulted in savings of 54.98 MW on a post-line-loss-adjusted basis. Additionally, a portion of the commercial and residential program load (approximately 40 MW) was registered in the PJM Emergency DR Program via Comverge to offset program costs.

9.4.4 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 76,976 residential participants representing 89,407 DCUs. At the end of PY6, PECO had 69,192 residential participants representing 80,575 DCUs.

While the program has seen some level of attrition since the incentive reduction at the end of Phase I, the program did not experience the 19 percent drop in participation predicted by the WTA survey. Rather, the program has seen a consistent drop in participation of approximately 1.4 percent per year since the end of PY4. Navigant attributes this drop to customer home sales, customer moves, and the reduced incentive—the effects of which have been offset by PECO's enrollment of new customers during the program year.

PECO plans to continue to recruit new customers into the program in PY7 to the extent the current backstock of hardware is available.

9.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

See Section 10 for the Smart AC Saver evaluation recommendations and their statuses.

9.6 FINANCIAL REPORTING

A breakdown of the program finances is presented in Table 9-10. The table indicates that the program was not cost-effective in PY6.

Table 9-10: Residential Smart AC Saver Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	6,921	13,845
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	185	54
8	Marketing[2]	6,736	13,791
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in Costs of Natural Gas (or Other Fuels) for Fuel-Switching Programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	6,921	13,845
13	Total NPV Lifetime Energy Benefits	12,329	30,342
14	Total NPV Lifetime Capacity Benefits	2,496	8,587
15	Total NPV TRC Benefits[4]	14,825	38,929
16	TRC Benefit-Cost Ratio[5]	2.14	2.81

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

10. 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 during the 4 months of summer (i.e., June through September).

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 over the course of Phase II.

10.1 PROGRAM UPDATES

PECO designed the Phase II Smart AC Saver program to call conservation events for fewer hours than in Phase I. In PY6, PECO called two conservation events that totaled less than 4 hours. Additionally, PECO registered a portion of its program load (approximately 40 MW) into the PJM Emergency DR program via its CSP, Comverge, to offset program costs. PECO called one 2-hour event in Bucks County Pennsylvania only and a second 1.5 hour systemwide PJM test event in PY6. The PJM test event resulted in a savings of 1.12 MW on a post line loss adjusted basis. Additionally, a portion of commercial and residential program load (approximately 40 MW) was registered in the PJM Emergency DR program via Comverge to offset program costs.

Participation in the Smart AC Saver program varies month to month based on participants dropping from the program for a variety of reasons, including customer moves, closing of businesses, etc. During PY6, 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 PY6, PECO had 3,257 active PCTs representing 1,824 participating businesses. The Smart AC Saver program experienced a drop in participation in PY6. Due to its efforts to backfill participants from a list of customers who had requested to join the program, PECO limited this drop in participation to approximately 8.7 percent.

10.1.1 Definition of Participant

For the purposes of reporting, a participant is defined as a single address.

10.2 IMPACT EVALUATION GROSS SAVINGS

This section includes discussion of the gross impact evaluation approach, gross impact evaluation results, and onsite inspections. Table 10-1 below shows the commercial Smart AC Saver results reported for Phase II in total.

Table 10-1: 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)
Residential	0	0	0.0	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	1,824	0	4.1	$610
Government, Non-Profit, and Institutional	0	0	0.0	$0
Phase II Total	**1,824**	**0**	4.1	**$610**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

10.2.1 Methods

Because there are no peak demand reduction targets for the Phase II EE&C Programs, Navigant relied on the results of the PY4 commercial analysis to validate the results of the PJM test event on July 23, 2014, which Comverge conducted to quantify commercial program saving for PY6. In PY4, Navigant obtained 5-minute interval data for the 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 hour preceding events, and the 2 hours following events.

In previous program years, Navigant has conducted onsite verification visits as part of the verification and due diligence process. Because PECO obtained a switch operability study from Comverge in October of 2013, which is suitable for load research studies submitted to PJM for five years, the team did not conduct any onsite verification visits in PY6.

10.2.2 Results

In its test event of July 23, 2014, Comverge reported a maximum hourly average reduction of 0.31 kW for the commercial segment. For the commercial segment, a total savings of 1.0 MW (1.2 MW adjusted for line losses) was calculated, with 3,227 active PCTs participating. Navigant verified the number of active PCTs on the date of the PJM test event and applied the switch operability study rate of 94 percent and calculated the number of participating PCTs to be 3,051. The Navigant team then sought to validate Comverge's findings utilizing average calculated savings from PY4.

For the PY6 program year, PECO did not purchase a load study from CSP Comverge but rather relied on the results of the PJM test event to report savings.

The results of the commercial population are illustrated below in Table 10-2.

Table 10-2: PY5 Commercial Average Impact (kW)

Event Date	Hour Beginning	Average Impact (kW)	# of Participating Switches	Total Load Reduction (MW)
July 23, 2014	14	0.714	3,051	2.2
Average	N/A	0.714	3,051	2.2
Values in tables may not reconcile as presented due to numerical precision.				

Source: Navigant analysis

Program impacts were calculated by applying kW reduction values to all event hours.

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 10-3, 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 10-3: Comparison of Impact Results after Line Loss Adjustment

Savings Analysis	Average Impact (kW)	Total Load Reduction (MW)
Navigant Commercial Analysis	0.851	2.6
Comverge Commercial Analysis	0.366	1.2
Values in tables may not reconcile as presented due to numerical precision.		

Source: Navigant analysis

Table 10-4 and Table 10-5 show the Navigant evaluation results for energy and demand savings, respectively.

Table 10-4: Program Year 6 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	0	N/A	0	N/A	N/A
Program Total	0	N/A	0	N/A	N/A

Source: Navigant analysis

Table 10-5: Program Year 6 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	1.12	1.00	1.12	N/A	N/A
Program Total	1.12	1.00	1.12	N/A	N/A
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis

10.3 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 10-6 and Table 10-7 are not applicable to this program.

Table 10-6: Commercial Smart AC Saver Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Program Manager	1	1	N/A	N/A	1	1	100%
Program Total	1	1	N/A	N/A	1	1	
[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.							

Source: Navigant analysis

Table 10-7: Program Year 6 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[1]	N/A	N/A	N/A	N/A	N/A
[1] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.					

Source: Navigant analysis

10.3.1 Impact Findings and Recommendations

1. **Finding:** For the PY6 program year, PECO did not purchase a load study from its CSP Comverge but rather relied on the results of the PJM test event to report savings.
    a. **Recommendation:** Navigant recommends that a load study be performed, preferably utilizing AMI data to more accurately verify demand savings, for the Commercial Smart AC Saver program in PY7.

10.4 PROCESS EVALUATION

For PY6, the evaluation team proposed a scaled down process evaluation similar to that of PY5 for the Smart AC Saver program, given that there are no demand goals as part of Act 129 in Phase II. For the PY6 process evaluation, Navigant employed the following methods:

- In-depth interview with PECO program manager
- Review of Smart AC Saver program marketing materials
- Review of the program tracking database and program finances

10.4.1 Continued Program Participation

At the end of PY6, PECO had 1,824 commercial participants representing 3,257 PCTs. PECO's enrollment of new customers during the program year offset program attrition, resulting in a drop in participation of approximately 6.7 percent in PY6. Navigant attributes this drop to business closures or sales, customer moves, and the reduced incentive of Phase II.

PECO plans to continue to recruit new customers into the program in PY7 to the extent the current back stock of hardware is available.

10.4.2 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.

10.4.3 Program Management and Staff Interviews

The Navigant team conducted an in-depth interview with PECO program staff during PY6 to understand the dates and durations of conservation events, as well as PECO's efforts to recruit new customers and utilize its back stock of hardware for these new installations. Furthermore, the team sought to understand the plan for the Smart AC Saver program in PY7, as well as potential design modifications to the program in Phase III of Act 129.

10.4.4 Tracking Database and Program Finances

On a quarterly basis, Navigant reviews the program tracking database and verifies the number of participants in the program and the number of active switches against those reported by PECO. Additionally, Navigant reviews the program finances, including invoices submitted by Comverge and capacity payments received from Comverge for the MW reductions registered in the PJM Emergency DR Program. Program expenses are offset by monthly capacity payments. Because there is not a separate line for capacity payments in the program finances tracking spreadsheet, it is difficult to easily verify program costs.

10.4.5 Sampling

No sampling was performed in the verification of program savings for PY6. Navigant relied on the results of the July 23, 2014 PJM test event that was performed by Comverge. Since Navigant did not obtain a copy of a load study for PY6, the Navigant team was did not review the sample utilized by Comverge for the PJM test event.

The Navigant team conducted one in-depth interview with PECO program staff, as indicated in Table 10-8.

Table 10-8: Commercial Smart AC Saver Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Program Manager	N/A	1	N/A	N/A	1	1	100%	Phone in-depth interview
Program Total	**N/A**	**1**	**N/A**	**N/A**	**1**	**1**	**100%**	

Source: Navigant analysis

10.4.6 Barriers, Activities, and Outcomes

The barriers to the Commercial Smart AC Saver program are that customers have limited or no knowledge of peak demand times and do not have the ability to cycle their CAC units automatically during conservation events. By recruiting eligible customers into the program, PECO is able to install an automated solution to address peak periods of demand. The customer does not need to have an understanding of these times of peak demand, and their CAC is automatically cycled to curtail demand.

The automated switch cycles the customer's CAC compressor and allows the fan to continue to operate during conservation events. Therefore, customers are financially incented to participate in the program and PECO is able to obtain demand savings from enrolled CACs.

Alerting customers to a conservation event via the Smart AC Saver website enhances customer awareness of the program, and the successful operation of the installed switches ensures customer comfort during conservation events and leads to improved satisfaction with PECO.

10.4.7 Process Findings and Recommendations

1. **Finding:** Because there is not a separate line for capacity payments in the program finances tracking spreadsheet, it is difficult to easily verify program costs.
    a. **Recommendation:** Add separate lines in the finance data extract spreadsheet for the commercial Smart AC Saver program to show capacity payments that tie to actual invoices.

10.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The recommendations for the commercial Smart AC Saver program and their status are illustrated in Table 10-9.

Table 10-9: Commercial Smart AC Saver Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1. Conduct a load study in PY7, preferably utilizing AMI data, to more accurately verify demand savings.	Being considered, no action by EDC to date.
Recommendation 2. Add separate lines in the finance data extract spreadsheet for both the residential and commercial Smart AC Saver programs to show capacity payments that	Being considered, no action by EDC to date.

tie to actual invoices.	

Source: Navigant and PECO

10.6 FINANCIAL REPORTING

A breakdown of the program finances is presented in Table 10-10. The table indicates that the program was not cost-effective in PY6.

Table 10-10: Commercial Smart AC Saver Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of incentives/rebates paid by utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	305	619
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	8	8
8	Marketing[2]	297	610
9	EDC Evaluation Costs	**0**	**0**
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	305	619
13	Total NPV Lifetime Energy Benefits	116	434
14	Total NPV Lifetime Capacity Benefits	54	303
15	Total NPV TRC Benefits[4]	170	737
16	TRC Benefit-Cost Ratio[5]	0.56	1.19

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant

11. SMART EQUIPMENT INCENTIVES – COMMERCIAL AND INDUSTRIAL

PECO launched the Smart Equipment Incentives (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.

11.1 PROGRAM UPDATES

The SEI program launched a new trade ally program in PY6 that financially rewards trade allies for achieving energy savings targets. PECO's program implementer, DNV GL, implemented an outreach team that is solely focused on engaging with customers and contractors. Communication between PECO and DNV GL is more consistent and transparent. SEI program implementer DNV GL completed 791 C&I retrofit projects in PY6. Sixty-two percent of total SEI PY6 energy savings came from lighting measures, including lighting controls.

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

Table 11-1 shows the reported results for the C&I program.

Table 11-1: Phase II Smart Equipment Incentives – C&I 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	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	1,117	109,273	16.8	$8,521
Government, Non-Profit, and Institutional [1]	0	0	0.0	$0
Phase II Total	**1,117**	**109,273**	**16.8**	**$8,521**

[1] This table does not include SEI GNI, SEI GNI is reported in the section below.

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

11.2.1 Methods

The sample design for PY6 SEI retrofit projects used stratified ratio estimation similar to the method used in PY5. Based on a combined paid annual population of 791 C&I retrofit projects, the final verified sample size was 64 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 and PY5 achieved relative precision targets.[37]

Navigant also added extra sites to meet the SWE's request of designing the sample to exceed 90/10 confidence and precision and to better ensure the results meet the required 85/15 confidence and precision.

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 percent of reported kWh savings in the Small stratum. The sampling strategy used in PY6 is presented in Table 11-2.

Table 11-2: Smart Equipment Incentives – C&I Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	14	85/15	14	14	Onsite and metering verification
Medium	57	85/15	29	28	Onsite and metering verification
Small	720	85/15	25	25	Onsite and phone verification
Program Total	**791**	**85/15**	**68**	**69**	
Values in tables may not reconcile as presented due to numerical precision.					

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 were made as needed to ensure that the sample design would meet the target confidence and precision. This process included reviewing the projects in the pipeline and estimating the number of projects that would be completed prior to the end of PY6. 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.

[37] 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.

The team also worked to mitigate systematic uncertainty in the PY6 evaluation. The sources, examples, and strategies to mitigate systematic uncertainty are listed below.

- **Source**: Onsite 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 non-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 if the information was not reasonable with normal lighting use. Navigant ensured against systematic uncertainty in equipment by utilizing experienced field staff to deploy and ensure metering equipment was installed correctly.
- **Source**: Survey design

  Examples: Incomplete information collected onsite, leading survey questions
  Strategies to Mitigate: Systematic uncertainty could have been found in the collection of information while onsite. 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 onsite. To prevent against this, Navigant trained field staff before completing onsite visits, and also 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. Navigant reviewed the sampled sites to ensure that it was representative of the entire population. Only one of the 68 sampled sites were not verified due to an inability to correctly meter the facility. This particular site is a large sporting arena that has event-based lighting and required metering to properly verify the energy and peak demand savings. Navigant will complete the project's verification this coming fall after the sporting arena's schedule has started.

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 onsite M&V. For all projects, Navigant completed a desk review. The team carefully reviewed all project documentation and the Smart Ideas Database (SIDS) for each sampled project.

11.2.1.1 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 (VFDs), 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.

11.2.1.2 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 the 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.

11.2.1.3 Onsite Inspections

Navigant conducted an onsite 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 52 of the 68 projects in the sample (11 of the 25Small projects, 27 of the 29 Medium projects, and 14 of the 14 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 the onsite verifications. Navigant found various discrepancies while onsite. The table below indicates the total number of discrepancies across all the projects. If Navigant's ex post evaluation found multiple discrepancies with a project, each discrepancy was added to this table. Therefore the number of

discrepancies can exceed the total number of projects that Navigant sampled. These discrepancies are detailed in the Table 11-3.

Table 11-3: Smart Equipment Incentives – C&I Onsite Discrepancies

Category of Change	C&I – Small	C&I – Medium	C&I – Large
Baseline Equipment Quantities	0	1	2
Post-Retrofit Equipment Quantities	2	2	2
Building Type	0	0	0
Space Cooling	3	0	0
Hours of Use	6	16	6
Coincidence Factor	2	4	2
Space Cooling HVAC Interaction Factor	0	0	0
Baseline Equipment Specifications	0	0	0
Post-Retrofit Equipment Specifications	1	12	7
Claimed Heating Savings	0	0	0
Measure Type Change (e.g., TRM vs. custom)	1	0	0
Other	1	2	4
Program Total	**16**	**37**	**23**

Note: Values in tables are number of sites.

Values in tables may not reconcile as presented due to numerical precision.

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.[38] 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 PY6 projects included a review of program tracking data and supporting documentation (e.g., invoices, spec sheets) before developing a SSMVP and conducting an onsite 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 onsite measurement and/or obtaining customer-stored data to support downstream M&V calculations. Measurement included spot measurements, runtime 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 (SCADA) systems when available.

[38] The SWE requirements were detailed in a February 11, 2014, memo titled *GM-022 Peak Demand Savings for PY5*.

In addition, the team requested billing data for some projects from PECO on a monthly or 15-minute interval basis, depending on the site.

11.2.2 Results

Overall, the program achieved gross realization rates of 1.08 for energy and 1.20 for demand. The program-level relative precision was 7 percent for the energy and 15 percent for the demand at 85 percent confidence interval. 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 6 Smart Equipment Incentives – C&I 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.
Small	26,813	26,813	1.04	27,981	0.64	18.6%
Medium	26,141	26,141	1.02	26,585	0.34	7.0%
Large	27,848	27,848	0.99	27,520	0.20	0.0%
Idiosyncratic	246	246	21.75	5,349	0.00	0.0%
Program Total [1]	**81,048**	**81,048**	**1.08**	**87,435**	**N/A**	**6.6%**

[1] This table does not include SEI GNI, SEI GNI is reported in the section below.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Table 11-5: Program Year 6 Smart Equipment Incentives – C&I Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	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.
Small	4.57	4.57	1.20	5.48	1.26	37.0%
Medium	3.79	3.79	1.12	4.24	0.58	11.9%
Large	3.45	3.45	1.09	3.77	0.34	0.0%
Idiosyncratic	0.03	0.03	21.19	0.68	0.00	0.0%
Program Total [1]	**11.84**	**11.84**	**1.20**	**14.17**	**N/A**	**14.8%**

[1] This table does not include SEI GNI, SEI GNI is reported in the section below.Navigant put one of the projects into a separate stratum because the realization rate was drastically different than 1.00. Navigant's ex post analysis differ greatly from the ex ante analysis because DNV GL did not have sufficient information to complete the ex ante analysis. The project consisted of controls on an air compressor. DNV GL's ex ante analysis only accounted for one air compressor, while in reality, the company operated two air compressors before the installation of the new controls. Since the installation of the new controls, the facility has primarily been only running one unit.

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

11.2.3 Impact Findings and Recommendations

1. **Finding:** Navigant's ex post analysis differ greatly from the ex ante analysis because DNV GL did not have sufficient information to complete the ex ante analysis.
   a. **Recommendation 1a:** PECO should direct DNV GL to make sure that they maintain a final set of project documents. DNV GL should review project files and make sure all the information is up to date. This will help ensure which files are drafts and which ones are final project files. This is important because it will result in more consistency between ex ante and ex post findings and allow PECO to manage the program more effectively. The more accurate the results are that enter the tracking database, the more consistent ex post findings will be. In addition, this will reduce evaluator cost and time searching through draft or irrelevant documents.
   b. **Recommendation 1b**: If the incentive amount is difficult to determine, DNV GL should seek further assistance from PECO and others to ensure that customers receive an accurate incentive. DNV GL should establish a quality control process to ensure all PECO customers receive the full program incentive they qualify for per the program ex ante review. This process should focus quality control on the HOU and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. In addition, this will help ensure consistency between the project files and the tracking system.

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.

11.3.1 Methods

Table 11-6 shows the sample design for the PY6 NTG research.

Table 11-6: Smart Equipment Incentives – C&I Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Small	< 550,000 kWh	294	0.50	85/15	10	15	100%
Medium	550,000 kWh to 3,500,000 kWh	21	0.50	85/15	8	6	100%
Large	> 3,500,000 kWh	3	0.50	85/15	3	2	100%
Program Total		**318**			**21**	**23**	

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Once the evaluation team estimated free ridership and spillover, Navigant calculated the NTG ratios, as illustrated in the equation below.

Equation 11-1. Total NTG Ratio

NTG Ratio = 1 – Free Ridership Rate + Spillover Rate

11.3.1.1 Free Ridership Methodology

The team assessed free ridership using a customer self-report approach following the SWE's Common Approach for Downstream Programs.[39] 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 11-2 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 11-2. 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:

- Would have canceled or postponed the project, upgrade, or purchase
- Would have done something that would have produced savings, but not as much as those achieved through the upgrade or equipment replacement as implemented
- Would have completed the upgrade or equipment replacement as implemented
- 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.

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

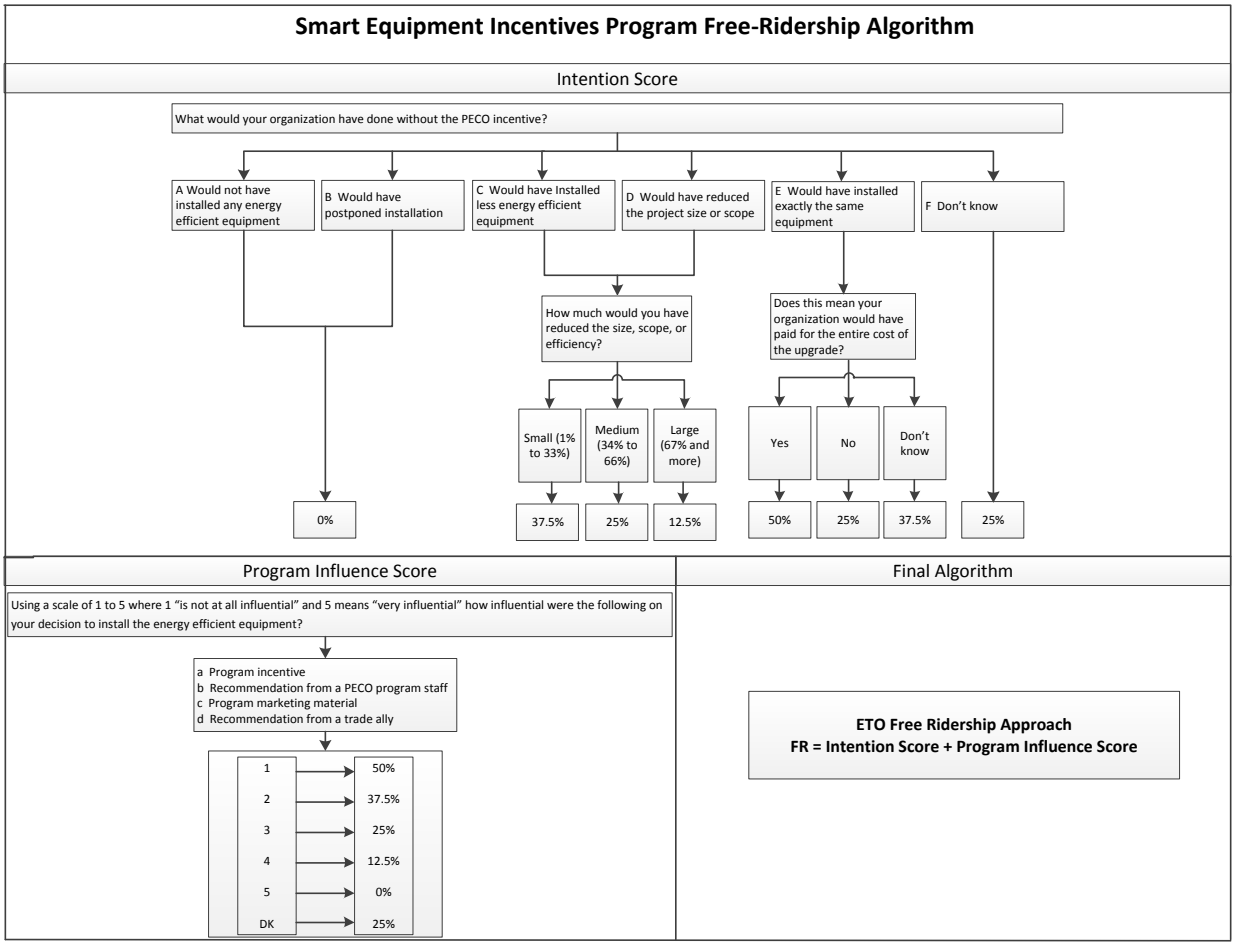
Program Influence Score

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

11.3.1.2 Spillover Methodology

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. Below are examples of the spillover questions:

- 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?
- To the best of your knowledge, do you know when you installed the additional energy efficient equipment?
- Could you describe the energy efficiency measure installed?
- Thinking of the additional measure(s) you installed on your own at this same facility, how do 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.)
- Since participating in the program, have you installed any energy efficient measures in other facilities within PECO's territory?
- 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.)
- Have or will these measures receive incentives through the program?
- 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.

- 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 11-3. Navigant calculated all spillover estimates using customer self-reported data and did not conduct follow-up interviews or site visits.

Equation 11-3. 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 11-4.

Equation 11-4. 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 11-5 shows the algorithm used to calculate spillover for the program.

Equation 11-5. 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 11-6.

Equation 11-6. Participant Spillover Percentage

$$\%\ Participant\ SO\ = \frac{\sum Participant\ SO\ (population)}{Program\ Savings} * 100$$

11.3.2 Results

The results from the NTG research are shown in Table 11-7. The PY6 SEI C&I NTG ratio is 0.77.

Table 11-7: Program Year 6 Smart Equipment Incentives – C&I Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Planned Coefficient of Variation or Proportion	Relative Precision
Small	0.41	0.11	0.70	0.50	8.4%
Medium	0.16	0.11	0.95	0.50	19.2%
Large	0.45	0.11	0.66	0.50	155.8%
Program Total[1]	**0.34**	**0.11**	**0.77**	**0.50**	**17.0%**

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

Values in tables may not reconcile as presented due to numerical precision.

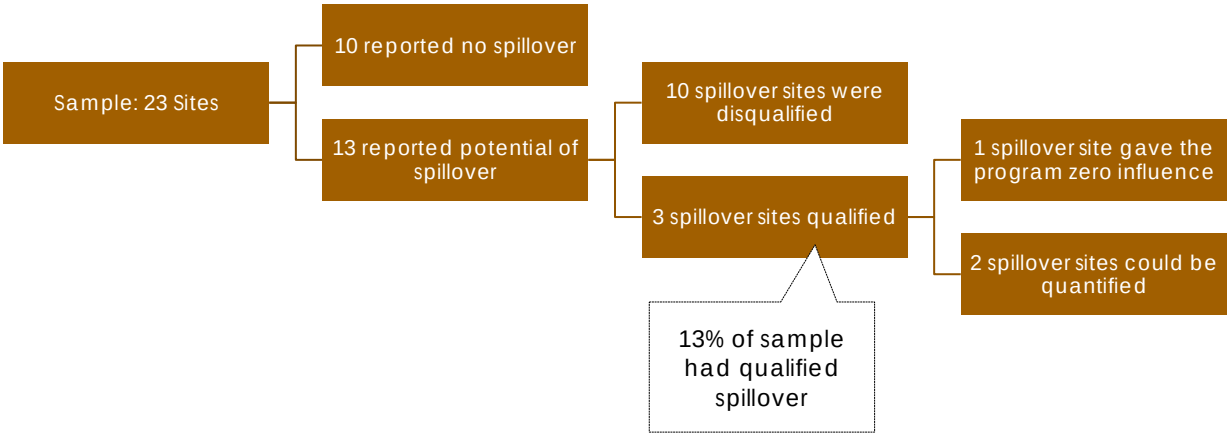
Source: Navigant analysis

In PY6, 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 23 participants surveyed, 13 reported installing additional energy efficient equipment. Out of the 13 participants, 10 participants either could not verify that the spillover projects were developed during PY6 or did not give enough information to estimate energy savings.

While the spillover evaluation revealed a high percentage of self-reported activity, only three participants provided enough information to quantify spillover; the spillover calculated was 0.11.

Figure 11-2: PY6 Spillover



Source: PY6 participant survey

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:

- Program marketing plan review
- Tracking system review
- Interviews with six PECO program management staff, four PECO account managers, and four implementation contractor staff
- Twelve interviews with market actors (5 distributors, 4 industry groups, and 3 non-lighting contractors)
- Online and telephone surveys with 26 participating C&I customers and 19 participating GNI customers

11.4.1 Program Marketing Plan Review

The evaluation team reviewed marketing and outreach materials available on the program's website,[40] 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 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 and an email hotlink.

[40] www.peco.com/smartideas.

11.4.2 Tracking System Review

PECO uses the SIDS to track its 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.

The evaluation team verified that the tracking system was consistent with the PY6 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 PY7 of Phase II. The findings, and some recommended steps for improvement, are listed below.

The tracking database still has room for improvement. The evaluation team discovered various discrepancies between the project application files and the SIDS tracking data; about 25 percent of projects have differences between what is in the SIDS tracking data and the project. The discrepancies found were:

- Savings values and algorithm inputs such as HOU did not always match between the project files and tracking system.
- Some projects were entered into the tracking system before their final analysis was completed. “Educated guess” savings values were therefore used as inputs. This leads to low predictability of final energy and demand savings.
- Measures listed in tracking system “Measures” tab did not always align with the project files. Some measure descriptions were blank. This limits the usability of the tracking system to know the measures installed.
- Customer contact information was sometimes missing or incorrect.
- Project completion dates in tracker do not always align with in-service dates. About 50 percent of projects in the database have an application date after the project installation date.

11.4.3 Program Management and Staff Interviews

The evaluation team conducted six in-depth interviews with PECO program staff, four interviews with PECO account managers, and four in-depth interviews with key members of the SEI program implementation contractor team, DNV GL, during the months of April 2015 and May 2015. Navigant designed the interview guides to enable the evaluation team to ask questions about the program’s

administration and delivery during PY6 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 and marketing plans and materials.

11.4.4 Participant Survey

The evaluation team conducted an online survey of participating customers for both the SEI C&I and SEI GNI PY6 retrofit programs. The evaluation team supplemented the online survey with telephone surveys of customers who had not responded to the online survey. In total, the evaluation team completed 45 participating customer surveys. Out of the 45 surveys, 26 surveys were with participating C&I customers and 19 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 11-8 shows the sampling strategy for the participant survey effort.

Table 11-8: Smart Equipment Incentives – C&I Sampling Strategy for Program Year 6

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[1] to Achieve Sample	Used For Evaluation Activities
Small	< 550,000 kWh	294	0.50	85/15	10	17	100%	Online and phone survey
Medium	550,000 kWh to 3,500,000 kWWh	21	0.50	85/15	8	7	100%	Online and phone survey
Large	> 3,500,000 kWh	3	0.50	85/15	3	2	100%	Online and phone survey
Program Total		**318**			**21**	**26**		

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

11.4.5 Process Findings and Recommendations

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. The findings from the process evaluation are listed below.

1. **Finding:** Incentive levels for non-lighting and custom projects do not fully reflect the cost of implementing the measure. Contractors and PECO Account Managers stated that rebates for non-lighting and custom projects are not enough to change decision-making because it is too costly and labor intensive to verify savings unless the size of the project is significantly large. Participants stated that the major challenge to implementing projects is budget, even though most respondents said they did have senior management support and energy efficiency is a value within their organization. The evaluation team found out that most of the organizations have a sustainability program in place but most of those programs do not have a capital budget set aside to implement energy efficiency projects. In addition,

participants stated that the incentive amount they receive from the program is only enough to cover the additional costs they have to incur to be eligible to participate.

   a. **Recommendation**: PECO should simplify savings calculations requirements and increase incentive levels for non-lighting and custom measures. The evaluation team heard from contractors that the application process—specifically calculating kWh savings and doing the associated M&V work—is costly and more complex than other utilities' programs in other states. They cited New Jersey and ComEd as simpler programs. In addition, participating respondents stated that in the case of non-lighting and complex custom projects, incentives only cover the expense they have to incur to calculate kWh savings and to comply with program requirements. PECO should use the knowledge of payback period (usually 2-3 year payback threshold) to developing incentive levels in Phase III for non-lighting and custom projects.

2. **Finding:** The SEI program is pushing the envelope and having a positive impact on the market. The interviews with distributors present evidence that the program is changing energy efficient equipment stocking practices and that it has increased the amount of energy efficiency projects implemented within PECO's service territory. Many participating respondents (60 percent) stated that the SEI program did affect the type of energy efficient equipment their organizations decided to buy and that PECO can be more influencial during the planning phase of the project cycle. Many customers anticipate participating in the program again in PY7 (70 percent of C&I respondents plan to participate again in PY7). Based on interviews with contractors and program participants, it seems the pre-approval process is a barrier to projects. The wait time after submitting a pre-application is a barrier to completing projects within the planned project timeline.

   a. **Recommendation:** PECO should get involved during the project planning cycle in order to have a greater influence in the type and amount of measures implemented. Based on feedback received from participating respondents, PECO can be more influential if it gets involved during the project planning phase. PECO should consider ways to reduce pre-application review time and compile a list of pre-approved equipment that serves as reference for routine projects.

3. **Finding:** Customer satisfaction is high, but there is an opportunity for PECO to improve customers' experience with the application process through increased outreach. Customer satisfaction with the program continues to be high (96 percent of C&I respondents were satisfied or very satisfied with the program in PY6). When asked for ways in which the program can be improved, respondents stated that the hardest part of the process is to establish a project baseline and that they want more assistance from PECO to figure out the engineering requirements included in the application form. Contractors stated that when it comes to filling out the paperwork, PECO's program requirements are more burdensome than other utility programs. They particularly referred to the simplicity of the per-kWh calculations for incentive amounts formulae of other utility programs. Two-thirds of the interviewed contractors stated that marketing is boring and outdated. The evaluation team found that customers who were brought into the program by trade allies and contactors knew of the program shift requiring pre-applications, but the customers whose main point of contact was through PECO's account managers did not know about the change early enough.

   a. **Recommendation:** PECO should instruct DNV GL to increase outreach, develop new and interesting promotional materials, and create metrics to measure the impact of all the marketing activities. Based on interviews with market actors, PECO should send an outreach employee to attend Chamber of Commerce meetings, trade association

meetings, and meetings for sales reps of electrical equipment distributors. In addition, participating respondents would like PECO to improve its outreach and promotional materials to include real-life case studies on businesses that participated in the program, these case studies should include small, medium, and large companies and provide a real cost-benefit analysis for these case studies. PECO should make sure program staff are well trained on the program and how to interact with customers. SEI program staff and DNV GL should interact with PECO account managers to keep them up to date on program developments and use them as a tool to increase program participation.

11.5 STATUS OF 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 PECO program managers, implementation contractor staff, and account managers; participant surveys; and market actors. This subsection details recommendations from the evaluation and Table 11-9 lists a summary of each recommendation along with the PECO status.

Table 11-9: Smart Equipment Incentives – C&I Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1a. PECO should direct DNV GL to provide a final set of project documents.	Being considered. Currently setting expectations with CSP to have a certain number of documents on all paid finished projects.
Recommendation 1b. DNV GL should ensure customers receive an accurate incentive.	In process. Working with outreach and ESO to ensure we are involved in every project in the earliest stage possible.
Recommendation 2. PECO should simplify savings calculations requirements and increase incentive levels for non-lighting and custom measures.	Being considered. Working with DNV engineering to identify measures that use a standard, industry-based baseline for usage.
Recommendation 3. PECO should get involved during the project planning cycle in order to have a greater influence in the type and amount of measures implemented.	In process. Working with outreach and ESO to ensure we are involved in every project in the earliest stage possible.
Recommendation 4. PECO should instruct DNV GL to increase outreach, develop new and interesting promotional materials, and create metrics to measure the impact of all the marketing activities.	In process. Working with outreach and ESO to ensure we are involved in every project in the earliest stage possible.

Source: Navigant analysis

11.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 11-10.

Table 11-10: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	21,913	28,511
2	EDC Incentives to Participants	6,342	8,520
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of incentives/rebates paid by utilities)	15,571	19,991
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	4,954	9,204
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	4,948	9,195
8	Marketing[2]	7	9
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	26,867	37,715
13	Total NPV Lifetime Energy Benefits	58,785	79,129
14	Total NPV Lifetime Capacity Benefits	7,517	10,085
15	Total NPV TRC Benefits[4]	66,311	89,225
16	TRC Benefit-Cost Ratio[5]	2.47	2.37

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

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 on the SEI GNI program.

12.1 PROGRAM UPDATES

The SEI program launched a new trade ally program in PY6 that financially rewards trade allies for achieveing energy savings targets. PECO's program implementer, DNV GL, implemented an outreach team that is solely focused on engaging with customers and contractors. Communication between PECO and DNV GL is more consistent and transparent.

SEI program implementer DNV GL completed 226 GNI retrofit projects in PY6. Sixty-two percent of total SEI PY6 energy savings came from lighting measures, including lighting controls.

12.1.1 Definition of Participant

Each participant in the SEI GNI 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.

12.2 IMPACT EVALUATION GROSS SAVINGS

Table 12-1 shows the reported results for the GNI program.

Table 12-1: Phase II Smart Equipment Incentives – GNI Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential [1]	0	0	0.0	$0
Low-Income [1]	0	0	0.0	$0
Small Commercial and Industrial [1]	0	0	0.0	$0
Large Commercial and Industrial [1]	0	0	0.0	$0
Government, Non-Profit, and Institutional	327	35,818	4.7	$3,863
Phase II Total	**327**	**35,818**	**4.7**	**$3,863**

[1] This table does not include SEI C&I, SEI C&I is reported in the section above.

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

12.2.1 Methods

The sample design for PY6 SEI retrofit projects used stratified ratio estimation similar to the method used in PY5. Based on a combined paid annual population of 226 GNI retrofit projects, the final verified sample size was 41 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 and PY5 achieved relative precision targets.[41]

Navigant also added extra sites to meet the SWE's request of designing the sample to exceed 90/10 confidence and precision and better ensure the results meet the required 85/15 confidence and precision.

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 percent of reported kWh savings in the Small stratum. The sampling strategy used in PY6 is presented in Table 12-2.

Table 12-2: Smart Equipment Incentive – GNI Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Muni Lighting	10	85/15	5	5	Onsite and phone verification
Small	208	85/15	23	23	Onsite and phone verification
Medium	16	85/15	12	11	Onsite and metering verification
Large	2	85/15	2	2	Metering verification
Program Total	**236**	**85/15**	**42**	**41**	
Values in tables may not reconcile as presented due to numerical precision.					

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 PY6. 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

[41] Navigant designed the SEI GNI 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.

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 PY6 evaluation. The sources, examples, and strategies to mitigate systematic uncertainty are listed below.

- **Source**: Onsite 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 non-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 if the information was not reasonable with normal lighting use. Navigant ensured against systematic uncertainty in equipment by utilizing experienced field staff to deploy and ensure metering equipment was installed correctly.
- **Source**: Survey design

  Examples: Incomplete information collected onsite, leading survey questions
  Strategies to Mitigate: Systematic uncertainty could have been found in the collection of information while onsite. 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 onsite. To prevent against this, Navigant trained its field staff before completing onsite visits and also 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. Navigant reviewed the sampled sites to ensure that they was representative of the entire population. Only one of the 41 sampled sites were not verified due to an inability to schedule the site in a timley manner. This particular site is a high security laboratory at a research university. Navigant will complete the project's verification this coming fall once the site is capable of finding the good time to complete the visit.

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 that both the installed quantity and 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 onsite M&V. For all projects, Navigant completed a desk review. The team carefully reviewed all project documentation and the SIDS for each sampled project.

12.2.1.1 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, VFDs, 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 emails and memoranda.

12.2.1.2 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 the 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.

12.2.1.3 Onsite Inspections

Navigant conducted an onsite 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 28 of the 41 projects in the achieved sample (15 of the 28 small projects, 11 of the 11 medium projects, and 2 of the 2 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 17 projects, Navigant also gathered metered data to measure runtime hours, energy consumption, or billing data. Warren Energy Engineering, Mondre Energy, and Navigant completed the onsite verifications. Navigant found various discrepancies while onsite. The table below indicates the total number of discrepancies across all the projects. If Navigant's ex post evaluation found

multiple discrepancies with a project, each discrepancy was added to this table. Therefore, the number of discrepancies can exceed the total number of projects that Navigant sampled. These discrepancies are detailed in the Table 12-3.

Table 12-3: Program year 6 Smart Equipment Incentive – GNI Onsite Discrepancies

Category of Change	GNI – Muni Lighting	GNI - Small	GNI - Medium	GNI - Large
Baseline Equipment Quantities	0	2	0	0
Post-Retrofit Equipment Quantities	0	4	0	0
Building Type	0	0	0	0
Space Cooling	0	1	0	0
Hours of Use	0	7	2	0
Coincidence Factor	0	2	1	0
Space Cooling HVAC Interaction Factor	0	0	0	0
Baseline Equipment Specifications	0	0	0	0
Post-Retrofit Equipment Specifications	0	2	1	2
Claimed Heating Savings	0	0	0	0
Measure Type Change (e.g., TRM vs. custom)	0	0	0	0
Other	0	0	1	0
Program Total	**0**	**18**	**5**	**2**

Note: Values in tables are number of sites.

Values in tables may not reconcile as presented due to numerical precision.

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.[42] 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 PY6 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 of site evaluations generally included performing onsite measurement and/or obtaining customer-stored data to support downstream M&V calculations. Measurement included spot measurements, runtime 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 SCADA

[42] The SWE requirements were detailed in a February 11, 2014, memo titled *GM-022 Peak Demand Savings for PY5*.

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.

12.2.2 Results

Overall, the program achieved gross realization rates of 1.04 for energy and 0.96 for demand. The program-level relative precision was under the 15 percent target (2.7 percent relative precision at 85 percent confidence interval) for the energy, as well as for the demand estimate (8.8 percent relative precision at 85 percent confidence interval). The summaries of evaluation results for energy and demand are presented in Table 12-4 and Table 12-5, respectively.

Table 12-4: Program Year 6 Smart Equipment Incentives – GNI 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.
Muni Lighting	2,665	2,665	1.00	2,665	0.00	0.0%
Small	10,145	10,145	1.04	10,577	0.14	4.2%
Medium	7,484	7,484	1.00	7,479	0.31	8.2%
Large	5,352	5,352	1.10	5,878	0.08	0.0%
Program Total	**25,645**	**25,645**	**1.04**	**26,599**	**N/A**	**2.7%**
Values in tables may not reconcile as presented due to numerical precision.						

Source: Navigant analysis and program data

Table 12-5: Program Year 6 Smart Equipment Incentives – GNI Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	Adjusted Ex-Ante Demand Savings (MW) [OPTIONAL COLUMN]	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.
Muni Lighting	0.02	N/A	1.00	0.02	0.00	0.0%
Small	1.78	N/A	0.99	1.75	0.10	2.9%
Medium	1.03	N/A	0.91	0.93	1.01	26.6%
Large	0.00	N/A	0.00	0.00	N/A	0.0%
Program Total	**2.83**	**N/A**	**0.96**	**2.71**	**N/A**	**8.8%**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*						

Source: Navigant analysis and program data

12.2.3 Impact Findings and Recommendations

1. **Finding:** Navigant found one particular customer received an incentive far below the proper incentive level. The particular project received an incentive that was only six percent of the ex post calculated incentive level. After speaking with the customer and DNV GL, Navigant determined that DNV GL did not have sufficient information to correctly calculate the incentive level. The customer was eager to receive the incentive rebate and the incentive was given before sufficient information was available to determine the correct incentive.
    a. **Recommendation:** If incentive amount is difficult to determine, DNV GL should seek further assistance from PECO and others to ensure that customers receive an accurate incentive. DNV GL should establish a quality control process to ensure all PECO customers receive the full program incentive they qualify for per the program ex ante review. This process should focus quality control on the HOU and coincidence factor for lighting projects and the motor nominal efficiency for VFD projects. In addition, this will help ensure consistency between the project files and the tracking system.
2. **Finding:** Navigant found that DNV GL supplies project files in an inconsistent manner. DNV GL provides Navigant project files for each project that Navigant includes in its sample. The PUC provides various appendices for implementers to use when calculating prescriptive which DNV GL uses, but they occasionally include multiple versions of the appendices that do not match. Additionally, DNV GL includes supporting documents such as invoices, drawings, applications, etc. Navigant has found that these documents are sometimes irrelevant or conflicting to the final analysis and application.
    a. **Recommendation:** PECO should direct DNV GL to make sure that it maintains a final set of project documents. DNV GL should review projects files and make sure all the information is up to date. This will help ensure which files are drafts and which are final project files. This is important because it will result in more consistency between ex ante and ex post findings and allow PECO to manage the program more effectively. The more accurate the results are that enter the tracking database, the more consistent ex post findings will be. In addition, this will reduce evaluator cost and time searching through draft or irrelevant documents.

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.

12.3.1 Methods

Table 12-6 shows the sample design for the PY6 NTG research.

Table 12-6: Smart Equipment Incentives – GNI Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Small	< 400,000 kWh	108	0.50	85/15	9	11	100%
Medium	400,000 kWh to 1,400,000 kWWh	10	0.50	85/15	6	6	100%
Large	> 1,400,000 kWh	3	0.50	85/15	3	2	100%
Program total		**121**			**18**	**19**	

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

Once the evaluation team estimated free ridership and spillover, Navigant calculated the NTG ratios as illustrated in the equation below.

Equation 12-1. Total NTG Ratio

$$NTG\ Ratio = 1 - Free\ Ridership\ Rate + Spillover\ Rate$$

12.3.1.1 Free Ridership Methodology

The team assessed free ridership using a customer self-report approach following the Research Into Action and ETO framework.[43] 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 12-2 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 12-2. 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

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

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:

- Would have canceled or postponed the project, upgrade, or purchase
- Would have done something that would have produced savings, but not as much as those achieved through the upgrade or equipment replacement as implemented
- Would have completed the upgrade or equipment replacement as implemented
- 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.

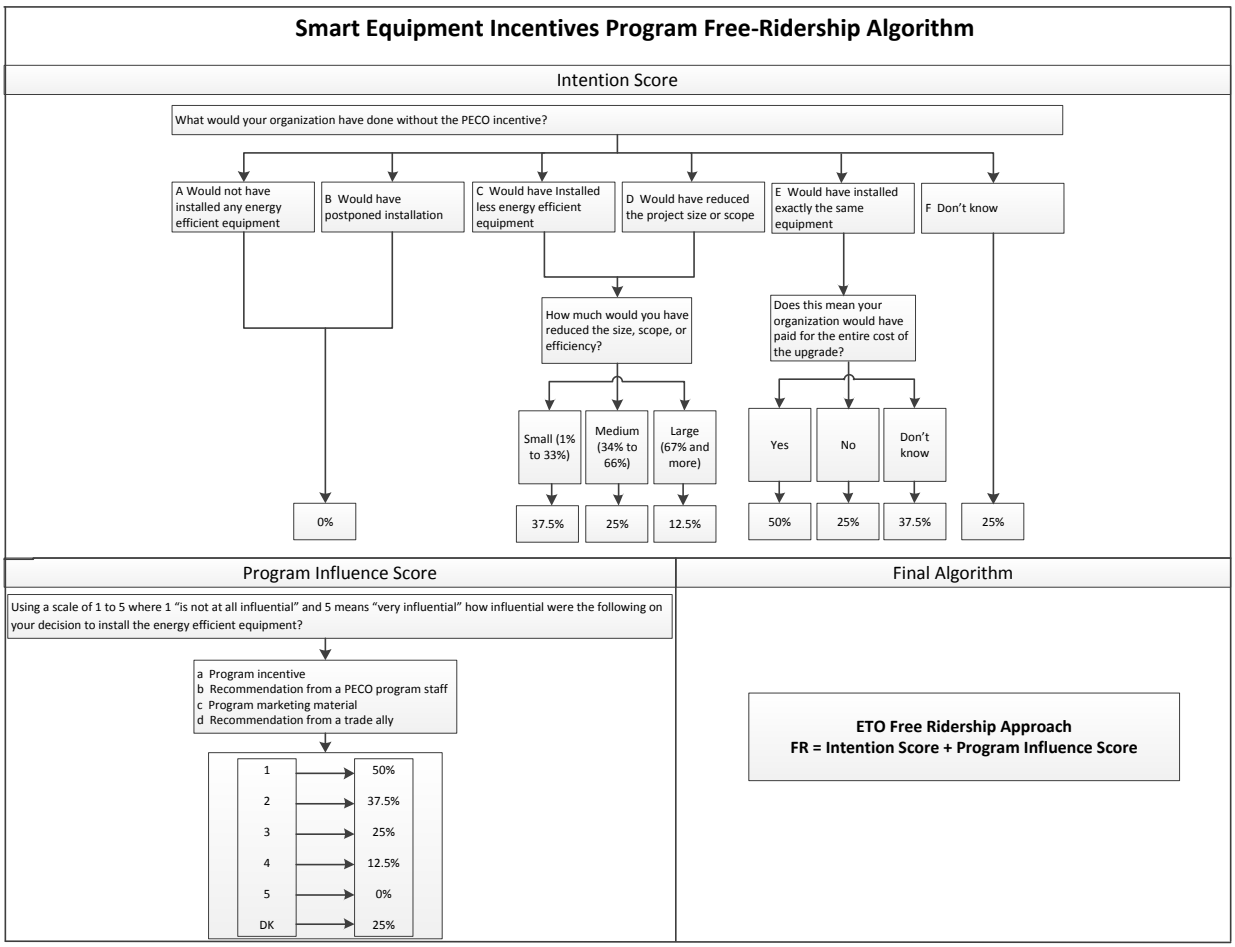
Program Influence Score

To assess the program influence score on participants' 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 analysis

Spillover Methodology

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. Below are examples of the spillover questions:

- 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?
- To the best of your knowledge, do you know when you installed the additional energy efficient equipment?
- Could you describe the energy efficiency measure installed?

- Thinking of the additional measure(s) you installed on your own at this same facility, how do 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.)
- Since participating in the program, have you installed any energy efficient measures in other facilities within PECO's territory?
- 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.)
- Have or will these measures receive incentives through the program?
- 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.

- 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 12-3. Navigant calculated all spillover estimates using customer self-reported data and did not conduct follow-up interviews or site visits.

Equation 12-3. 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 12-4.

Equation 12-4. 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 12-5Equation 11-5 shows the algorithm used to calculate spillover for the program.

Equation 12-5. 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 12-6.

Equation 12-6. Participant Spillover Percentage

$$\%\ Participant\ SO\ = \frac{\sum Participant\ SO\ (population)}{Program\ Savings} * 100$$

12.3.2 Results

The results from the NTG research are shown in Table 12-7. The PY6 SEI GNI NTG ratio is 0.42.

Table 12-7: Program Year 6 Smart Equipment Incentives – GNI Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Planned Coefficient of Variation or Proportion	Relative Precision
Small	0.74	0.02	0.28	0.50	72.4%
Medium	0.40	0.02	0.62	0.50	23.1%
.4Large	0.67	0.02	0.35	0.50	98.9%
Program Total[1]	**0.60**	**0.02**	**0.42**	**0.50**	**21.0%**

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

Values in tables may not reconcile as presented due to numerical precision.

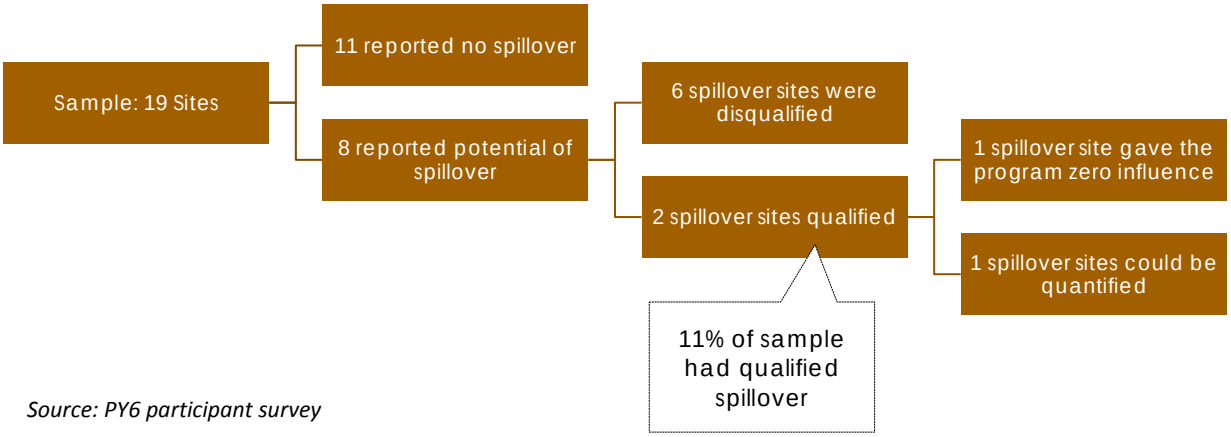
Source: Navigant analysis and program data

In PY6, 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 19 participants surveyed, 8 reported installing additional energy efficient equipment. Out of the eight participants, six participants either could not verify that the spillover projects were developed during PY6 or 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 0.02.

Figure 12-2: PY6 Spillover



Source: PY6 participant survey

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:

- Program marketing plan review
- Tracking system review
- Interviews with six PECO program management staff, four PECO account managers, and four implementation contractor staff
- Twelve interviews with market actors (5 distributors, 4 industry groups, and 3 non-lighting contractors)
- Online and telephone surveys with 26 participating C&I customers and 19 participating GNI customers

12.4.1 Program Marketing Plan Review

The evaluation team reviewed marketing and outreach materials available on the program's website,[44] 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 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 program website 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 and an email hotlink.

[44] www.peco.com/smartideas.

12.4.2 Tracking System Review

PECO uses the SIDS to track its 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.

The evaluation team verified that the tracking system was consistent with the PY6 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 was 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 PY7 of Phase II. The findings, and some recommended steps for improvement, are listed below.

The tracking database continues to get better but still has room for improvement. The evaluation team discovered various discrepancies between the project application files and the SIDS tracking data, about 25 percent of projects have differences between what is in the SIDS tracking data and the project. The discrepancies found were:

- Savings values and algorithm inputs (such as HOU) did not always match between the project files and tracking system.
- Some projects were entered into the tracking system before their final analysis was completed. “Educated guess” savings values were therefore used as inputs. This leads to low predictability of final energy and demand savings.
- Measures listed in tracking system “Measures” tab did not always align with the project files. Some measure descriptions were blank. This limits the usability of the tracking system to know the measures installed.
- Customer contact information was sometimes missing or incorrect.
- Project completion dates in the tracker do not always align with in-service dates. About 50 percent of projects in the database have an application date after the project installation date.

12.4.3 Program Management and Staff Interviews

The evaluation team conducted six in-depth interviews with PECO program staff, four interviews with PECO account managers, and four in-depth interviews with key members of the SEI program implementation contractor team, DNV GL, during the months of April 2015 and May 2015. Navigant designed the interview guides to enable the evaluation team to ask questions about the program’s

administration and delivery during PY6 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 and marketing plans and materials.

12.4.4 Participant Survey

The evaluation team conducted an online survey of participating customers for both the SEI C&I and SEI GNI PY6 retrofit programs. The evaluation team supplemented the online survey with telephone surveys of customers who had not responded to the online survey. In total, the evaluation team completed 45 participating customer surveys. Out of the 45 surveys, 26 surveys were with participating C&I customers and 19 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 12-8 shows the sampling strategy for the participant survey effort.

Table 12-8: Smart Equipment Incentives – GNI Sampling Strategy for Program Year 6

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[1] to Achieve Sample	Used For Evaluation Activities
Small	< 400,000 kWh	108	0.50	85/15	9	11	100%	Online and phone survey
Medium	400,000 kWh to 1,400,000 kWWh	10	0.50	85/15	6	6	100%	Online and phone survey
Large	> 1,400,000 kWh	3	0.50	85/15	3	2	100%	Online and phone survey
Program Total		**121**			**18**	**19**		

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

12.4.5 Process Findings and Recommendations

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. The findings from the process evaluation are listed below.

1. **Finding:** Incentive levels for non-lighting and custom projects do not fully reflect the cost of implementing the measure. Contractors and PECO Account Managers stated that rebates for non-lighting and custom projects are not enough to change decision-making because it is too costly and labor intensive to verify savings unless the size of the project is significantly larger. Participants stated that the major challenge to implementing projects is budget, even

though most respondents said they did have senior management support and energy efficiency is a value within their organization. The evaluation team found out that most of the organizations have a sustainability program in place, but most of those programs do not have a capital budget set aside to implement energy efficiency projects. In addition, participants stated that the incentive amount they receive from the program is only enough to cover the additional cost they have to incur to be eligible to participate.

   a. **Recommendation:** PECO should simplify savings calculations requirements and increase incentive levels for non-lighting and custom measures. The evaluation team heard from contractors that the application process—specifically calculating kWh savings and doing the associated M&V work—is costly and more complex than other utilities' programs in other states. They cited New Jersey and ComEd as simpler programs. In addition, participating respondents stated that in the case of non-lighting and complex custom projects, incentives only cover the expense they have to incur to calculate kWh savings and to comply with program requirements. PECO should use the knowledge of payback periods (usually 2-3 year payback threshold) to develop incentive levels in Phase III for non-lighting and custom projects.

2. **Finding:** The SEI program is pushing the envelope and having a positive impact on the market. The interviews with distributors present evidence that the program is changing energy efficient equipment stocking practices and that it has increased the amount of energy efficiency projects implemented within PECO's service territory. Many participating respondents (60 percent) stated that the SEI program did affect the type of energy efficient equipment their organizations decided to buy and that PECO can be more influencial during the planning phase of the project cycle. Many customers anticipate participating in the program again in PY7 (58 percent of GNI respondents plan to participate again in PY7). Based on interviews with contractors and program participants, it seems like the pre-approval process is a barrier to projects. The wait time after submitting a pre-application is a barrier to completing projects within the planned project timeline.

   a. **Recommendation:** PECO should get involved during the project planning cycle in order to have a greater influence on the type and amount of measures implemented. Based on feedback received from participating respondents, PECO can be more influential if it was involved during the project planning phase. PECO should also consider ways to reduce pre-application review time and compile a list of pre-approved equipment that serves as reference for routine projects.

3. **Finding:** Customer satisfaction is high, but there is an opportunity for PECO to improve customer experience with the application process through increased outreach. Customer satisfaction with the program continues to be high (90 percent of GNI respondents were satisfied or very satisfied with the program in PY6). When asked for ways in which the program can be improved, respondents stated that the hardest part of the process is to establish a project baseline and that they want more assistance from PECO to figure out the engineering requirements included in the application form. Contractors stated that when it comes to filling out the paperwork, PECO's program requirements are more burdensome than other utility programs. They particularly referred to the simplicity of the per-kWh calculations for incentive amounts formulae of other utility programs. Two-thirds of the interviewed contractors stated that marketing is boring and outdated. The evaluation team found that customers who were brought into the program by trade allies and contactors knew of the program shift requiring pre-applications, but the customers whose main point of contact was through PECO's account managers did not know about the change early enough.

a. **Recommendation:** PECO should instruct DNV GL to increase outreach, develop new and interesting promotional materials, and create metrics to measure the impact of all the marketing activities. Based on interviews with market actors, PECO should send an outreach employee to attend Chamber of Commerce meetings, trade association meetings, or meetings for sales reps of electrical equipment distributors. In addition, participating respondents would like PECO to improve their outreach and promotional materials to include real-life case studies on businesses that participated in the program, these case studies should include small, medium and large companies and provide a real cost-benefit analysis. PECO should make sure program staff are well trained on the program and on how to interact with customers. SEI program staff and DNV GL should interact with PECO account managers to keep them up to date on program developments, and use them as a tool to increase program participation.

12.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The evaluation team used various analytical methods to complete the evaluation, including performing a gross impact evaluation; a program materials review; a tracking system review; a verification and due diligence review; interviews with PECO program managers, implementation contractor staff, and PECO account managers; participant surveys; and market actors. This subsection details recommendations from the evaluation, and Table 12-9 lists a summary of each recommendation along with the PECO status.

Table 12-9: Smart Equipment Incentives – GNI Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1. PECO should direct DNV GL to provide a final set of project documents.	Being considered. Currently setting expectations with CSP to have a certain number of documents on all paid finished projects.
Recommendation 2. DNV GL should ensure customers receive an accurate incentive. If incentive amount is difficult to determine, seek further assistance.	In process. Working with outreach and an internal point of contact helping manage large accounts to ensure we are involved in every project in the earliest stage possible
Recommendation 3. PECO should simplify savings calculations requirements and increase incentive levels for non-lighting and custom measures.	Being considered. Working with DNV engineering to identify measures that use a standard, industry-based baseline for usage.
Recommendation 4. PECO should get involved during the project planning cycle in order to have a greater influence on the type and amount of measures implemented.	In process. Working with outreach and an internal point of contact helping manage large accounts to ensure we are involved in every project in the earliest stage possible.
Recommendation 5. PECO should instruct DNV GL to increase outreach, develop new and interesting promotional materials, and create metrics to measure the impact of all marketing activities.	In process. Currently working with promotions team to develop new pathways and materials to customers and trade allies.

Source: Navigant and PECO

12.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 12-10.

Table 12-10: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	8,005	10,503
2	EDC Incentives to Participants	2,833	3,863
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of incentives/rebates paid by utilities)	5,173	6,640
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	3,046	5,580
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	3,046	5,580
8	Marketing[2]	0	0
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	11,052	16,084
13	Total NPV Lifetime Energy Benefits	17,336	22,993
14	Total NPV Lifetime Capacity Benefits	1,339	2,033
15	Total NPV TRC Benefits[4]	18,675	25,038
16	TRC Benefit-Cost Ratio[5]	1.69	1.56

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

13. SMART CONSTRUCTION INCENTIVES

The PECO Smart Construction Incentives (SCI) program kicked off in February 2011 during the second half of PY2 in PECO's Phase I Energy Efficiency and Conservation Plan. The program is designed to instill and accelerate adoption of energy efficient design and construction practices so that new C&I facilities in the PECO territory are more energy efficient than the current stock. The program covers both new construction as well as buildings undergoing major renovation, which is defined as construction that involves the complete removal, redesign, and replacement of two or more major building systems. The target markets for the PECO SCI program are decision makers for the design and/or construction of new facilities, renovation contractors and developers. The program provides facility designers and builders with training, design assistance, and financial incentives to incorporate energy efficient systems into their building designs.

The eligible customer population for the program is all C&I projects under consideration in the PECO service territory or accounts provided with electricity by PECO, including GNI facilities.

13.1 PROGRAM UPDATES

PECO has fully implemented the marketing plan it developed in the latter half of PY5. Strategies 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 continued working to increase program awareness among the design community by hosting educational seminars, presenting case studies, and promoting success stories. PECO also fully implemented the strategy of staffing specific managers and engineers on projects based on their project type or industry, which aims to create longer term relationships with customers. These strategies helped increase program participation in PY6 to be over two and half times the participation in PY5. Program managers are confident that the strategies will continue to increase program participation into PY7.

PECO's program CSP, DNV GL, also implemented outreach strategies in PY6 by establishing an outreach team that is solely focused on engaging with customers and contractors. In addition, communication between PECO and DNV GL is more consistent and transparent in PY6. This helps the teams coordinate efforts effectively.

The SCI program completed 73 projects in PY6. Of these 73 projects, 56 were in the C&I sector and 17 were in the GNI sector.

13.1.1 Definition of Participant

Each participant of 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.

13.2 IMPACT EVALUATION GROSS SAVINGS

Table 13-1 shows the program reported savings by sector.

Table 13-1: Phase II Smart Construction Incentives 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	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	78	13,876	2.4	$1,674
Government, Non-Profit, and Institutional	24	4,833	0.5	$595
Phase II Total	**102**	**18,708**	**3.0**	**$2,269**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

13.2.1 Methods

The impact evaluation consisted of a combination of desk reviews, telephone verifications, onsite verifications, and building models 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 PY6 tracking database. Sampling was conducted after Q3 and Q4, when all projects completed in PY6 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 PY6. The sampling strategy used in PY6 is presented in Table 13-2.

Table 13-2: Smart Construction Incentives Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large Projects	7	85/15	6	6	Desk Review and Onsite M&V
Small Projects	54	85/15	27	27	Desk Review and Telephone Verification
Large Whole Building	7	85/15	6	6	Desk Review, Onsite M&V, and Whole Building Modeling
Small Whole Building	5	85/15	5	5	Desk Review, Telephone Verification, and Whole Building Modeling
Program Total	**73**	**N/A**	**44**	**44**	**N/A**

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Navigant used four main approaches for evaluating the sampled projects: desk review, telephone verification, onsite M&V, and whole building modeling. 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 U.S. Department of Energy (DOE).

13.2.1.1 Desk Review and Telephone Verification

Navigant conducted desk reviews for all projects in the evaluation sample. The desk review made use of project applications. project-specific analysis files and associated calculation sheets, measure invoices, measure specification sheets, construction plans, and other construction documents provided by PECO. Documentation included scanned files of hard copy forms, as well as electronic files of CSP inspection reports, photos of installed measures, and important email and memoranda. For whole-building projects, PECO also provided the executable modeling files and related model output files. The evaluation team supplemented the desk reviews with telephone verification or onsite verification. The telephone verification consisted of interviewing customers about their project, the quantities and type of each measure installed, the operating status of the measures, equipment nameplate data, operating schedules, a careful description of site conditions, and overall verification of the information contained in the project files. Onsite verifications are described below.

13.2.1.2 Desk Review and Onsite M&V

Navigant conducted desk reviews for all projects in the evaluation sample. In addition, Navigant conducted onsite verification for all projects in the Large Projects stratum and the Large Whole Building stratum to supplement the desk reviews. Navigant also conducted onsite verification for complex projects in the Small Projects and Small Whole Building strata where project documentation was insufficient for verification via desk review and telephone interview. Navigant also conducted onsite verification for projects where the 2014 PA TRM required detailed inventory, such as lighting projects with demand savings greater than 20 kW. The primary objective of the visits was to collect the data identified in the SSMVP), including verification of installed measure 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 projects that surpassed the expected kWh savings thresholds set in Table 13-2 of the 2014 PA TRM, the evaluation team also collecteted site-specific information for open variables used in the calculation of energy and demand savings. Site-specific information included end-use metered data and trend data from building management systems (BMSs).

13.2.1.3 Whole Building Modeling

Navigant verified the building models for all projects in the Small Whole Building and Large Whole Building strata. Analysis included comparing model inputs to verified parameters and making adjustments to modeled savings as needed. In all cases, PECO provided the executable modeling files, and Navigant was able to directly adjust the original models.

13.2.1.4 Onsite Inspections

The evaluation team conducted onsite verification for a total of 19 projects in the PY6 evaluation sample. Of these projects, six were in the Large Projects stratum, six were in the Large Whole Building stratum, five were in the Small Projects stratum, and two were in the Small Whole Building stratum.

Trained engineering staff from Navigant and Warren Energy Engineering, a Navigant subcontractor, performed these site verifications. The onsite verification of these 19 projects aligns with the SCI Evaluation Plan for Phase II,[45] which states that Navigant will conduct onsite verification for all sampled projects in the top whole building strata (Large Whole Building) and the top non-whole building strata (Large Projects). In addition, the Plan states that Navigant may support verification by gathering supplemental information or performing onsite verification for other whole building projects (Small Whole Building stratum) and projects for which project files are unclear (Small Whole Building and Small Projects strata).

The onsite verification teams verified that equipment was installed and in operation in all cases, thus no sites failed the inspection process. The data gathered by the verification teams were used to update the inputs for open variables used in the calculation of verified energy and demand savings. The parameter that was updated with the most frequency was equipment hours of operation. Navigant updated open variables used in the calculation of verified energy and demand savings in 16 of the 19 projects that were verified onsite.

13.2.2 Results

Overall, the PY6 program achieved gross realization rates of 1.10 for energy and 1.02 for demand. The PY6 program-level relative precisions were 4 percent at 85 percent confidence for energy and 9 percent at 85 percent confidence for demand. The summary of evaluation results for energy and demand are presented in Table 13-3 and Table 13-4, respectively.

Table 13-3: Program Year 6 Smart Construction Incentives 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 Projects	3,440	1.41	4,858	0.33	8.6%
Small Projects	3,215	0.91	2,942	0.74	14.9%
Large Whole Building	5,758	1.03	5,916	0.06	1.5%
Small Whole Building	630	0.97	611	0.07	0.0%
Program Total	**13,043**	**1.10**	**14,326**	**N/A**	**4.4%**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis and program data

[45] Evaluation Plan: PECO Act 129 – Phase II, Energy Efficiency and Conservation Portfolio Phase II

Table 13-4: Program Year 6 Smart Construction Incentives 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.
Large Projects	0.59	1.05	0.62	0.41	10.7%
Small Projects	0.78	0.83	0.65	0.56	11.4%
Large Whole Building	0.67	0.94	0.63	1.24	32.4%
Small Whole Building	0.06	3.90	0.24	1.40	0.0%
Program Total	**2.10**	**1.02**	**2.13**	**N/A**	**9.3%**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

13.2.3 Impact Findings and Recommendations

Based on the data collection approach described above, Navigant developed the following findings.

1. **Finding:** Savings values and measure descriptions in the tracking system were sometimes inconsistent with the information in the project files. The evaluation team found that the energy and demand savings values listed in the tracking system sometimes did not match the information contained in the project files, and therefore over or underreported the actual ex ante savings values. Further research showed that this was due to data entry errors or to outdated project savings information that was not updated in the tracking system. The evaluation team also found that measure-level information in the tracking system was sometimes blank. Other times the information was inaccurate and did not align with the details listed in project files. The evaluation team's verification of measure counts and specifications showed that the information in the project files was correct.
   a. **Recommendation:** PECO should instruct the program CSP, DNV GL, to establish a quality control process to ensure that project information entered into the tracking system is correct and complete. A structured quality control process will help ensure that measure-level data entered into the tracking system is complete and no fields are left blank. It will also help ensure that the information itself is correct and aligns with the specifications listed in the project files. The quality control process will also help ensure that data entry errors for reported energy and demand savings values are fixed before the data is transferred to PECO. Finally, it will help ensure that energy and demand savings values entered into the tracking system are correct and align with the final savings analysis for each project. These tracking system improvements will help PECO have a more accurate understanding of the program's performance.
2. **Finding:** Inputs for open variables used in the calculation of energy and demand savings were sometimes incorrect for projects that surpassed the kWh savings thresholds set in Table 1-2 of the 2014 PA TRM. The evaluation team found that variable inputs were incorrect in the ex ante savings calculations for some projects, particularly those that surpassed the kWh savings thresholds set in Table 1-2 of the 2014 PA TRM. The hours of operation for equipment and the square footage used in lighting power density calculations

were the parameters that were updated most often during ex post analyses. These parameters were the key in most projects that did not achieve a 100 percent realization rate in energy and demand savings at the project level. The equipment hours of operation made a large difference in projects where hours differed greatly from the defaults listed in the TRM. Examples are retail stores that operate as 24/7 facilities, but the CSP used default retail hours in the ex ante analyses—the evaluation team updated these inputs in the ex post analyses. The square footage used in lighting power density calculations was key in cases where fractions of very large facilities had large new lighting installations, yet the square footage values used to calculate savings were those of the entire facilities, not the specific fractions where the projects took place. This skewed the savings attributed to the lighting projects and was updated during the ex post analyses.

a. **Recommendation:** PECO should instruct the program CSP, DNV GL, to gather project-specific data through customer interviews for projects that surpass the expected kWh savings thresholds set in Table 1-2 of the 2014 PA TRM. These projects are the largest in the program and greatly influence the program-level verified savings and realization rates. The CSP should gather inputs for open variables through customer interviews during the application or final inspection processes. These customer-reported values should be used to calculate ex ante energy and demand savings. This will allow the results for these projects to be closer to the verified savings that result from Navigant's end-use metering and BMS trend data gathering during verification. This will in turn allow PECO to have a more accurate understanding of energy and demand savings for these large projects throughout the program year.

13.3 IMPACT EVALUATION NET SAVINGS

13.3.1 Methods

Navigant calculated gross program impacts and then derived net program impacts by estimating an NTG ratio. The ratio quantifies the percentage of the gross program impacts that can reliably be attributed to the program. Table 13-5 shows the sample design for the PY6 NTG research.

Table 13-5: Smart Construction Incentives Sampling Strategy for Program Year 6 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[1] to Achieve Sample
Small	< 310,000 kWh	47	0.50	85/15	9	12	100%
Medium	310,000 kWh to 850,000 kWh	8	0.50	85/15	6	5	100%
Large	> 850,000 kWh	3	0.50	85/15	3	2	100%
Program Total	**N/A**	**58**	**N/A**	**N/A**	**18**	**19**	**100%**

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis and program data

Navigant calculated the NTG ratio as described in Equation 13-1. The methodologies for estimating free ridership and spillover are described further below.

Equation 13-1 Total NTG Ratio

$$NTG\ Ratio = 1 - Free\ Ridership + Spillover\ Rate$$

13.3.1.1 Free Ridership Methodology

The evaluation team assessed free ridership using a customer self-report approach following the SWE's Common Approach for Downstream Programs.[46] 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 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 11-2 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 13-2. Total Free Ridership

$$Free\ Ridership\ (FR) = \frac{Intention\ Score + Program\ Influence\ Score}{100}$$

Intention Score

Navigant assessed the intention score through several brief questions used to determine how the equipment upgrade 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 technical assistance and other program features. The offered response options captured the following four general outcomes:

- Respondent would have canceled or postponed the project, upgrade, or purchase
- Respondent would have done something that would have produced savings, but not as much as those achieved through the equipment upgrade implemented
- Respondent would have completed the equipment upgrade implemented
- Respondent does not know

The algorithm considers 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 considered 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 such as SCI). The respondents that indicated they would have undertaken the project as implemented without the program received a

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

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.

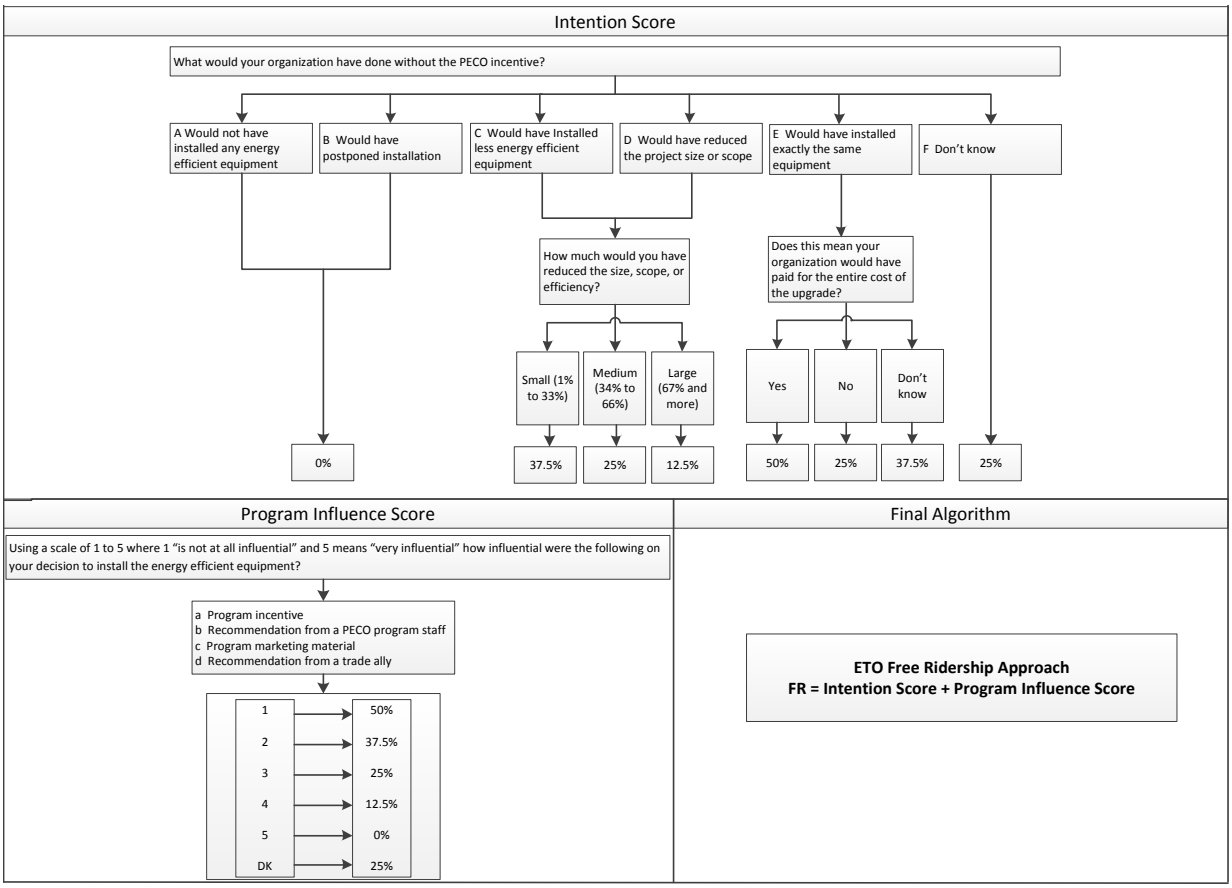
Program Influence Score

Navigant asked respondents how much influence various program elements had on the decision to implement the project to assess the program influence score. The scale for responses ranged from 1 (no influence) to 5 (great influence). The elements included as potential influencers on customer decision-making included program information, program incentives, interaction with program staff (technical assistance), and interaction with program proxies such as members of the trade ally network.

A participant’s program influence score was 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 13-1 summarizes both the intention score and program influence score calculations for the SCI 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 13-1: SCI Free Ridership Algorithm for Program Year 6



Source: Navigant analysis and program data

13.3.1.2 Spillover Methodology

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. Below are examples of the spillover questions:

- 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?
- To the best of your knowledge, do you know when you installed the additional energy efficient equipment?
- Could you describe the energy efficiency measure installed?
- Thinking of the additional measure(s) you installed on your own at this same facility, how do 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.)
- Since participating in the program, have you installed any energy efficient measures in other facilities within PECO's territory?
- 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.)
- Have or will these measures receive incentives through the program?
- 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.

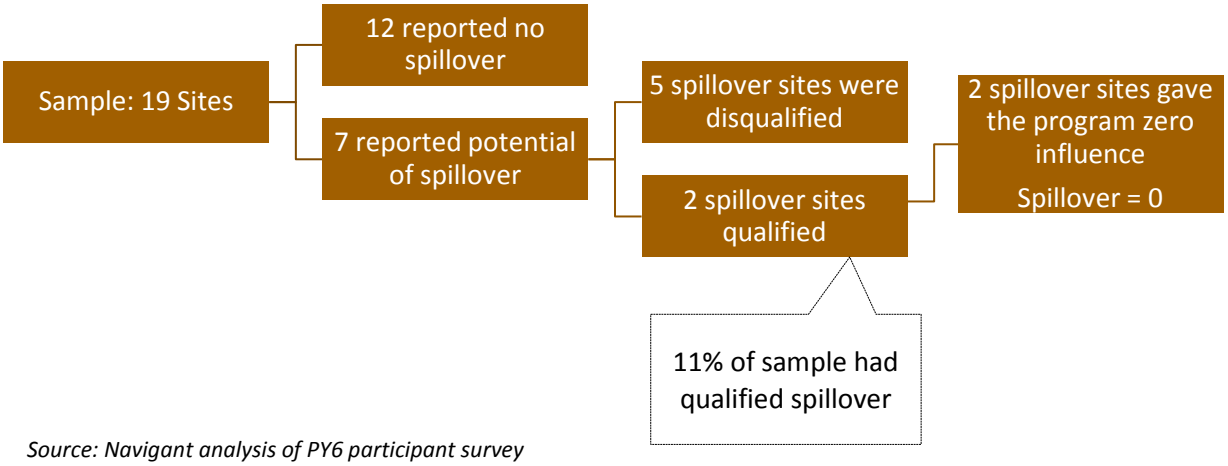
- On a 0 to 5 scale, with 0 meaning "not at all influential" and 5 meaning "extremely influential," how influential was your experience with PECO's program in your decision to install the additional energy efficient equipment?

The team assigned the influence rating a value that determined what proportion of the measure's energy savings were attributed to the program:

- A rating of 4 or 5 = 1: 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

As shown in Figure 13-2, the Navigant team determined that of the 19 participants surveyed, seven reported installing additional energy efficient equipment. Out of the seven participants that reported installing additional energy efficient equipment, five participants either could not verify that the spillover projects were developed during PY6 or 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. These two participants gave the program an influence score of zero. Therefore, no savings were attributed to the program, and the total spillover was zero.

Figure 13-2: SCI Spillover for Program Year 6



Source: Navigant analysis of PY6 participant survey

13.3.2 Results

The results from the NTG research are shown in Table 13-6. The PY6 SCI NTG ratio is 0.52.

Table 13-6: Program Year 6 Smart Construction Incentives Summary of Evaluation Results for NTG Research

Stratum	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Planned Coefficient of Variation or Proportion	Relative Precision
Small	0.69	0.00	0.31	0.50	46.5%
Medium	0.43	0.00	0.57	0.50	12.5%
Large	0.35	0.00	0.65	0.50	17.3%
Program Total[1]	**0.48**	**0.00**	**0.52**	**0.50**	**9.5%**

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

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

13.4 PROCESS EVALUATION

In accordance with the evaluation plan, the evaluation team conducted multiple research activities in support of the process evaluation in PY6. These research activities are listed below:

- Program marketing plan review

- Interviews with three PECO program management staff
- Interviews with two CSP staff
- Interviews with six market actors
- Online and telephone surveys with 21 participating SCI customers

13.4.1 Program Marketing Plan Review

The evaluation team reviewed marketing and outreach materials available on the program's website,[47] as well the Strategic Marketing and Outreach Plan developed by DNV GL, the program's CSP.

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 SCI website 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 and an email hotlink.

13.4.2 PECO Program Management and CSP Staff Interviews

The evaluation team conducted three in-depth interviews with PECO program staff and two in-depth interviews with key members of the SCI program implementation team, DNV GL, during the months of April 2015 and May 2015. Navigant designed the interview guides to enable the evaluation team to ask questions about the program's administration and delivery during PY6, and also to obtain real-time information about current program activity through open-ended questions that created a free-flowing conversation. To aid in making these interviews informative, the evaluation team reviewed current program reporting documents and marketing plans and materials.

13.4.3 Market Actor Interviews

Navigant conducted six in-depth interviews with new construction market actors within PECO's service territory. The interviewees included representatives from architectural, engineering, manufacturing, general construction, and energy management consulting firms. The interviewees' work focused on non-residential building types including healthcare, science and technology, pharmaceuticals manufacturing, sports and entertainment, government, higher education, culture, grocery stores, and high rise buildings for large offices and apartments/condominiums. The purpose of these interviews was to understand the current new construction market and the effects of SCI program marketing and training, the barriers to program participation, and ways the program can better address market needs. Navigant designed the interview guides to enable the evaluation team to ask questions about the program, and also to obtain feedback about program activities through open-ended questions that created a free-flowing conversation.

13.4.4 Participant Survey

The evaluation team conducted an online survey for PY6 SCI participating customers. The evaluation team supplemented the online survey with telephone surveys of customers who had not responded to the online survey after the initial outreach and follow-up. In total, the evaluation team completed 21 participating customer surveys. The team emailed all participants the survey and ensured the number of responses needed to meet an 85 percent confidence level at 15 percent precision 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 areas such as program design and implementation, program marketing and awareness, and customer satisfaction. Table 13-7 shows the sampling strategy for the participant survey effort.

[47] www.peco.com/smartideas

Table 13-7: Smart Construction Incentives Sampling Strategy for Program Year 6

Stratum	Stratum Boundaries	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	Used For Evaluation Activities (Impact, Process, NTG)
Small	< 310,000 kWh	47	0.50	85/15	9	13	100%	Process, NTG
Medium	310,000 kWh to 850,000 kWh	8	0.50	85/15	6	6	100%	Process, NTG
Large	> 850,000 kWh	3	0.50	85/15	3	2	100%	Process, NTG
Program Total	**N/A**	**58**	**N/A**	**N/A**	**18**	**21**	**100%**	**Process, NTG**
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant analysis and program data

13.4.5 Process Findings and Recommendations

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. The findings from the process evaluation are listed below.

1. **Finding:** Incentive levels are not enough to influence decision makers. Respondents stated that the incentive amount they receive from the program is only enough to cover the additional cost they have to incur to be eligible to participate, such as building energy modeling requirements. In addition, they stated that the two major challenges to implementing projects are budget and the difficulty of measuring energy savings. About 55 percent of respondents said the program did not affect what energy efficient equipment their organization decided to purchase. About 47 percent of respondents stated they would have done the project if the program was not available; this is consistent with the high level of free ridership found in the NTG analysis.
   a. **Recommendation**: PECO should offer an incentive for building modeling expenses. Implementing an incentive to cover modeling costs will compensate participants for the administrative costs of participating in the program. Other energy efficiency/DSM programs across the country offer similar incentives. This incentive would help offset the cost of participating in the program and could potentially help PECO increase program participation.
2. **Finding:** Project building cycles determine the potential pool of participants, not the SCI program. The evaluation team found that the timeline of new construction projects does not always align well with project application timeline requirements. For example, a project application may be due before the building design is finalized, limiting program participation. Most new construction projects take more than 1 year to be completed. PECO could be more influential in design decisions if it gets involved the during planning and budgeting phases of the projects. Most respondents (70 percent) stated their organization is considering installing additional energy efficient equipment in the next 12 months. Future

types of projects being considered include: new/ongoing construction projects, lighting, chillers, VFD controls, refrigeration, and HVAC.

a. **Recommendation:** PECO should gain better understanding of the new construction market and the project cycle by getting involved earlier in new construction projects. Based on feedback received from participating respondents, PECO can be more influential if it becomes involved during the project planning and budgeting phases of the project cycle. Given that many new construction projects take more than 1 year to be completed, PECO should start getting involved in new construction projects that are in the project planning and budgeting phases during PY7 to gain a better understanding of the type and size of projects that are likely to go through the program in Phase III. Getting involved earlier will also help to reduce program free ridership.

3. **Finding:** Participant satisfaction can be improved by overcoming program process hurdles such as difficulties and expenses involved with the application form engineering calculations. Seventy-five percent of respondets said they are very satisfied or somewhat satisfied with the program. This satisfaction level for the SCI program is lower than the levels found in other PECO programs. Most importantly, 15 percent of respondents stated they were not at all satisfied with the SCI program. The main reasons for dissatisfaction were that the respondents anticipated a higher rate of return and that the application requirements were cumbersome and of little value to them. In addition, the evaluation team found that program outreach to customers is sometimes too late in the building design process for measure specifications to be updated to meet program requirements.

   a. **Recommendation:** PECO should instruct the program CSP, DNV GL, to begin outreach earlier in the project cycle and to implement metrics to track promotion activities. An increase in outreach can mitigate some of the hurdles of the application process that respondents reported. The SCI application requires a significant amount of documentation (i.e., building plans, energy modeling, and other documents). Starting outreach earlier in the project cycle will help clarify customers' questions and improve their overall experience with the SCI program.

13.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

This subsection details recommendations from the evaluation. A summary of each recommendation's status is included in Table 13-8.

Table 13-8: Smart Construction Incentives Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1. PECO should instruct the program CSP, DNV GL, to establish a quality control process to ensure that project information entered into the tracking system is correct and complete.	Being considered/in process. Working with CSP to develop better methods and have established a peer review process.
Recommendation 2. PECO should instruct the program CSP, DNV GL, to gather project-specific data through customer interviews for projects that surpass the expected kWh savings thresholds set in Table 13-2 of the 2014 PA TRM.	Being considered/in process. Working with CSP to develop better methods and have established a peer review process.
Recommendation 3. PECO should offer an incentive for building modeling expenses.	Being considered. These incentives are being considered for Phase III.
Recommendation 4. PECO should gain better understanding of the new construction market and the project cycle by getting involved earlier in new construction projects.	In process. PECO agrees and is gaining a better understanding of the cycle.
Recommendation 5. PECO should instruct the program CSP, DNV GL, to begin outreach earlier in the project cycle and to implement metrics to track promotion activities.	Implemented. Program CSP has been instructed to begin project outreach earlier and track promotional activities.

Source: Navigant and PECO

13.6 FINANCIAL REPORTING

The SCI program achieved a TRC benefit-cost ratio 2.11 in PY6. This shows that the program continues to operate cost-effectively. A breakdown of the program finances is presented in Table 13-9.

Table 13-9: Summary of Smart Construction Incentives Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	6,627	8,912
2	EDC Incentives to Participants	1,465	2,017
3	EDC Incentives to Trade Allies	189	252
4	Participant Costs (Net of incentives/rebates paid by utilities)	4,973	6,642
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	1,317	2,335
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	1,317	2,335
8	Marketing[2]	0	0
9	EDC Evaluation Costs	**0**	**0**
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	7,943	11,247
13	Total NPV Lifetime Energy Benefits	14,052	18,575
14	Total NPV Lifetime Capacity Benefits	2,691	3,147
15	Total NPV TRC Benefits[4]	16,743	21,722
16	TRC Benefit-Cost Ratio[5]	2.11	1.93

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits and is 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

14. SMART MULTI-FAMILY SOLUTIONS PROGRAM

The PECO Smart Multi-Family (SMF) Solutions program's purpose is to increase awareness of energy savings opportunities in multi-family buildings and to assist multi-family tenants and property owners/managers (referred to as landlords in the remainder of this report) to act on those opportunities. This program is designed to encourage and assist customers by offering two main participation channels. The direct install (DI) channel offers cost-free CFL, low-flow showerhead (LFSH), and low-flow faucet aerator (LFFA) DI in apartment units/condos (units), or common areas. The prescriptive channel offers incentives to multi-family landlords who install high-efficiency equipment in common areas. So far in Phase II, the program has not seen any participation in the prescriptive channel, and 100% of verified savings resulted from DI measures. In PY6, lighting measures contributed to 80% of DI measure savings.

A major barrier to energy efficient measure adoption in multi-family buildings is the division of responsibilities between landlords and tenants. Landlords are responsible for building improvements; however, they usually are not the ones paying the energy bills for tenant spaces, and therefore do not reap the benefits of installing more expensive, energy efficient measures within those spaces. This is also known as the split incentive issue. The issue often results in energy efficiency becoming a low-priority item for both landlords and tenants. The SMF Solutions program helps PECO overcome the split incentive issue by including cost-free DI measures. By working directly with the landlords to implement cost-free DI measures, the SMF Solutions program helps landlords save capital to potentially spend on the program's prescriptive channel offerings.

The SMF Solutions program evaluation team analyzed the program's residential and nonresidential sectors separately. The nonresidential sector includes participants from the C&I segment and the GNI segment. In PY6, the GNI segment represented just 4% of the total program nonresidential sector savings.

14.1 PROGRAM UPDATES

PECO has not made any major changes to the SMF Solutions program offerings since the beginning of Phase II.

14.1.1 Definition of Participant

For reporting purposes, PECO defines the participant count as the number of individual utility accounts affected by SMF Solutions program projects. In the residential sector, a single utility account corresponds to an individually metered apartment unit or condo. In the nonresidential sector, a single utility account could correspond to either a property's common or office areas, a group of master metered units, or a group of third-party units.

14.2 IMPACT EVALUATION GROSS SAVINGS

In PY6, the SMF Solutions program reported 6,828 MWh gross energy savings and 0.84 MW gross demand savings. Reported savings in PY6 split almost evenly between the residential (51% of reported gross energy savings and 53% of reported gross demand savings) and nonresidential (49% of reported gross energy savings and 47% of reported gross demand savings) sectors. Table 14-1 provides the Phase II totals at the PY6 close.

Table 14-1: Phase II Smart Multi-Family Solutions Program Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)*	Incentives ($1,000)
Residential	17,753	5,886	0.6	$0
Low-Income	0	0	0.0	$0
Large Commercial and Industrial	673	6,000	0.6	$0
Small Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	23	278	0.0	$0
Phase II Total	**18,449**	**12,164**	**1.3**[1]	**$0**

[1] Note that the Phase II Total is greater than the sum of the individual sectors because of rounding
* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

14.2.1 Methods

The gross impact evaluation consisted of several steps. The evaluation team conducted file reviews and telephone surveys with participants for verbal verification of DI measure installation. The team then conducted on-site visits for a subset of telephoned participants for enhanced verification. The evaluation team also verified the ex ante savings algorithm's adherence to the TRM for the census of program projects.

The evaluation team selected a stratified random sample from the program population for file reviews and telephone surveys. A separate sample was selected for each the residential and nonresidential sectors. The evaluation team selected sample sites from size-stratified residential (strata = unit project size) and nonresidential populations (strata = property total project size). The evaluation team selected 44 total units for the residential sector and 40 properties for the nonresidential sector. This sample was also utilized for the NTG research and process evaluation telephone surveys. The evaluation team sub-sampled 16 sites (8 residential and 8 non-residential) from the 84 sample points for onsite visits. Table 14-2 details the sampling strategy for the gross impact evaluation.

Table 14-2: Smart Multi-Family Solutions Program Sampling Strategy for Program Year 6

Stratum	Population Size[1]	Target Levels of Confidence & Precision	Target Sample Size[2]	Achieved Sample Size[3]	Evaluation Activity
Residential Participants	11,308	85/15	30 (8)	44 (8)	File Reviews & Telephone Surveys (Onsite Visits)
Nonresidential Participants	158	85/15	30 (8)	40 (8)	File Reviews & Telephone Surveys (Onsite Visits)
SMF Solutions Program Total	**11,466**	**85/15**	**60 (16)**	**84 (16)**	**File Reviews & Telephone Surveys (Onsite Visits)**

[1] The residential population size indicates the number of participants (i.e., apartment units or condos). The nonresidential population size indicates the number of participating properties.
[2] Paranthetical values indicate the target sample size for onsite verification. Onsite visits were made to a sub-sample of the telephoned population.
[3] Paranthetical values indicate the achieved sample size for onsite verification. Onsite visits were made to a sub-sample of the telephoned population.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis of program tracking data

The evaluation team performed savings calculations for each record in the program tracking data based on guidance from the Pennsylvania TRM (June 2014). The evaluation team compared the independently calculated savings to each record's reported savings. This review found that reported gross savings aligned with TRM methodology.

The evaluation team conducted file reviews on the selected sample to verify that measure counts, efficiency ratings, and reported savings in the project summary files matched the program tracking data. Telephone surveys were then conducted to verify measure counts. A sub-sampled set of the reviewed projects were visited to verify measure counts and efficiency ratings through visual inspection. For those sample points that received onsite visits, the onsite visit results replaced telephone survey results in gross impact calculations. In total, the evaluation team included 84 sample points in the gross impact evaluation, where 16 of the 84 sample points received enhanced gross impact evaluations through onsite visits.

Mondre Energy conducted the gross impact evaluation onsite visits. During each visit, the onsite M&V personnel conducted a walkthrough of the facility in order to verify installed measure counts and pertinent details such as wattage and flow rate. Installed measures included CFLs, LFFA, and LFSH. The program tracking data does not include the DI measures' make and model information. For CFLs, the tracking data only lists the bulb shape and the wattage. For LFFA and LFSH, the tracking data only lists

the fixture's flow rate. Onsite M&V personnel identified a bulb or fixture as a program measure if the shape and wattage (CFLs) or the marked flow rate (LFFA or LFSH) matched the tracking data specifications. It is important to note that if a program measure failed or was otherwise removed and was replaced in kind, the visual inspection would falsely identify the equipment as an installed program measure.

For those sample points that received onsite visits, the onsite visit results replaced telephone survey results in gross impact calculations. In total, the evaluation team included 84 sample points in the gross impact evaluation, where 16 of the 84 sample points received enhanced gross impact evaluations through onsite visits.

14.2.2 Results

The residential sector gross impact evaluation efforts yielded a 0.91 realization rate for energy and demand savings. The realization rate is less than one because telephone survey participants indicated that either the measure counts were wrong, they did not receive the measure at all, or that the measure had been replaced. Additionally, the onsite efforts discovered a site where one CFL had been replaced by an incandescent bulb and one CFL had burnt out but was still in place. The residential gross impact evaluation achieved 6% relative precision at 85% confidence (below the 15% target). Table 14-3 and Table 14-4 provide residential sector energy and demand savings gross impact summaries, respectively.

Table 14-3: Program Year 6 Smart Multi-Family Solutions Residential Sector 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) in Sample Design	Relative Precision at 85% C.L.
SMFRES - Large	1,179	0.93	1,100	0.17	8.2%
SMFRES - Medium	1,171	0.82	960	0.44	14.9%
SMFRES - Small	1,162	0.98	1,135	0.07	2.5%
Program Total	**3,512**	**0.91**	**3,195**	**N/A**	**5.7%**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis

Table 14-4: Program Year 6 Smart Multi-Family Solutions Residential Sector 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) in Sample Design	Relative Precision at 85% C.L.
SMFRES - Large	0.15	0.93	0.14	0.18	8.6%
SMFRES - Medium	0.15	0.81	0.12	0.44	15.0%
SMFRES - Small	0.15	0.98	0.15	0.07	2.4%
Program Total	**0.45**	**0.91**	**0.41**	**N/A**	**5.8%**
* All reported and verified demand savings in this report include line losses as required. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis

The nonresidential sector gross impact evaluation yielded a 0.98 realization rate for energy and demand savings. All survey participants confirmed that at least 98% of the measures were still in place or replaced in kind. The onsite efforts discovered one site where the CFL count found in the property's common area was less than reported in the tracking data. The nonresidential gross impact evaluation achieved 2% relative precision at 85% confidence (well below the 15% target).

Table 14-5 and Table 14-6 provide the nonresidential sector energy and demand savings gross impacts, respectively.

Note that the nonresidential realization rate nears 1.0, likely due to response bias regarding nonresidential in-unit projects. Landlords were asked to confirm all nonresidential measure installations, including any nonresidential measures installed within a unit. These questions were asked of landlords, as opposed to the unit tenants, because nonresidential tenants could not be contacted. Since nonresidential in-unit projects occur in master-metered or third-party customer units, residents are not direct PECO customers. As such, PECO does not maintain these residents' contact information. Therefore, landlords were asked to verify all nonresidential measures on their property, including nonresidential in-unit projects. When asked, many landlords likely responded without accurately ascertaining the measure installation status within individual units. The effect of this response bias was overcome by onsite visits, as activities including visits to a sub-sample of apartment units. However, the nonresidential onsite sample made up only 8 sites, and the remaining 32 sites relied on verbal responses (with possible bias) from landlords during the telephone survey.

Table 14-5: Program Year 6 Smart Multi-Family Solutions Nonresidential Sector 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) in Sample Design	Relative Precision at 85% C.L.
SMFNONRES - Large	1,068	1.00	1,068	0.00	0.1%
SMFNONRES - Medium	1,147	0.96	1,098	0.08	6.2%
SMFNONRES - Small	1,101	1.00	1,101	0.00	0.0%
Program Total	**3,317**	**0.98**	**3,266**	**N/A**	**2.1%**
Values in tables may not reconcile as presented due to numerical precision.					

Source: Navigant analysis

Table 14-6: Program Year 6 Smart Multi-Family Solutions Nonresidential Sector 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) in Sample Design	Relative Precision at 85% C.L.
SMFNONRES - Large	0.12	1.00	0.12	0.00	0.0%
SMFNONRES - Medium	0.14	0.96	0.13	0.08	6.1%
SMFNONRES - Small	0.13	1.00	0.13	0.00	0.0%
Program Total	**0.39**	**0.98**	**0.38**	**N/A**	**2.2%**

*** All reported and verified demand savings in this report include line losses as required.**

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Recommendation: Collect, maintain, and provide nonresidential participant tenant contact information. Direct contact with nonresidential tenants would aid evaluation efforts such as gross impact surveys, NTG surveys, and gross impact onsite visit scheduling.

14.2.3 Impact Findings and Recommendations

1. **Finding:** The program tracking data does not include the DI measures' make and model information. For CFLs, the tracking data only lists the bulb shape and the wattage. For LFFA and LFSH, the tracking data only lists the fixture's flow rate.
    a. **Recommendation:** Track DI equipment make and model in SIDS. As described above, onsite visits rely on program tracking data to identify program measures. By tracking and including the DI equipment make and model, the evaluation team can more accurately identify program equipment and attribute savings appropriately. Alternatively, place stickers or identifying marks on DI equipment to help onsite M&V personnel easily identify program equipment for gross verification. Additionally, branded stickers (e.g., "PROVIDED BY PECO SMART IDEAS") would frequently remind customers that they received the free equipment from PECO, thus improving both PECO's customer perception and gross verification accuracy.
2. **Finding:** Since nonresidential in-unit projects occur in master-metered or third-party customer units, residents are not direct PECO customers. As such, PECO does not maintain these residents' contact information.
    a. **Recommendation:** Collect, maintain, and provide nonresidential participant tenant contact information. Direct contact with nonresidential tenants would aid evaluation efforts such as gross impact surveys, NTG surveys, and gross impact onsite visit scheduling.

14.2.4 Results

The net impact evaluation yielded a 0.75 NTG ratio in the residential sector and a 0.83 NTG ratio in the nonresidential sector. Both sectors indicate low likelihoods of program free ridership. Spillover was not found in either sector. The residential net impact evaluation achieved 7% relative precision, and the nonresidential net impact evaluation achieved 8% relative precision (both below the 15% target), at 85% confidence. Table 14-9 and Table 14-10 provide a summary of the residential and nonresidential sector NTG ratios, respectively.

14.3 IMPACT EVALUATION NET SAVINGS

The evaluation team determined net impact by including the SWE Common NTG methodology's free ridership and spillover question batteries in the participant telephone survey. The evaluation team utilized the SWE Common NTG methodology for analyzing the responses to those questions to determine NTG ratios for all sampled sites. In the residential sector, tenants answered questions regarding the project in their apartment unit or condo. In the nonresidential sector, landlords answered questions regarding all the projects at a property.

14.3.1 Methods

As described in the gross impact section, the evaluation team selected a stratified random sample from the program population for the telephone survey. A separate sample was selected for each the residential and nonresidential sectors. The sample was selected from size-stratified residential (strata = unit project size) and nonresidential populations (strata = property total project size). Forty-four total units were selected for the residential sector and 40 properties for the nonresidential sector. This sample was also utilized for the gross impact and process evaluation telephone surveys. Table 14-7 and Table 14-8 detail the sampling strategy for the residential and nonresidential NTG surveys, respectively.

Table 14-7: SMF Solutions Residential Sector Sampling Strategy for Program Year 6 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[1] to Achieve Sample
SMFRES - Large	Projects >528 Reported kWh Savings	1,749	0.50	85/15	10	10	100%
SMFRES - Medium	Projects 306-528 Reported kWh Savings	2,881	0.50	85/15	10	19	100%
SMFRES - Small	Projects ≤305 Reported kWh Savings	6,678	0.50	85/15	10	15	100%
SMFRES Total		**11,308**	**0.50**	**85/15**	**30**	**44**	**100%**

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Table 14-8: SMF Solutions Nonresidential Sector Sampling Strategy for Program Year 6 NTG Research

Stratum	Stratum Boundaries	Population Size	Assumed CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[1] to Achieve Sample
SMFNONRES - Large	Properties >125 MWh reported savings	6	0.50	85/15	4	2	100%
SMFNONRES - Medium	Properties 37.5-125 MWh reported savings	18	0.50	85/15	10	3	100%
SMFNONRES - Small	Properties ≤37.5 MWh reported savings	134	0.50	85/15	16	35	100%
SMFNONRES Total		**158**	**0.50**	**85/15**	**30**	**40**	**100%**

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

14.3.2 Results

The net impact evaluation yielded a 0.75 NTG ratio in the residential sector and a 0.83 NTG ratio in the nonresidential sector. Both sectors indicate low likelihoods of program free ridership. Spillover was not found in either sector. The residential net impact evaluation achieved 7% relative precision, and the

nonresidential net impact evaluation achieved 8% relative precision (both below the 15% target), at 85% confidence. Table 14-9 and Table 14-10 provide a summary of the residential and nonresidential sector NTG ratios, respectively.

Table 14-9: Program Year 6 SMF Solutions Residential Summary of Evaluation Results for NTG Research

Stratum	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
SMFRES - Large	0.23	0.00	0.77	0.31	14.3%
SMFRES - Medium	0.31	0.00	0.69	0.28	9.2%
SMFRES - Small	0.21	0.00	0.79	0.26	9.5%
SMFRES Total [1]	**0.25**	**0.00**	**0.75**	**0.30**	**6.6%**

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

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Table 14-10: Program Year 6 SMF Solutions Nonresidential Summary of Evaluation Results for NTG Research

Stratum	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision
SMFNONRES - Large	0.00	0.00	1.00	0.00	0.0%
SMFNONRES - Medium	0.28	0.00	0.72	0.33	25.2%
SMFNONRES - Small	0.22	0.00	0.78	0.24	5.1%
SMFNONRES Total [1]	**0.17**	**0.00**	**0.83**	**0.39**	**7.7%**

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

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

14.4 PROCESS EVALUATION

The process evaluation for the SMF Solutions program consisted primarily of participant telephone surveys with residential tenants and nonresidential landlords and in-depth interviews with the PECO and implementer program managers. This is the first evaluation year to include participant telephone surveys as part of the process evaluation. The telephone survey residential tenant sample and nonresidential landlord sample was used for the gross and net impact evaluations, as well. In addition, the evaluation team targeted landlords of properties with residential projects for process evaluation. However, this population of landlords overlaps with the nonresidential landlord population. Of the 82 residential landlords, only 15 do not overlap with the nonresidential landlord population. The nonresidential landlord population was contacted first for the telephone survey. That effort exhausted that landlord population, so only 15 landlords were available to be contacted for the residential landlord sample. Of those 15, only one residential landlord responded to the telephone survey. Table 14-11 shows target sample sizes and achieved sample sizes for each data collection method.

Table 14-11: SMF Solutions Program Process Sampling Strategy for Program Year 6

Target Group	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	Used For Evaluation Activities (Impact, Process, NTG)
Residential Tenant Participants	11,308	0.5	85/15	30	44	100%	Telephone Survey
Nonresidential Landlord Participants	94	0.5	85/15	30	40	100%	Telephone Survey
Residential Landlord Participants	82	0.5	85/15	30	1	100%	Telephone Survey
Program Manager	1	N/A	N/A	1	1	100%	In-Depth Telephone Interviews
Program Implementer	1	N/A	N/A	1	1	100%	In-Depth Telephone Interviews
Values in tables may not reconcile as presented due to numerical precision.							

Source: Navigant analysis

14.4.1 Program Theory

The structure of the SMF Solutions program aims to overcome several barriers in its successful implementation. These barriers include the high up-front cost associated with energy efficient measures, split incentives between decision makers and electric bill payers, a lack of understanding about energy efficiency savings opportunities, and a lack of awareness of the program.

The SMF Solutions program design directly addresses these barriers. The cost-free DI measures and prescriptive incentives directly lower the up-front cost of energy efficient measures. By offering cost-free DI measures, landlords save capital that can be applied to participation in the program's prescriptive channel offerings, thus overcoming the split incentive barrier. The program's marketing efforts raise customer awareness of the program and its offerings. Educational efforts during the audit visit and via the audit report left with landlords enhance understanding of the long-term energy and financial savings achievable through energy efficiency investments. Interactions with program representatives 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, and effective implementation of program measures. Intermediate-term outcomes include increased awareness and appreciation of the financial value and energy savings associated with energy efficient measures, and increased participation by qualified customers in other Smart Ideas programs. Long-term outcomes include increased implementation of program-qualifying measures across PECO service territory, increased Smart Ideas program participation, and public exposure of PECO's commitment to energy efficiency. Success in these outcomes will help PECO with its overall portfolio goals and increase the sense of PECO's role as an energy conservation partner.

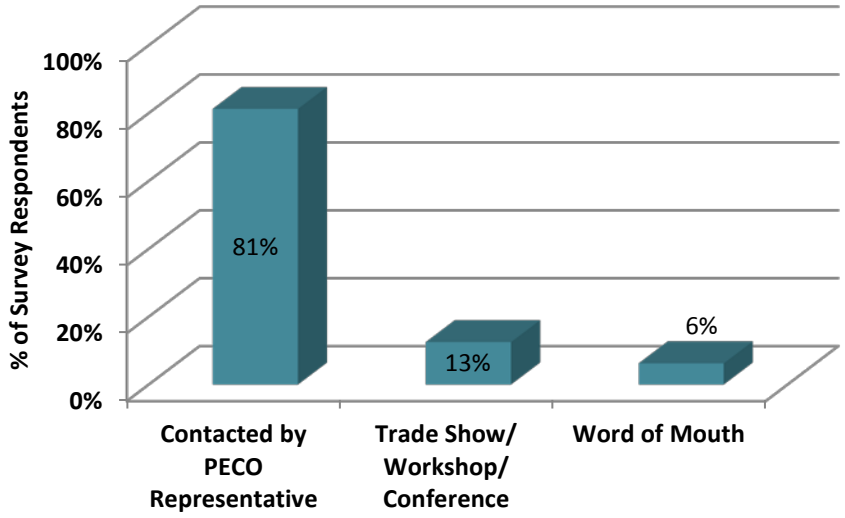
14.4.2 Customer Experience

This section presents results from the participant telephone survey and discussions with landlords during onsite visits regarding participants' experience and satisfaction with the SMF Solutions program.

14.4.2.1 Program Marketing

The SMF Solutions program's marketing efforts targeted landlords directly. Since tenants did not directly sign up for the program, and were only provided an opt-out option, marketing efforts were not aimed toward this group. When asked, landlords described having heard of the SMF Solutions program via a limited number of channels. As shown in Figure 14-1 below, the majority of participants (81%) were contacted directly by a PECO representative (i.e., the program implementer). Secondly, 13% of landlords reported that they learned about the program at a tradeshow, workshop, or conference. Lastly, just 6% of landlords learned about the program by word of mouth. These findings are consistent with the marketing efforts discussed with the program manager and implementer, who indicated a large direct mail and cold call effort to reach out to potential landlord participants.

Figure 14-1. How Landlords First Learned of SMF Solutions Program



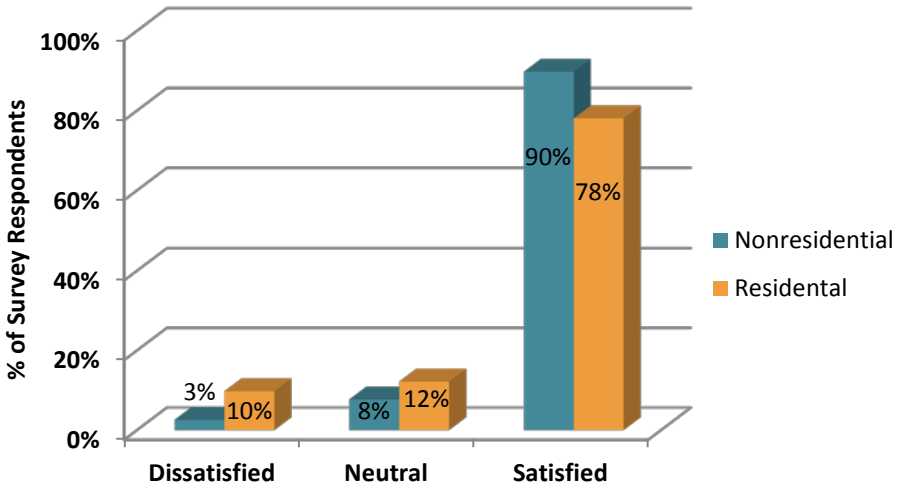
Source: Navigant analysis

14.4.2.2 Satisfaction

Participants generally noted a high degree of satisfaction with the program. Survey respondents were asked to rate their satisfaction with the SMF Solutions program overall on a scale of 1 to 5, where 1 is "not satisfied" and 5 is "extremely satisfied." Both residential and nonresidential participants reported satisfaction with the program. Nonresidential landlords reported a 4.5 average satisfaction score, whereas the residential tenants reported a 4.2 average satisfaction score.

Satisfaction scores can be classified as satisfied (scores of 4 or 5), neutral (score of 3), or dissatisfied (score of 1 or 2). Figure 14-2 presents the participant percentages that self-reported as satisfied, neutral, or dissatisfied with the program. Although generally satisfied, 10% of surveyed residential tenants reported dissatisfaction with the program.

Figure 14-2. Participant Satisfaction with SMF Solutions Program



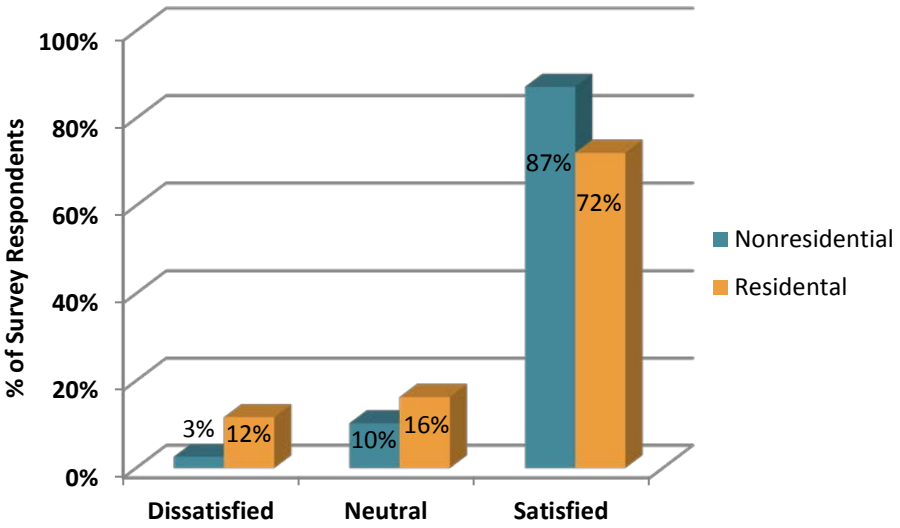
Source: Navigant analysis

Residential tenants cited two main reasons for their dissatisfaction with the program. First, some tenants did not receive notification about the program prior to apartment entry for installation. In fact, 10% of surveyed tenants reported that they were not informed of the program prior to installation. Second, residential tenants cited dissatisfaction with the program due to poor CFL quality.

Survey respondents were asked to rate their satisfaction with the equipment installed through the SMF Solutions program. Participants reported generally high satisfaction with program equipment. Nonresidential landlords reported a 4.5 average satisfaction score, and residential tenants reported a 4.0 average satisfaction score.

Figure 14-3 presents the participant percentages that self-reported as satisfied, neutral, or dissatisfied with the equipment installed through the program. Although generally satisfied, 12% of residential tenants reported dissatisfaction with the equipment, with the majority citing CFLs as the source of dissatisfaction. Residential tenants cited both CFL color quality and delayed brightness as the reasons for their dissatisfaction with CFLs.

Figure 14-3. Participant Satisfaction with DI Equipment



Source: Navigant analysis

Dissatisfaction with CFL quality has not been found to be a major motivator for program measure removal. In PY6, only 2.5% of residential tenants reported uninstalling program CFLs due to CFL quality issues. However, as LED technology continues to permeate the market, customers might begin to have higher expectations for energy efficient bulbs due to their experiences with LEDs. Over time, the portion of customers that find issues with CFLs and remove the technology could increase.

Through discussions with the evaluation team during onsite visits, landlords requested information on the installed equipment's make and model in order to replace inkind. This request reflects positively on the program, as it shows that landlords perceive the equipment they received through the program in high regard and want to continue using energy efficient equipment at their own expense. The evaluation team recommends providing this information to landlords as part of the project closeout materials.

14.4.3 Participant Awareness and Motivations

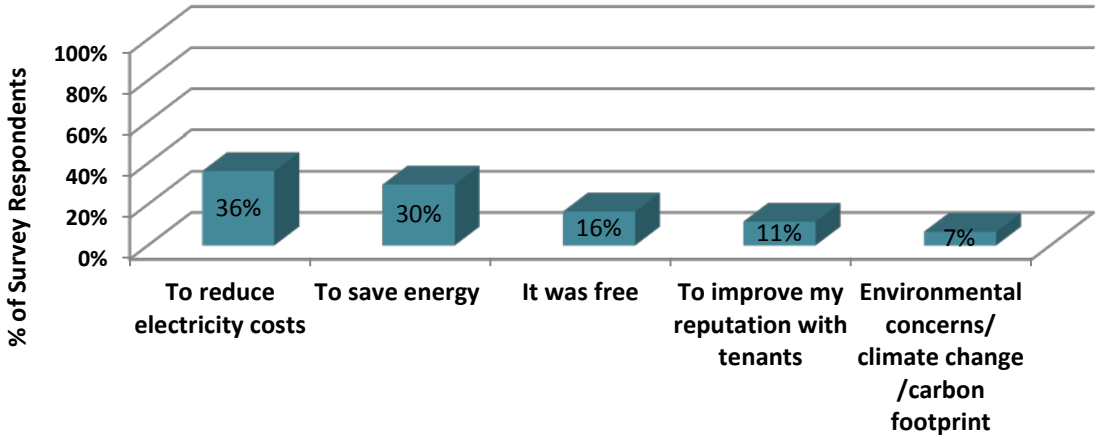
This section discusses participant's reasons for participation in the SMF Solutions program, underlying motivations regarding energy efficient measures in the multi-family setting, and participant awareness of the program's prescriptive offerings. The section concludes with the review of an alternative program design meant to overcome participant's barriers to participation, especially in the prescriptive channel.

14.4.3.1 Reasons for Participation

When asked, nonresidential landlords described a number of reasons for making the decision to participate in the SMF Solutions program. As shown in Figure 14-4 below, the most commonly cited reasons for program participation were to reduce electricity costs (36%) and to save energy (30%). Secondarily, landlords cited the fact that the DI measures were free as a motivating factor (16%). Some

landlords also reported participating in the program in order to improve their reputation with tenants (11%).

Figure 14-4. Nonresidential Landlord Reasons for Program Participation



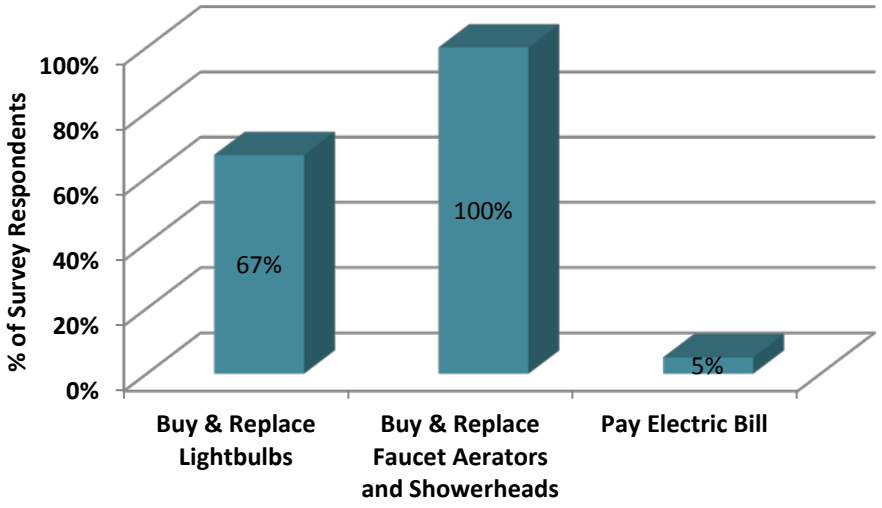
Source: Navigant analysis

14.4.3.2 Split Incentives

To test assumptions behind the split incentive issue, survey respondents were asked a series of questions regarding landlord and tenant division of responsibilities.

The breakdown of responsibilities reported by nonresidential landlords is presented in Figure 14-5. According to 95% of respondents, nonresidential landlords are not responsible for in-unit electric bills. However, the majority of nonresidential landlords are responsible to buy and replace in-unit lightbulbs (67%) and in-unit faucet aerators and showerheads (100%). Even though landlords have the responsibility to replace these units, they are not responsible for the associated electricity costs. This confirms that nonresidential landlords likely would not take the steps to install energy efficient equipment without the SMF Solutions program.

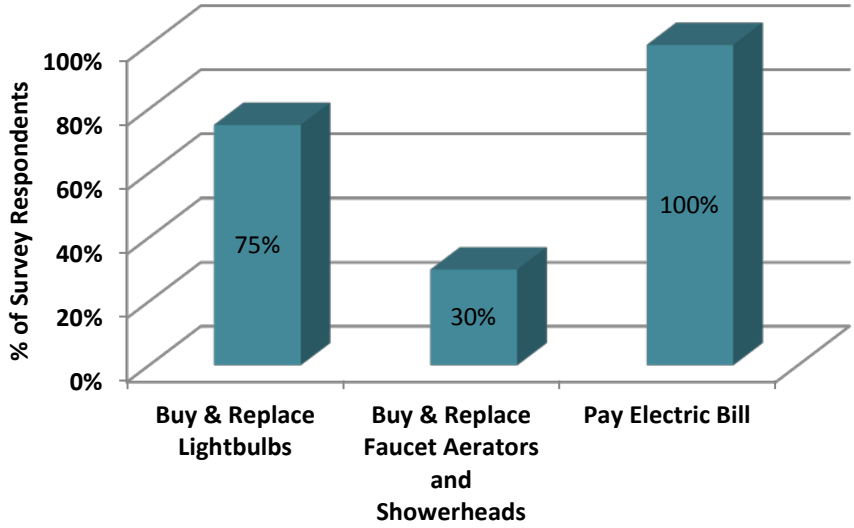
Figure 14-5. Nonresidential Landlord Cited Responsibilities



Source: Navigant analysis

On the other hand, residential tenants may be more likely than nonresidential landlords to install energy efficient equipment on their own without the program. The breakdown of responsibilities reported by residential tenants is presented in Figure 14-6. The majority of residential tenants buy and replace their own lightbulbs (75%) and pay their own electric bill (100%). Tenants are already thinking about what bulb to purchase and are responsible for the associated costs. This implies that residential tenants have the motivation to buy energy efficient lighting on their own to save money. However, only 30% of residential tenants reported that they buy and replace faucet aerators or showerheads. Landlords are still primarily responsible for replacing these fixtures in the residential sector, but do not pay the associated electric costs. Therefore, it appears that only faucet aerators and showerheads suffer from the split incentive issue in the residential sector.

Figure 14-6. Residential Tenant Cited Responsibilities



Source: Navigant analysis

14.4.3.3 Prescriptive Channel Awareness

The SMF Solutions program has seen zero participation through the prescriptive channel to date. The participant telephone survey included a series of questions to better understand participants' awareness of the program prescriptive offerings. When asked, only 40% of landlords recalled receiving a list of incentivized energy efficiency equipment recommended through the program. The majority of landlords are not aware of, or able to recall, incentivized offerings through the program's prescriptive channel. To encourage prescriptive participation, the implementer should follow up more frequently with participating landlords regarding prescriptive offerings available via the SMF Solutions program.

14.4.3.4 Outside Perspective: A Pilot Inter-Property Competition

During review of multi-family programs in other regions, the evaluation team came across a unique multi-family pilot program in California. This program implements a competition among multi-family buildings to encourage energy efficient behavioral changes. The evaluation team identified this program as pushing the boundaries of traditional multi-family program design, and considered whether a competition between multi-family properties could encourage prescriptive participation, as well.

The implementation manager mentioned during the in-depth interview that properties in highly competitive segments participate in the SMF Solutions program and implement energy efficient measures in order to stay competitive. In the participant telephone survey, 11% of nonresidential landlords indicated that one reason they decided to participate in the SMF Solutions program was "to improve reputation with tenants." From these two findings, it appears that landlords looking for additional ways to market themselves as energy efficient might like to participate in an inter-property competition. In that vein, the competition's top saving building could receive a "most efficient multi-family property" certificate. A peer competition might encourage buildings to implement measures through the prescriptive channel, as a way to edge out competition to win the "most efficient" award. The evaluation team suggests exploring ways to apply these same competition principles to PECO's multi-family program.

14.4.4 Process Findings and Recommendations

1. **Finding:** Some tenants did not receive notification about the program prior to apartment entry for installation and cited this as a reason for dissatisfaction with the program overall. Ten percent of surveyed tenants reported that they were not informed of the program prior to installation.
    a. **Recommendation:** Review current protocols and work with landlords to ensure that the proper communication protocol is followed in every case to notify tenants before installation.
2. **Finding:** Twelve percent of residential tenants reported dissatisfaction with the equipment, with the majority citing CFLs as the source of dissatisfaction. Residential tenants cited both CFL color quality and delayed brightness as the reasons for their dissatisfaction with CFLs. As LED technology continues to permeate the market, customers might begin to have higher expectations for energy efficient bulbs due to their experiences with LEDs. Over time, the portion of customers that find issue with CFLs and remove the technology could increase.
    a. **Recommendation:** Offer direct install LEDs.
3. **Finding:** Through discussions with the evaluation team during onsite visits, landlords requested information on the installed equipment's make and model in order to replace in kind.
    a. **Recommendation:** Provide installed equipment make and model to landlords in closeout report.

4. **Finding:** When asked, only 40% of landlords recalled receiving a list of incentivized energy efficiency equipment recommended through the program. The majority of landlords are not aware of, or able to recall, incentivized offerings through the program's prescriptive channel.
    a. **Recommendation:** Follow up more frequently with landlords after the DI measure installation project completion to encourage prescriptive participation.
5. **Finding:** There has been zero participation in the prescriptive channel to date. However, there have been multiple repeat landlord participants in the program that have taken advantage of the free DI aspect of the program within this program year and from the previous program year.
    a. **Recommendation:** Establish a predetermined minimum prescriptive participation level for repeat landlords in order to qualify for future DI projects.

14.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 14-12 lists recommendations for the SMF Solutions program along with the PECO status for each recommendation.

Table 14-12: SMF Solutions Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1. Track the DI equipment make and model in SIDS or place stickers or identifying marks on DI equipment by the program implementer.	Rejected. PECO's implements a comprehensive marketing strategy at the point of sale but does not maintain a relationship with product manufacturers.
Recommendation 2. Collect, maintain, and provide nonresidential participant tenant contact information by the program implementer.	Being Considered. Looking into management of participant tenant contract information by the implementer.
Recommendation 3. PECO should review current protocols with the program implementer, who should work with landlords to ensure that the proper communication protocol is followed in every case to notify tenants before installation.	Implemented. PECO has reviewed protocols to support communication with implementer, landlords, and tenants.
Recommendation 4. Offer DI LEDs.	Being Considered. Budget and evaluation impacts are being reviewed.
Recommendation 5. Provide installed equipment make and model to landlords in closeout report.	Being Considered. Process is being reviewed.
Recommendation 6. Follow up more frequently with landlords after the DI measure installation project completion to encourage prescriptive participation.	Implemented. Follow up frequency has increased.
Recommendation 7. Establish a predetermined minimum prescriptive participation level for repeat landlords in order to qualify for future DI projects.	Being Considered. Process and qualifying levels are being reviewed.

Source: Navigant and PECO

14.6 FINANCIAL REPORTING

Spending in the residential sector at the end of PY6 reached $2.4 million, surpassing the combined PY5 and PY6 planned spend of $2.2 million. Table 14-13 presents a breakdown of program finances in the residential sector.

Table 14-13: Summary of SMF Solutions Program Residential Sector Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	0
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (net of incentives/rebates paid by utilities)	0	0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	1,461	2,437
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	1,405	2,363
8	Marketing[2]	56	74
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	1,461	2,437
13	Total NPV Lifetime Energy Benefits	1,859	3,454
14	Total NPV Lifetime Capacity Benefits	119	188
15	Total NPV TRC Benefits[4]	2,168	3,955
16	TRC Benefit-Cost Ratio[5]	1.48	1.62

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

Nonresidential program overhead costs at the end of PY6 reached $2.1 million, matching the combined PY5 and PY6 planned spend of $2.1 million. Table 14-14 presents a breakdown of program finances in the nonresidential sector.

Table 14-14: Summary of SMF Solutions Program Nonresidential Sector Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	281
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (net of incentives/rebates paid by utilities)	0	281
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	1,185	2,122
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	1,185	2,122
8	Marketing[2]	0	0
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	1,185	2,403
13	Total NPV Lifetime Energy Benefits	1,080	2,232
14	Total NPV Lifetime Capacity Benefits	106	199
15	Total NPV TRC Benefits[4]	1,340	2,705
16	TRC Benefit-Cost Ratio[5]	1.13	1.13

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs include Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis

15. SMART ON-SITE

The PECO Smart On-Site (SOS) program is designed to build interest in combined heat and power (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 baseload 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 capacity incentives are paid on a declining tiered incentive rate by installed capacity. The capacity tiers include: less than 0.5 MW, between 0.5 MW and 1.5 MW, and 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.

PECO pays the performance incentive on a fixed per-kWh basis based on actual energy savings after a 1-year monitoring period. Performance incentives are paid at $0.02 per kWh generated. 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.

15.1 PROGRAM UPDATES

No new CHP projects participating in the SOS program became operational in PY6. Given the lengthy design, permitting, construction, and commissioning processes for CHP projects, it is not surprising that no new projects were completed in PY6. The two SOS projects for which incentives were paid in PY5 had been in development well before the beginning of Phase II and were originally considered projects in PECO's SEI program.

At the close of PY6, the SOS program had a pipeline of nine CHP projects targeting completion within Phase II. These pipeline projects have an aggregate capacity of 5.0 MW and estimated annual generation of over 41 GWh.

15.1.1 Definition of Participant

A participant in the SOS program is considered to be one project at one facility.

15.2 IMPACT EVALUATION GROSS SAVINGS

As noted, no SOS projects were completed in PY6. Accordingly, PECO reported no savings, and Navigant conducted no impact evaluation activities. The reported results shown in Table 15-1 refer to the two projects completed in PY5, both of which were in the GNI sector.

Table 15-1: Phase II Smart On-Site 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	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	0	0	0.0	$0
Large Commercial and Industrial	0	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**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: PECO program database

As there were no completed projects in PY6, Navigant did not conduct a gross savings analysis.

Table 15-2: Smart On-Site Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant

Table 15-3: Program Year 6 Smart On-Site 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.
N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant

Table 15-4: Program Year 6 Smart On-Site Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	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.
N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Navigant

15.2.1.1 Onsite Inspections

As there were no completed projects in PY6, no onsite inspections to confirm measure instllation were performed for the PY6 SOS impact evaluation.

15.3 IMPACT EVALUATION NET SAVINGS

As there were no completed projects in PY6, Navigant did not conduct a net savings analysis.

Table 15-5: Smart On-Site Sampling Strategy for Program Year 6 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
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

Table 15-6: Program Year 6 Smart On-Site 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

15.4 PROCESS EVALUATION

Navigant's process evaluation of the PY5 SOS program consisted of in-depth interviews with program managers and project developers. No sampling was necessary for these activities.

Table 15-7: Smart On-Site Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Program Managers	N/A	2	N/A	N/A	2	2	100	Process
Project Developers	N/A	6	N/A	N/A	6	5	100	Process
Program Total	**N/A**	**8**	**N/A**	**N/A**	**8**	**7**	**100**	**Process**
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant

15.4.1 Program Manager Interviews

Navigant's in-depth interviews with the PECO and DNV GL program managers yielded information consistent with the PY5 evaluation. Both managers believe that the program is operating well, a view that is corroborated by the project developers Navigant interviewed. The program managers had no substantive suggestions when Navigant asked about program improvements they would like to see, though they are amenable to increased incentives or adding a design incentive if this program is continued in Phase III.

The program managers acknowledge that three projects currently scheduled for completion at the end of PY7 could slip and not be completed until after the end of Phase II. They maintain frequent contact with the project developers and are keeping PECO management informed so that PECO can take appropriate action to try to mitigate this risk. If any of these projects are not complete at the end of Phase II, the program will likely not meet its energy savings goal. Moreover, since these projects collectively project energy savings amounting to over 1 percent of PECO's portfolio goal, they represent a risk to PECO's ability to achieve its portfolio savings target.

15.4.2 Project Developer Interviews

Navigant interviewed five project developers, all of whom are working on CHP projects that have reserved SOS funds. The following findings are based on information collected through these interviews.

- **PECO's incentives do not affect CHP system design.** All five project developers Navigant interviewed stated that PECO's incentives are insufficient to impact system capacity or design, but that they do help to make projects financially viable.

- **The potential for free riders is high.** Developers were divided when asked whether their projects would have been built without the PECO incentive. There was one unqualified "yes," but the other four were uncertain. These responses imply that the potential for free ridership is high for this program.

- **The SOS program is beginning to affect the CHP market for smaller systems and hospitals.** When Navigant asked if the program was having an impact on the market, those developers offering an opinion indicated that 1) the program is affecting the hospital industry because of prior CHP projects at hospitals, and 2) that the program has more impact at the small end of the market (<500 kW) where the PECO incentive is a significant fraction of total project cost.

- **Factors currently driving the CHP market.** The developers listed the following factors that are drivers for the CHP market:
    - Low, stable gas prices (although this cuts both ways, because this also reduces the need to be proactive about energy costs)
    - State, federal, and utility grants and incentives
    - Desire for enhanced reliability
    - Ability to upgrade infrastructure to reduce operating expenses

- **Factors inhibiting the uptake of CHP technology.** Project developers mentioned the following factors as impediments to CHP:
    - Finding facilities that have both sufficient thermal and electrical loads to justify the expense of the system
    - Complexity and time requirements to design, finance, permit and install a system; this was described as a much bigger barrier for smaller (250-300 kW) systems than multi-MW systems, because the interconnection and transactional costs are almost the same regardless of system size
    - The complexity of the interconnection agreement

- **Factors that delay CHP projects.** The developers mentioned the following as factors that contribute to delays in completing CHP projects:
    - Getting the operating permit from the DEP, which can take 6 months
    - The PECO interconnection process
        - *"I understand that utilities need to protect their system and their workers, but it slows the process down. I don't view it as overly oppressive but would like to see it go faster. Utilities could outline a specific process and the timing for it. Create a schedule and list of steps."*
    - For one developer, finding financing for systems can be a problem; another developer specifically stated that financing is not an issue
    - Noise and zoning ordinances can slow a project or bring it to a stop

- **Reducing PECO's risk.** When Navigant asked how PECO could bring greater certainty to the CHP project development process to reduce its risk, the developers had two constructive suggestions:
    - Develop a pool of pre-qualified CHP developers and contractors that participants are required to work with if they want a PECO incentive
    - Provide higher incentives for projects that are completed earlier in a phase, because such projects pose less risk for PECO; reduce the incentive as the end of the phase approaches

- **Customer awareness of CHP.** The developers indicated businesses and organizations that have financially viable opportunities for CHP are generally unaware of those opportunities. There are niches (such as hospitals) where awareness is growing. This suggests that should it choose to, PECO could dramatically increase SOS participation by actively promoting CHP technology and the SOS program to the owners and operators of the facility types where it is likely to be financially attractive.

  > *"Most people don't fully get it. They're just trying to manage their existing facility and get overwhelmed by day to day operations."*

- **Philadephia Gas Works is promoting SOS.** Although PECO does not market the SOS program, one developer mentioned that Philadelphia Gas Works (PGW) is promoting it:

  > *"PGW wants to sell gas, so they use CHP as an entre´ for doing a fuel conversion. They brief the customer on the advantages of CHP and they discuss the incentives that PECO offers."*

- **Financial metrics used to evaluate CHP.** The project developers provided a range of responses to a Navigant question about the financial metrics they or their customers use to determine whether or not to proceed with CHP. As Table 15-8 demonstrates, the financial metrics show little consistency.

Table 15-8: Financial Metrics used to Evaluate CHP

Facility Type	CHP Ownership	Financial Metric
Multifamily residential	Facility owner (REIT)*	12%-15% ROI
Assisted living facility	Third-party investors	8%-11% ROI
Hospital	Facility owner	Payback period ≤ 7 years
Healthcare facility	Facility owner	Payback period < 10 years
Food production	Third-party investors	Payback period ≤ 6 years
*Real-estate investment trust		

Source: Navigant interviews with project developers

- **Most project developers are quite satisfied with the SOS program.** Navigant asked the project developers to rate the program on a 0 to 10 scale, with 0 meaning "extremely dissatisfied" and 10 meaning "extremely satisfied." Three provided ratings of 8 or higher, while the other two rated the program at 5 and 6. The following verbatim quotes provide additional insight into the participant's satisfaction ratings.

The developer offering the rating of 5 made it clear that they are not actually unhappy with the program, but that their low rating reflects their uncertainty that PECO will actually provide the anticipated rebate. In the respondents words:

  - *"They've been very cooperative and communicative. From that perspective it's been fine. They told us in the beginning that we had to finish by May 2015 in order to get the rest of rebate because they wanted a full year of performance data. We worked that out—we'll*

extrapolate. I'm still hedging [on the program rating] because I want to make sure that happens."

The rating of 6 came from a developer who seemed not to fully understand the program requirements about minimum efficiency levels and system monitoring. The respondent explained their rating this way:

- *"The application process was painful, and didn't accommodate our particular usage. PECO had trouble with the fact that we were not going to operate 24/7. We just want to follow the thermal load. Their reporting requirements added cost. The rebate is reduced by a third by the reporting requirements."*

Navigant notes that the above comment reveals disappointment with the approved program design rather than the way the program has been implemented. PECO requires that the CHP systems it provides rebates for meet certain minimum fuel use efficiency levels, which essentially requires the systems to utilize the available thermal energy whenever the generators are running. Without this provision, PECO would be incentivizing inefficient, small-scale generators that would increase overall energy consumption and emissions levels, contrary to the goals of Act 129. Additionally, although PECO's reporting requirements add cost, they are necessary to comply with PUC-mandated M&V requirements.

The following are the verbatim comments of the three project developers who provided high ratings:

- *"The program has been great. Everybody has been very helpful and everything has gone smoothly."*
- *"I think it's a really positive program, people involved are highly professional and responsive."*
- *"It was hard to figure out how to get PECO engaged, but they've been super after that."*

- **Developer suggestions for program improvement.** The developers offered a few ideas when Navigant asked for suggestions about how the program could be improved. Navigant is not endorsing these suggestions, but is presenting them for PECO's consideration.

  - *"At some point, maybe direct communication with the customer. More of an endorsement of the technology."*
  - *"Accommodate multifamily and need to follow the load in the building. Seems like the program is more set up for industrial or commercial than the multifamily sector."*
  - *"You don't really need the full year of M&V—it makes financiers a little nervous and takes longer to get paid on a project. I would make the incentive all capacity-based and make the final payment on proper commissioning."*
  - *"Simplify the application process from the seven-sheet spreadsheet. Every box has one right answer. It's sometimes difficult to navigate."*

15.4.3 Process Evaluation Findings and Recommendations

Navigant offers the following findings and recommendations based on its process evaluation interviews:

1. **Finding**: PECO faces substantial risk of a regulatory penalty due to delays in CHP project completion, over which PECO currently has little or no control.

   a. **Recommendation 1a**: Should PECO choose to offer the SOS program in the future, Navigant recommends that it cease accepting project applications at least 2 years in advance of the end of the phase, as this will reduce the risk of projects remaining uncompleted at the end of the phase.
   b. **Recommendation 1b:** PECO should also consider an incentive structure that reduces incentives steeply as the end of a phase approaches. Such a structure might ramp incentives from 100 percent to zero over the final 6 months of a phase.
   c. **Recommendation 1c:** PECO should consider offering its customers a CHP system design incentive. Doing so would promote earlier notification to PECO of prospective projects, give PECO an opportunity to exercise greater influence early in the decision-making process, and allow PECO to weigh in with suggestions to improve design or identify when a design is clearly non-compliant with program rules. Navigant recommends that any design incentive be payable upon PECO's receipt of documentation demonstrating that an order for major project equipment (e.g., prime mover, heat recovery equipment) had been ordered.
   d. **Recommendation 1d:** PECO should consider developing a pool of pre-qualified CHP project developers with whom participants must work to receive program incentives. Requiring customers to work with developers who have a demonstrable track record of successful CHP projects would give PECO a measure of control over proposed system designs and greater confidence that projects that reserve funds with the program have a good probability of completion.

2. **Finding**: There are numerous factors beyond PECO's control that can delay the completion of CHP projects. One factor that PECO does have control over is the interconnection process.
   a. **Recommendation 2**: Navigant recommends that SOS program managers work with the PECO staff members who develop interconnection agreements to identify any opportunities to expedite the process, and to develop a schedule template that can be used to identify each step in the process and the dates by which each is to be completed. This schedule would demystify the process for SOS participants and provide greater clarity on the amount of time it will take to complete.

3. **Finding**: Many customers with viable applications for CHP are unaware of the opportunity.
   a. **Recommendation 3:** If PECO decides to derive greater savings from CHP projects in the future, it should develop and deploy an educational and marketing campaign targeting specific market segments, such as hospitals, municipalities with wastewater treatment facilities, college campuses, and nursing or convalescent facilities.

15.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 15-9 summarizes Navigant's recommendations and their current status.

Table 15-9: Smart On-Site Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1a: Cease accepting project applications at least 2 years in advance of the end of the phase.	A 2 year cut off is being considered for Phase III.
Recommendation 1b: Consider an incentive structure that reduces incentives steeply as the end of a phase approaches.	Incentive structure changes are being considered for Phase III.
Recommendation 1c: Consider offering customers a CHP system design incentive.	CHP system design incentives are being considered for Phase III.
Recommendation 1d: Consider developing a pool of pre-qualified CHP project developers with whom participants must work to receive program incentives.	Making incentives contingent on using a qualified developer is being considered for Phase III.
Recommendation 2: Identify opportunities to streamline the interconnection process; develop a schedule identifying all steps in the process.	Streamlining opportunities and process information collection are being considered.
Recommendation 3: Develop and deploy an educational and marketing campaign targeting specific market segments.	A campaign targeting specific market segments is being considered for Phase III.

Source: Navigant and PECO

15.6 FINANCIAL REPORTING

Navigant's application of the TRC test, presented in Table 15-10, indicates that the SOS program has not been cost-effective in Phase II. The program was not cost-effective in PY5, and although costs were low in PY6, the program did not produce quantifiable benefits in PY6 because no projects were completed. As a result, the program's TRC declined slightly from what was reported last year. Navigant expects the program's benefit-cost ratio to improve significantly in PY7, when several projects will be completed, all of which fall under the lower Phase II incentive structure (recall that the two completed PY5 projects were grandfathered in under the more generous Phase I incentive structure). In addition, Navigant notes that although the lifetime of CHP systems is 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.

Table 15-10: Summary of Smart On-Site Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	0	49,319
2	EDC Incentives to Participants	0	4,993
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of incentives/rebates paid by utilities)	0	44,326
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	423	765
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	423	765
8	Marketing[2]	0	0
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	0	13,044
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	423	63,128
13	Total NPV Lifetime Energy Benefits	0	37,981
14	Total NPV Lifetime Capacity Benefits	0	4,542
15	Total NPV TRC Benefits[4]	0	42,523
16	TRC Benefit-Cost Ratio[5]	0.00	0.67

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Values in tables may not reconcile as presented due to numerical precision.

16. 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. SBS is a DI 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.

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 proactively identifying and evaluating potential savings from energy savings opportunities, providing incentives that are generally higher than similar measures installed through prescriptive and custom programs, and by providing turnkey installation services.

16.1 PROGRAM UPDATES

In its second year of operation, the program focused primarily on lighting measures, but also included installed measures addressing efficiency opportunities in refrigerated display cases. Ninety-two percent of PY6 savings came from lighting measures; electrically commutated fan motors and anti-sweat heater controls for refrigerated display cases accounted for 4 percent of savings each.

PECO chose to reduce SBS program activity significantly in Q4 of PY6 as program spending approached the Phase II budget. As of Q4, SmartWatt (SW), the contractor implementing the SBS program, ceased its proactive, door-to-door approach to marketing and began providing services only to customers that it had previously contacted, or those that learned of the program from other participants. Program managers are now targeting energy savings of about 500 MWh per month through the end of Phase II.

SW completed 566 projects in PY6, including seven projects in the GNI sector.

16.1.1 Definition of Participant

A participant in the SBS 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, more than 96 percent of reported program activity through PY6 has been in the C&I sector, with the remainder in the GNI sector.

Table 16-1: Phase II Smart Business Solutions 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	$0
Low-Income	0	0	0.0	$0
Small Commercial and Industrial	967	25,866	5.0	$0
Large Commercial and Industrial	0	0	0.0	$0
Government, Non-Profit, and Institutional	16	864	0.2	$0
Phase II Total	**983**	**26,730**	**5.1**[1]	**$0**

[1]Note that the Phase II total demand reduction is less than the sum of the individual sectors because of rounding

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: PECO tracking data

16.2.1 Methods

Navigant conducted two activities in its impact evaluation of PY6 program activity. The first activity was a comprehensive engineering review of all measure-specific records in the tracking database to verify proper application of TRM algorithms in reported savings values. Navigant's second evaluation activity was a review of project files coupled with participant surveys for a sample of PY6 participants. For the latter activity, Navigant designed a stratified random sample from the population of program participants in the PY6 tracking database at the project level. Navigant presented its sampling plan to the SWE in a memo dated April 28, 2015. The SWE subsequently approved that plan.

Navigant completed file reviews of a stratified sample of 16 completed projects and telephone surveys of 14 of the 16 participants in the file review sample (the other two refused to participate in the survey). Both of these evaluation activities provided information on the types and quantities of baseline and retrofit 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.

The participant sample is a stratified random sample from the population of program participants in the PY6 tracking database at the project level. Once the strata break points were determined and each project was assigned to one of the strata, each project was assigned a random number. The projects were sorted first by stratum and then by random number. The number of projects identified in Table 16-2 was then selected from within each stratum to form the sample. Note that the smallest projects that cumulatively account for 2 percent of the aggregate population ex ante savings were excluded from the sample, due to the low value of information those projects can provide to the program evaluation as a whole.

Table 16-2: Smart Business Solutions Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Large	62	85%/60%	5	5	File review
Medium	130	85%/60%	5	5	File review
Small	307	85%/60%	6	6	File review
Very Small	67	85%/60%	0	0	File review
Program Total	**566**	**85%/15%**	**16**	**16**	
Values in tables may not reconcile as presented due to numerical precision.					

Source: PECO tracking data, Navigant analysis

16.2.2 Results

As Table 16-3 presents, Navigant's analysis resulted in an energy realization rate of 0.86, resulting in verified gross energy savings for PY6 of 13,413 MWh. This is 107 percent of the PY6 SBS target of 12,513 MWh.[48] The realization rate of 0.86 for this program is primarily due to differences between the hours of use (HOU) used by the CSP in its ex ante estimates and the HOU reported by the sampled participants. Participants verified the types and quantities of measures recorded in the tracking database for all projects, so the verification rate was 100%.

Table 16-3: Program Year 6 Smart Business Solutions 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.
Large	5,108	-	0.88	4,472	0.37	21.0%
Medium	5,335	-	0.82	4,363	0.22	13.9%
Small	4,841	-	0.89	4,305	0.12	7.3%
Very Small	319	-	0.86	274	N/A	N/A
Program Total	**15,603**	**-**	**0.86**	**13,413**	**N/A**	**8.7%**
Values in tables may not reconcile as presented due to numerical precision.						

[48] *PECO Energy Efficiency and Conservation Plan (EE&C)*, p.107, March 2014.

Source: Navigant analysis, tracking data

Table 16-4 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 the sampled participants 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 all ex ante demand reductions were 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 the default values listed for each facility type in the TRM. As was true for the energy realization rate, the low CV and relative precision indicate a high degree of consistency in the program implementer's savings estimation methodology.

Table 16-4: Program Year 6 Smart Business Solutions Summary of Evaluation Results for Demand*

Stratum	Reported Gross Demand Savings (MW)	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.
Large	0.84	-	1.36	1	0.26	14.4%
Medium	0.98	-	1.40	1	0.24	11.4%
Small	0.94	-	1.22	1	0.19	12.6%
Very Small	0.07	-	1.33	0	N/A	N/A
Program Total	**2.84**	**-**	**1.33**	**3.76**	**N/A**	**7.2%**

* All reported and verified demand savings in this report include line losses as required.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis, tracking data

16.3 IMPACT EVALUATION NET SAVINGS

Per Navigant's approved evaluation plan for the SBS program, the results of the net impact evaluation conducted for PY5 program activity will apply to activity in PY6 and PY7. Therefore, the remainder of this section describes net impact evaluation activities conducted for PY5.

16.3.1 Methods

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.[49] Navigant targeted 15 percent precision at 85 percent confidence for its estimate of the program-level NTG ratio. As Table 16-5 indicates, the evaluation team collected NTG information from a total of 50 PY5 participants.

Table 16-5: Smart Business Solutions 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[1] 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**

[1] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Values in tables may not reconcile as presented due to numerical precision.

Source: Navigant analysis, tracking data

16.3.2 Results

Navigant's NTG analysis, which is summarized in Table 16-6, 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 DI 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 16-6. Navigant estimates program-level spillover at 0.0. The resulting NTG ratio at the program level is 0.9.

Table 16-6: Program Year 5 Smart Business Solutions 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

[49] 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*.

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[1]	**0.1**	**0.00**	**0.9**	N/A	**3.0%**
[1] NTG ratio at the program level should be developed using stratum weight and stratum NTG ratios. *Values in tables may not reconcile as presented due to numerical precision.*					

Source: Navigant analysis

16.3.3 Impact Evaluation Findings and Recommendations

Navigant's PY6 impact evaluation activities support the following findings and recommendations:

1. **Finding:** Based on Navigant's discussions with sampled participants, there are significant inaccuracies in the HOU utilized by the CSP in its ex ante savings estimates. Participant-reported hours were below those used in the ex ante estimates in most of the sampled sites. The discrepancy was greater than 20 percent in half of the sampled sites. In addition, the documentation provided in the project files made it difficult to determine how the ex ante HOU estimate was determined. The evaluator was often unable to find correspondence between the HOU indicated in the project file and the value used for the ex ante estimate.
    a. **Recommendation:** The SW sales auditor must be responsible for gathering accurate lighting schedules at the time of the initial facility audit, documenting that information clearly in the project file (including assumptions about the number of holidays when lighting is unused) and utilizing either the TRM default or customer-reported hours (if the latter vary from the TRM by more than 10 percent) in the initial estimate of savings that is presented to the customer. This same estimate of operating hours must be utilized in the ex ante energy savings estimate.

2. **Finding:** SW consistently used default coincidence factors in its demand calculations for lighting measures, even where it used non-default HOU in calculating energy savings. In its Guidance Memo #27, issued July 24, 2014, the SWE specified that whenever site-gathered data on HOU is utilized, the CF must be calculated based on the same site-gathered data.
    a. **Recommendation:** SW should comply with the CF calculation requirements stated above, which were incorporated into the 2015 TRM.

16.4 PROCESS EVALUATION

Navigant's primary process evaluation activities in PY6 consisted of in-depth interviews with the PECO and SW program managers and in-depth interviews with SW installers. Navigant also planned to conduct online surveys for partial participants[50] and nonparticipants.[51] Navigant did develop, gain SWE approval for, and field online surveys for these populations. However, by the time these surveys were fielded, PECO had decided to ramp program activity down substantially, so that the program was not being actively marketed, but only responding to requests for service from customers. Because participation now required customers to be proactive to receive program services, this change effectively eliminated non-participants and made it much less likely that those who received an audit would decline to install efficiency measures. As a result, the online surveys did not yield meaningful results.

[50] Partial participants are defined as customers who agree to have the initial energy audit conducted for their facilities, but subsequently decide not to install any of the recommended measures.

[51] Nonparticipants are defined as customers who refuse to have an energy audit conducted at their facilities to identify potential energy saving measures.

Table 16-7: Smart Business Solutions Sampling Strategy for Program Year 6

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	Used For Evaluation Activities (Impact, Process, NTG)
Program Managers	N/A	2	N/A	N/A	2	2	100	Process
SmartWatt Installers	N/A	4	N/A	N/A	4	3	100	Process
Program Total	**N/A**	**6**	**N/A**	**N/A**	**6**	**5**	**100**	**Process**
Values in tables may not reconcile as presented due to numerical precision.								

Source: Navigant

16.4.1 Program Manager Interviews

Navigant conducted independent interviews with the PECO and SW program managers to gather their input and perspectives on the operation of the program in PY6 and their thoughts about any changes that would improve the program.

Both program managers noted that the biggest change to the program this year was the decision to substantially curtail program activity due to the fact that the program had exceeded its PY6 budget. As of the time of Navigant's interview, SW had limited program activity to responding to requests from customers that had previously been contacted by the propgram and word-of-mouth. Both program managers were expecting program activity of about 500 MWh per month through the end of PY7.

There was a change in SW program management during PY6, when the original program manager was transferred to implement a similar program at another utility. The PECO program manager indicated that there have been no problems caused by this transition—in her words, it has been "seamless." She indicated that she feels that SW has run the program extremely well.

When Navigant inquired into whether adjustments to the measure mix would be necessary if the program is continued in Phase III, both program managers indicated that new measures enabling more comprehensive treatment of savings opportunities should be considered. The SW program manager expressed the opinion that there will be a continued role for T12 linear fluorescent fixture replacements with T8 fixtures in Phase III. Navigant notes that reported energy savings from T12 replacement projects will be dramatically reduced in Phase III, as the baseline energy consumption for such projects will no longer be the replaced T12 fixtures, but instead will be standard efficiency T8 fixtures. Given the much smaller wattage difference between standard efficiency and high performance T8 fixtures, it will be much more difficult to cost-justify such replacement projects in Phase III.

16.4.2 SmartWatt Installer Interviews

Navigant conducted interviews with three installers who work on PECO's SBS program. All were SW employees. Navigant inquired into how well the program was operating from their perspective, whether there were any common issues that arose, and asked for their recommendations for improvements to the program. All three installers were generally very positive about current program operation and none could think of specific problems that need to be addressed.

The three installers interviewed all agreed that the materials needed for projects are almost always onsite and available when they arrive to begin work. There have been a small number of cases where a few items were missing, but installers either compensate for this with a small stock of equipment they maintain in their vehicles or they can call into the SW office and have the necessary materials delivered, usually the same day.

Navigant asked the installers for recommendations on opportunities to improve the installation process. They offered the following suggestions:

- Include a small number of extra lamps and ballasts for each job, so that replacements are available if units don't function properly when first installed. This appears to be a rare occurrence, but there have been cases where installers have had to return to a work site to replace faulty ballasts or bulbs.
- One installer noted that in rare cases, site-specific conditions make it impossible to install precisely what the auditor specified, and that substitutions are sometimes needed in these cases, which slows the process down. His suggestion was to have a technician accompany or follow the audit, so that these issues could be pointed out in advance. Navigant notes that this practice would add considerable expense to each project. This installer also stated that where this happens, the auditor is made aware of the situation and why the specified equipment is not viable in the particular project, so there is a feedback loop in place.
- Two installers recommended that the program have a greater focus on exterior and parking lot lighting, as such lighting is on for many hours and is typically inefficient. Navigant agrees that there are likely many opportunities to improve exterior lighting efficiency within the target market for SBS, but notes that such measures were not included in the approved EE&C Plan for Phase II.
- One installer recommended adding LED exit signs with remote heads to the project. These types of exit signs include battery-backed lighting that illuminates the area on the exterior side of emergency exits. Again, this measure was not part of the approved Phase II Plan.

When asked about their perceptions of participants' satisfaction with the program, the installers unanimously reported that most participants are very satisfied with the program. Two indicated that very small percentages have some complaints, such as one participant who felt that the replacement lighting was not as bright as he had expected.

16.4.3 Process Evaluation Findings and Recommendations

Navigant offers the following findings and recommendations based on its process evaluation interviews:

1. **Finding**: SBS program implementation diverged significantly from the EE&C Plan from the beginning of Phase II, because PECO's contract with SW was based on the program funding level and saving goal in the original EE&C plan and was not updated to aligned with the revised Plan that was filed in March 2014.
    a. **Recommendation:** PECO should ensure that its CSP contracts are tightly aligned with approved program plans and that contract language allows PECO to either modify budgets and savings goals based on PUC-approved plan changes or to terminate the contract if the CSP refuses to accommodate such modifications.

2. **Finding**: SW's administrative fee is determined as a fixed multiplier of the estimated annualized savings from each project.

a. **Recommendation:** If PECO wishes to implement a small business DI program in Phase III, Navigant recommends that in any future contract CSP remuneration be completely divorced from project-level energy savings estimates, as this could create a perverse incentive for the CSP to inflate savings. PECO should consider a CSP payment structure that provides a per-project payment, but bases a substantial portion of CSP payment—perhaps the majority—on the level of savings verified by the evaluator following the end of each program year.

3. **Finding:** It is clear that from the installers' perspectives, the program is operating well, there are no consistent problems, and participant feedback is almost entirely favorable. The only recommendations installers offered to improve the program were to offer additional measures as described above and to provide installation crews with a small inventory of the most common bulbs and ballasts to replace units that malfunction upon installation.
   a. **Recommendation 5a:** SW should consider providing installers with a stock of common bulbs and ballasts, as this would likely improve customer service and could reduce program implementation costs.
   b. **Recommendation 5b:** If PECO decides to implement the SBS program in Phase III, Navigant should evaluate the value of including parking lot lighting and LED exit signs with remote heads in the program design.

16.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 16-8 summarizes Navigant's recommendations and their current status.

Table 16-8: Smart Business Solutions Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: The SW sales auditor should gather and document lighting schedules accurately and use this information in the savings estimates presented to customers and in the calculation of ex ante savings.	In process. CSP will add an additional form to document the actual hours of operation vs. stated. An example would be a restaurant which requires prep time before HOU and break down time after hours of operation.
Recommendation 2: Where it uses non-default HOU, SW should calculate a non-default coincidence factor in compliance with the TRM and prior SWE guidance.	Implemented. This is in process for the instances of non-default HOU.
Recommendation 3: PECO should ensure that its CSP contracts are tightly aligned with approved program plans and that contract language allows PECO to either modify budgets and savings goals based on PUC-approved plan changes, or to terminate the contract if the CSP refuses to accommodate such modifications.	Implemented. This has been addressed with all parties. A process for careful attention to new contracts and amendments are in place.
Recommendation 4: Navigant recommends that in any future contract CSP remuneration be divorced from project-level energy savings estimates, as this could create a perverse incentive for the CSP to inflate savings.	This contract change will be considered for Phase III.
Recommendation 5a: SW should consider providing installers with a stock of common bulbs and ballasts, as this would likely improve customer service and could reduce program implementation costs.	Being Considered. This will be discussed with CSP. Although their method of buying materials and inventory control play a part in their ability to be efficient.
Recommendation 5b: If PECO decides to implement the SBS program in Phase III, Navigant should evaluate the advisability of including parking lot lighting and LED exit signs with remote heads in the program design.	In process. This has been addressed in Phase III program design.

Source: Navigant and PECO

16.6 FINANCIAL REPORTING

Navigant's cost-effectiveness analysis, presented in Table 16-9, indicates that the SBS program was again cost-effective in PY6, with a benefit-cost ratio of 1.64. The program's PY6 benefit-cost ratio is approximately half that of the PY5 ratio. The primary reason for this is the implementation in the 2014 TRM of reduced effective lifetimes in the calculation of lifetime savings for T12 fluorescent fixture replacement projects. Because the Energy Policy Act of 2005 phased out T12 lamps beginning in July 2012, the baseline for calculating savings from T12 replacement projects has been shifting to standard T8 fixtures. The 2014 TRM is the first Pennsylvania TRM to reflect this shift by implementing reduced measure lifetimes (or equivalently, the application of savings adjustment factors) for projects that replace T12 fixtures. Since nearly 70 percent of PY6 SBS savings came from such projects, these adjustments have a substantial impact on program cost-effectiveness.

Table 16-9: Smart Business Solutions Summary of Program Finances

Row #	Cost Category	Actual PY6 Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	3,645	6,391
2	EDC Incentives to Participants	0	0
3	EDC Incentives to Trade Allies	0	0
4	Participant Costs (Net of incentives/rebates paid by utilities)	3,645	6,391
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	2,615	4,536
6	Design & Development	0	0
7	Administration, Management, and Technical Assistance[1]	2,613	4,531
8	Marketing[2]	2	5
9	EDC Evaluation Costs	0	0
10	SWE Audit Costs	0	0
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	**0**	**0**
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	6,260	10,927
13	Total NPV Lifetime Energy Benefits	8,515	16,702
14	Total NPV Lifetime Capacity Benefits	1,681	3,216
15	Total NPV TRC Benefits[4]	10,240	20,013
16	TRC Benefit-Cost Ratio[5]	1.64	1.83

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, Electric Distribution Company (EDC) and Conservation Service Provider (CSP) program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
Values in tables may not reconcile as presented due to numerical precision.

Appendix A. EM&V INFORMATION

A.1 PARTICIPANT DEFINITIONS

Table A-1: Program Year 6 Participant Definition by Program[52]

Program	Participant Definition	Can there be more than one measure per participant?	Sample Defined By:
Smart Home Rebates	One purchased measure	Yes	One purchased measure
Smart House Call	One home	Yes	One Home
Smart Appliance Recycling	One appliance	Yes	One appliance
Smart Usage Profile	One home	No	One home
Smart Energy Saver	One kit	Yes	One kit
Smart Builder Rebates	One home	Yes	One home
Low Income Energy Efficiency Program	One audit/One giveaway recipient/One household	Yes	Participant
Smart AC Saver – Residential	One address	Yes	N/A
Smart AC Saver – Commercial	One address	Yes	N/A
Smart Equipment Incentives – C&I	One project	Yes	Project (Impact); Participant (Process)
Smart Equipment Incentives - GNI	One project	Yes	Project (Impact); Participant (Process)
Smart Construction Incentives	One project	Yes	Project
Smart Multi-Family Solutions	Master utility account ID	Yes	kWh
Smart On-Site	One project	No	Project
Smart Business Solutions	One project	Yes	Project

Source: Navigant

[52] EDCs can modify table as necessary to provide additional granularity.

A.2 PROGRAM YEAR 6 EVALUATION ACTIVITIES

Table A-2: Program Year 6 Actual Evaluation Activities

Programs (Sub Programs if necessary)	Sectors	Records Review	Participant Surveys	Non-participant Surveys	Site Visits	Metering[53]
Smart Home Rebates	Residential	99,228	200	0	0	0
Smart House Call	Residential	4,591	0	0	0	0
Smart Appliance Recycling	Residential	100	125	0	0	0
Smart Usage Profile	Residential	89,785	250	200	0	0
Smart Energy Saver	Residential	4,197	0	0	0	0
Smart Builder Rebates	Residential	98	0	0	0	0
Low Income Energy Efficiency Program	Low Income Residential	126	125	0	0	0
Smart AC Saver – Residential	Residential	1	0	0	0	0
Smart AC Saver – Commercial	Commercial	1	0	0	0	0
Smart Equipment Incentives – C&I	C&I	69	26	0	42	53
Smart Equipment Incentives - GNI	GNI	41	19	0	39	13
Smart Construction Incentives	Commercial, GNI	44	21	0	19	12
Smart Multi-Family Solutions	Residential, Commercial, and GNI	38,393	84	0	16	0
Smart On-Site	Commercial, GNI	0	0	0	0	0
Smart Business Solutions	Commercial	16	0	0	0	0

Source: Navigant

[53] Does not include statistical billing analysis

Appendix B. TRC INCREMENTAL COSTS

Table B-1: Measure Incremental Costs Not Taken from SWE Database or Filed Plan

Program	Measure	Incremental Cost	Incremental Cost Source
Smart AC Saver (Commercial)	Air Conditioning Control Switch	0.00 / Switch	Inferred from Program Design
Smart AC Saver (Residential)	Air Conditioning Control Switch	0.00 / Switch	Inferred from Program Design
Smart Business Solutions	ENERGY STAR Screw-in CFL Bulbs (general service, non-dimmable) - lumens = 1490 to 2600 - 23W	45.70 / Lamp	Program Tracking Database
Smart Business Solutions	ENERGY STAR Screw-in CFL Bulbs (general service, non-dimmable) - lumens = 750-1049 - 13W	25.93 / Lamp	Program Tracking Database
Smart Business Solutions	ENERGY STAR Screw-in CFL Bulbs (Specialty: Globe) - lumens = 310-749 - 9W	26.02 / Lamp	Program Tracking Database
Smart Business Solutions	ENERGY STAR Screw-in CFL Bulbs (Specialty: Reflector) - lumens = 310-749 - 16W	22.38 / Lamp	Program Tracking Database
Smart Business Solutions	Controls: Interior Occupancy Sensor - Ceiling Mount Sensor	184.19 / Sensor	Program Tracking Database
Smart Business Solutions	Controls: Interior Occupancy Sensor - Fixture Mount Sensor	119.77 / Sensor	Program Tracking Database
Smart Business Solutions	Controls: Interior Occupancy Sensor - Wall Switch Sensor	110.95 / Sensor	Program Tracking Database
Smart Business Solutions	Interior LED Exit Signs - 2W	72.54 / Fixture	Program Tracking Database
Smart Business Solutions	Leave Existing Control - Daylighting Photocell	0.00 / Sensor	Program Tracking Database
Smart Business Solutions	Leave Existing Control - Personal Dimmers	0.00 / Sensor	Program Tracking Database
Smart Business Solutions	LED Refrigeration Case Lighting - 4 Door LED Refrigerated Case - 60" LED Sticks - 64W	1,506.07 / Refrigerated Case	Program Tracking Database
Smart Business Solutions	LED: A19 - lumens = 310-749 - 6.5W	35.68 / Lamp	Derived from similar measures
Smart Business Solutions	LED: A19 - lumens = 310-749 - 7W	36.50 / Lamp	Program Tracking Database
Smart Business Solutions	LED: A19 - lumens = 310-749 - 9.5W	40.62 / Lamp	Derived from similar measures
Smart Business Solutions	LED: A19 - lumens = 750-1049 - 11W	43.09 / Lamp	Program Tracking Database
Smart Business Solutions	LED: BR30 - lumens = 561-837 - 13W	83.15 / Lamp	Program Tracking Database
Smart Business Solutions	LED: BR40 - lumens = 561-837 - 14W	25.85 / Lamp	DEER Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	New LED Area/Pole Mount Fixture replacing HID 250-400 W - 93W	956.40 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Area/Pole Mount Fixture replacing HID 400 W - 137W	1,408.89 / Fixture	Derived from similar measures
Smart Business Solutions	New LED Canopy replacing HID 400W - 150W	1,691.75 / Fixture	Derived from similar measures
Smart Business Solutions	New LED Canopy replacing HID 400W - 88W	1,063.37 / Fixture	Derived from similar measures
Smart Business Solutions	New LED Flood replacing HID 100-175 W - 22W	433.44 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Flood replacing HID 175-320 W - 41W	528.51 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Flood replacing HID 400 W - 79W	991.65 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Wallpack replacing HID 100-150 W - 12W	402.20 / Fixture	Derived from similar measures
Smart Business Solutions	New LED Wallpack replacing HID 151-175 W - 20W	451.62 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Wallpack replacing HID 176-250 W - 26W	424.05 / Fixture	Program Tracking Database
Smart Business Solutions	New LED Wallpack replacing HID 176-250 W - 30W	501.99 / Fixture	Program Tracking Database
Smart Business Solutions	LED: MR16 - lumens = 180 to 309 - 5W	36.90 / Lamp	Program Tracking Database
Smart Business Solutions	LED: MR16 - lumens = 310-749 - 6.5W	20.58 / Lamp	DEER Database
Smart Business Solutions	LED: MR16 - lumens = 310-749 - 6W	45.45 / Lamp	Program Tracking Database
Smart Business Solutions	LED: PAR20 - lumens = 310-749 - 8W	46.43 / Lamp	Program Tracking Database
Smart Business Solutions	LED: PAR30 - lumens = 561-837 - 12W	75.81 / Lamp	Program Tracking Database
Smart Business Solutions	LED: PAR38 - lumens = 750-1049 - 13W	66.36 / Lamp	Program Tracking Database
Smart Business Solutions	LED: BR30 - lumens = 310-749 - 9.5W	12.86 / Lamp	DEER Database
Smart Business Solutions	LED: BR30 - lumens = 561-837 - 10.5W	45.86 / Lamp	Program Tracking Database
Smart Business Solutions	LED: CLBR - lumens = 180 to 309 - 4W	61.55 / Lamp	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-5 - T5 2F54HO	129.00 / fixture	DEER Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-5 - T5 4F54HO	287.42 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-5 - T5 6F54HO	374.99 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-8 - HPT8 3F32 ISH	232.91 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-8 - HPT8 4F32 ISH	243.00 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - High Bay Fluorescent T-8 - HPT8 6F32 ISH	287.64 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2' Relamp and Reballast - HPT8 1F17 ISL	7.18 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2' Relamp and Reballast - HPT8 2F17 ISL	62.94 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2' Relamp and Reballast - HPT8 3F17 ISL	68.82 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x2 Troffer Retrofit - HPT8 2F17 ISL	80.5 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x2 Troffer Retrofit - HPT8 3F17 ISL	90.98 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x4 Troffer Retrofit - HPT8 2F28 ISL	87.90 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x4 Troffer Retrofit - HPT8 2F32 ISH	98.56 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x4 Troffer Retrofit - HPT8 2F32 ISL	91.70 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2x4 Troffer Retrofit - HPT8 2F32 ISN	91.70 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 3' Relamp and Reballast - HPT8 1F25 ISL	59.69 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 3' Relamp and Reballast - HPT8 2F25 ISL	64.04 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Retrofit - HPT8 1F28 ISL	80.59 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Retrofit - HPT8 1F32 ISL	82.49 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Retrofit - HPT8 1F32 ISN	82.49 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Retrofit - HPT8 2F28 ISL	81.22 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Retrofit - HPT8 2F32 ISL	81.22 / Fixture	Program Tracking Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 1F28 ISL	58.83 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 1F32 ISL	60.73 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 2F28 ISL	62.31 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 2F32 ISL	66.11 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 2F32 ISN	60.05 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 3F28 ISL	67.88 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 3F32 ISL	73.58 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 4F28 ISL	72.89 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 4F32 ISH	54.90 / fixture	DEER Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Relamp and Reballast - HPT8 4F32 ISL	73.34 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 6' Industrial Retrofit - HPT8 2F25 ISL	113.35 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 6' Industrial Retrofit - HPT8 4F25 ISL	139.81 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 2F28 ISL	94.32 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 2F32 ISH	104.98 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 2F32 ISN	98.12 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 4F28 ISL	111.09 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 4F32 ISH	129.78 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Retrofit - HPT8 4F32 ISN	118.69 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 2X2 Recessed Troffer - HPT8 2F17 ISL	146.00 / fixture	DEER Database
Smart Business Solutions	Linear Fluorescent - HPT8 2X2 Recessed Troffer - HPT8 3F17 ISL	165.01 / Fixture	Derived from similar measures
Smart Business Solutions	Linear Fluorescent - HPT8 2X4 Recessed Troffer - HPT8 2F32 ISN	129.62 / Fixture	Program Tracking Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Business Solutions	Linear Fluorescent - HPT8 2X4 Recessed Troffer - HPT8 3F32 ISL	130.50 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Fixture - HPT8 1F28 ISL	100.89 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Fixture - HPT8 1F32 ISL	102.79 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Fixture - HPT8 2F28 ISL	98.54 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Industrial Fixture - HPT8 2F32 ISL	102.34 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Vaportight Fixture - HPT8 2F32 ISH	126.82 / Fixture	Derived from similar measures
Smart Business Solutions	Linear Fluorescent - HPT8 4' Vaportight Fixture - HPT8 2F32 ISL	149.16 / Fixture	Derived from similar measures
Smart Business Solutions	Linear Fluorescent - HPT8 4' Wrap Fixture - HPT8 1F28 ISL	116.34 / Fixture	Derived from similar measures
Smart Business Solutions	Linear Fluorescent - HPT8 4' Wrap Fixture - HPT8 2F28 ISL	116.34 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 4' Wrap Fixture - HPT8 2F32 ISL	120.14 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Fixture - HPT8 2F28 ISL	133.68 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Fixture - HPT8 2F32 ISH	144.92 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Fixture - HPT8 4F28 ISL	145.43 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Fixture - HPT8 4F32 ISH	163.67 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Industrial Fixture - HPT8 4F32 ISN	168.60 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Vaportight Fixture - HPT8 2F32 ISH	253.63 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Vaportight Fixture - HPT8 4F28 ISL	298.31 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Vaportight Fixture - HPT8 4F32 ISH	266.16 / Fixture	Program Tracking Database
Smart Business Solutions	Linear Fluorescent - HPT8 8' Wrap Fixture - HPT8 4F28 ISL	194.58 / Fixture	Program Tracking Database
Smart Business Solutions	Removed Fluorescent Case Lighting	0.00 / Refrigerated Case	Program Tracking Database
Smart Business Solutions	Removed Lighting Fixture	0.00 / Fixture	Program Tracking Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Equipment Incentives (C&I)	A/C: Air Source - < 65,000 Btu/h (5.5 tons) - 15 SEER or greater (Second Tier)	172.00 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	A/C: Air Source - < 65,000 Btu/h - 15 SEER or greater	180.43 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	A/C: Air Source - >= 135,000 Btu/h and < 240,000 Btu/h - 12.1 EER or greater	89.13 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	A/C: Air Source - >= 65,000 Btu/h and < 135,000 Btu/h - 12.3 EER or greater	27.35 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	A/C: Air Source - >= 760,000 Btu/h (> 63.33 tons) - 10.2 EER/10.3 IPLV or greater	151.35 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	Basic Time Control - EMS	0.51 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	Basic Time Control - Plus at least 3 Enhancements	0.51 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Coil Defrost Control	500.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Floating-head pressure controls - Compressors > 1.0 HP	867.25 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Floating-head pressure controls - Compressors > 5 HP	867.25 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Hotel Guest Room Occupancy Sensor - Electric Heat/AC	260.00 / Per Ton	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Reach-in Cases - Freezer - Shaded Pole to ECM (unknown power)	185.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Reach-in Cases - Freezer - Shaded Pole to ECM, Freezer	185.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Reach-in Cases - Refrigerator - Shaded Pole to ECM (unknown power)	185.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Walk-in Cases - Freezer - PSC to ECM (unknown power)	250.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Walk-in Cases - Freezer - Shaded Pole to ECM (unknown power)	250.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Walk-in Cases - Refrigerator - PSC to ECM (unknown power)	250.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Walk-in Cases - Refrigerator - Shaded Pole to ECM (unknown power)	250.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	Evaporator Fan EC Motor for Walk-in Cases - Refrigerator - Shaded Pole to ECM, Cooler	250.00 / Per Unit	Program Tracking Database
Smart Equipment Incentives (C&I)	VSD on Air Compressors - Screw Air Compressor < 50 HP - < 50 HP	430.00 / Per Fan	Program Tracking Database

Program	Measure	Incremental Cost	Incremental Cost Source
Smart Equipment Incentives (GNI)	A/C: Air Source - >= 135,000 Btu/h and < 240,000 Btu/h - 12.1 EER or greater	89.13 / Per Ton	Program Tracking Database
Smart House Call	LED: Plug-in LED (Specialty: Nightlight) - LED Nightlight - LED Nightlight	0.00 / unit	Inferred from 2011 PUC TRC Order

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

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 cross-sector installation rate used in the PY6 evaluation was drawn from the SHR PY5 in-store intercepts surveys. As shown in Table E-1, the PY5 intercepts were conducted in a representative sampling of participating retail stores by sales channel.

Table D-1: Store Sampling for PY5 Intercepts Based on Proportion of Program Bulb Sales

Retailer Name	Proportion of Total Program Bulb Sales	Proportional Sample Number of Stores, by Program Sales	Number of Stores Actually Visited
The Home Depot	57%	11	15
Costco	17%	3	0
Lowe's	12%	2	2
Walmart	5%	1	3
Goodwill	2%	0.5	0
Giant Food Stores	2%	0.4	0
Wegmans	1%	0.2	0
Sam's Club	1%	0.2	0
Walgreens	1%	0.2	3
True Value	0.3%	0.1	0
BJ's Wholesale Club	0.1%	0.0	0
Best Buy	0.05%	0.0	0
Ace Hardware	0.01%	0.0	0
Total	**100%**	**20**	**23**

Source: Navigant analysis

In the PY5 evaluation, 313 respondents answered questions pertaining to cross-sector installation of bulbs. Of the 1,348 bulbs in the baskets of those 313 respondents, 122 were slated for non-residential sockets, which yielded a cross-sector sales rate of 8.5%. The PY5 research provided a robust estimate of cross-sector sales for efficient bulbs overall, but the sample was not designed to provide statistically significant estimates for individual bulb types. Hence the overall cross-sector sales rate of 8.5% was applied to all program bulb sales in PY5, and this same approach was used in PY6. Table D-2 shows cross-sector installations by bulb type and by commercial building type from the PY5 intercepts data. Additional details regarding sampling methodology and findings from the PY5 in-store intercepts are available in the PY5 annual report.

Table D-2: PY5 Cross-Sector Bulb Installations by Business Type

Business Type	Standard CFLs	Specialty CFLs	LEDs
Restaurant	37	3	0
Office	24	0	5
Lodging common areas	15	0	0
Grocery	12	0	0
Auto Related	9	0	1
Retail	8	0	0
Daycare	4	1	0
Religious Worship	2	0	0
Industrial/Manufacturing	--	0	1
Total	**111**	**4**	**7**

Source: In-Store Intercepts Data

Appendix E. RESIDENTIAL LIGHTING LONG-TERM MARKET EFFECT MODEL

This section describes Navigant's market model approach to develop a comprehensive net-to-gross (NTG) estimate for CFLs in PECO's service area—one that encompasses not only free ridership and spillover, but also includes other market effects. In simplistic terms, the approach used was to pull together many pieces of available market data, model what the CFL market would have been in the absence of PECO programs, and compare it to the market with PECO programs. Navigant used national and PECO-specific saturation data (data on the average percentage of total bulbs in sockets in a home that are CFLs) and Bass diffusion curve modeling (a widely proven equation for the rate of adoption of a new technology) to predict the saturation that would have existed in PECO's service territory in 2013 in the absence of the program. This result was compared with data reflecting actual saturation of CFLs in PECO territory in 2013.[54] The result is a 2013 NTG ratio estimate of 45% that accounts for the long-term, cumulative effects of the program on the market since its inception in 2009. This low value results from market effects that are calculated as negative, indicating an additional amount of free riders in the cumulative 2013 analysis. Nevertheless, an additional analysis that looks at only the first two program years (2009 and 2010) shows substantial promise, with a NTG ratio of 111%.[55]

The conclusion of this report points to strong program support of the CFL market in 2009 and 2010 and illustrates that continued support for PECO programming is essential to transforming the CFL market in PECO's territory. Program support was cut back because of a regulatory framework that refuses to incentivize savings beyond program targets, which the CFL programs reached after only 2 years. The throttling of program support in 2011-2013 resulted in market confusion and an untransformed market that reverted to slow saturation growth. Had programs continued at the same level after 2010, continued market transformation would have likely continued.

As the lighting market continues to evolve, PECO has the opportunity to influence and transform the market. Two possible actions for PECO include:

- Continuing to incentivize CFLs until CFL saturation reaches higher, sustainable levels. PECO territory CFL saturation in 2013 fell short of the national average CFL saturation. PECO could continue to rebate CFLs until PECO territory saturation at least matches national saturation.
- Focus lighting market transformation efforts going forward on LEDs. LEDs have long measure lives, better lighting quality, the ability to dim, as well as other favorable features that appeal to residential customers. With a large incandescent base in PECO territory, the opportunities for installing LEDs, and their resulting savings, could be high. In states with high CFL saturation, Navigant has observed the potential for LEDs can be low due to the small incremental savings of LEDs replacing CFLs, as well as the long life of CFLs, which decreases the number of installation opportunities.

[54] Saturation data for 2013 is the most recent available. A reliable saturation data point is needed to complete this analysis, thus the analysis could not be extended to 2014.

[55] Because this method makes use of market-level socket saturation data, it is not possible to discern the specific effect of individual CFL programs. Therefore, by necessity, this NTGR value applies to the suite of PECO programs that offer discounted or free CFLs.

A key lesson can be learned from past CFL programs. Regardless of the future path taken by PECO, residential lighting programs should be more consistent year to year in their funding level so as to not confuse the market with major changes. Consistent programs are key to achieving market transformation.

The following sections describe the challenge in NTG research that the CFL Market Model addresses, followed by a detailed discussion of the method Navigant used and a summary of findings. Navigant then concludes with a review of strengths and limitations of the method. Some of the terminology used is unique to NTG analysis as a whole, and some is unique to this particular analysis. Section E.7 of this Appendix provides a glossary of terms to assist readers.

E.1 THE CHALLENGE OF ESTIMATING A NTG RATIO THAT INCLUDES MARKET EFFECTS

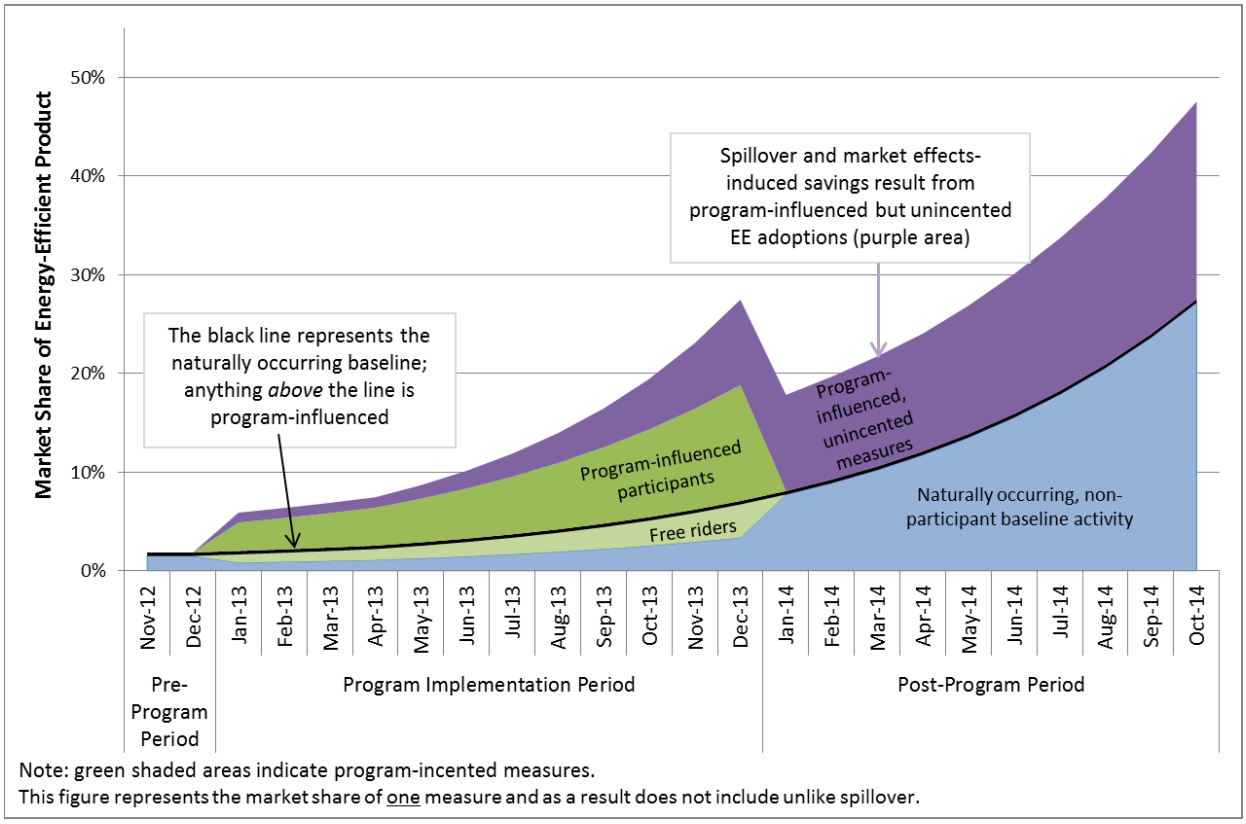
The CFL Market Model uses multiple years of data on CFL program activity and national market activity to estimate NTG ratio, market effects,[56] and free ridership associated with PECO's CFL programs. Multi-year program influences are not accounted for in most NTG methods, and spillover is often ignored due to the challenges of its estimation. This method addresses these limitations by using saturation rather than annual sales data to account for program influences that carry over from year to year.

Multi-year program influences are frequently mistakenly counted as free ridership, significantly decreasing a program's NTG ratio. For example, consider a customer who has purchased and installed CFLs for the last 4 years. In the first year, the customer was influenced to begin purchasing CFLs by a utility's program marketing, education, and discounted pricing. The customer continued to purchase discounted CFLs in the second, third, and fourth year based on their new knowledge and acceptance of CFLs. If a survey was conducted in the program's fourth year, the customer would likely report that they would have purchased the CFL even if the utility program was not active in that year. Traditional evaluation approaches would conclude that this customer was a free rider and thereby part of the naturally occurring baseline (NOB) (as illustrated in Figure E-1). In contrast, this CFL Market Model reports this participant's activity as program-influenced.

[56] The term market effects as used in this paper consists of untracked installations (installations occurring without a discount from a utility) of energy efficient equipment; this includes spillover and utility influenced non-participants. See glossary for other definitions.

Figure E-1 illustrates the framework to examine multi-year program influences. Traditional evaluation methodologies attempt to quantify free ridership and use this term to subsequently estimate the NTG ratio. These analyses rarely attempt to estimate the NOB. The NOB is meant to reflect what would have happened if the utility intervention had never occurred, going all the way back to the program's inception. Estimating free ridership of a widely adopted technology in a single program year (long after the program start) often results in an overestimate of free ridership, as described by the example in the previous paragraph. In extreme cases, the calculated value for free ridership may be larger than the actual NOB (which in reality cannot happen by definition) and effectively deduct savings from program-influenced participants (PIPs)**.** Thus, directly estimating the NOB is a preferred approach for evaluating the NTG ratio.

Figure E-1: Generic Framework for Examining Multi-year Program Influences



Source: Navigant analysis

The CFL Market Model is an analysis that estimates the NOB of CFL activity in PECO territory as a preliminary step in the estimation of the NTG ratio. Ideally, the following steps would be taken to estimate the NOB and NTG ratio of CFLs in PECO territory:

- Obtain CFL annual sales data within PECO territory from 1990 to 2014.
- Split CFL annual sales data into two sets:
    - CFL sales from 1990-2008 (prior to PECO programs)
    - CFL sales in 2009 and beyond (after PECO programs came into effect)

- Use 1990-2008 CFL sales to project the sales of CFLs in 2009 and beyond. This forecast represents CFL activity absent any PECO program influence (i.e., the NOB)[57].
- The difference between actual CFL sales and the NOB divided by the number of CFLs discounted by PECO, when summed over the life of the program, yields an estimate of the overall NTG ratio for the life of the program.

This ideal analysis is not possible because reliable CFL sales data within PECO territory from 1990 to 2014 are unavailable. Thus, Navigant developed an approach to estimate the NOB and NTG ratio using reliable data that are available. The available data include:

- CFL annual sales in the United States from 1990 to 2014[58]
- Residential CFL saturation in the United States from 2008 to 2010[59]
- PECO program-discounted bulbs sold from 2009 to 2014[60]
- PECO residential CFL saturation in 2010 and 2013[61]

Section E.2 of this Appendix describes how Navigant used these data to estimate the NOB and the NTG ratio. Navigant does not distinguish between the various types of CFLs (standard vs. specialty) in this analysis. Rather, this analysis groups all types of CFLs together into one category of bulbs for consistency with national saturation data.

[57] This model inherently includes the influence of all non-PECO programs. The PECO NOB represents the NOB that would occur in PECO territory if PECO programs did not exist but other CFL programs did exist. PECO NONPs are the portions of the NOB that represent what would happen if absolutely no programs for CFLs existed, anywhere.

[58] 1990-2012: U.S. International Trade Commission – Import Statistics. 2013-2014: Extrapolated using NEMA Estimated National Shipments. (http://www.regulations.gov/#!documentDetail;D=EERE-2013-BT-STD-0051-0037)

[59] The 2010 value is from DOE 2010 Lighting Market Characterization (2010 value, Table 4.2, p. 24) (http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf).
The 2009 value is from DOE 2010 CFL Market Profile (2009 value, based on weighted average of data from 16 regions- multi-state effort, Figure 8, p. 17) (http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile_2010.pdf).
The 2008 value is calculated, based on data provided in the DOE 2009 CFL Market Profile (p.5) (http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile.pdf) and the DOE 2010 CFL Market Profile (Table 9, p. 20).

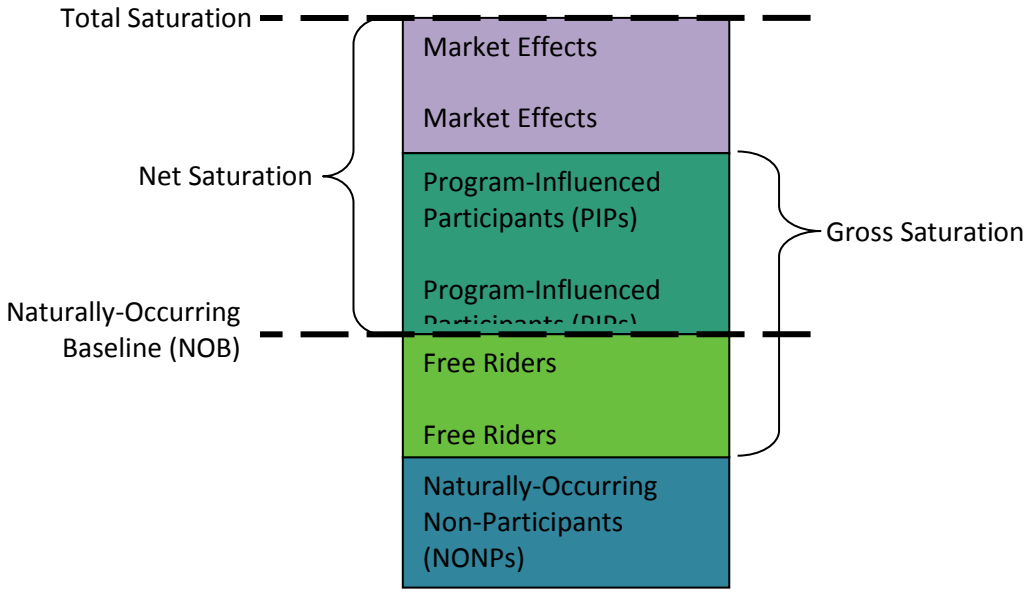
[60] PECO Program records, 2009-2014.

[61] The 2010 value is from the 2011 PECO Baseline Study. The 2013 value is from PECO-specific data collected for the 2014 PA Statewide Study by GDS.

E.2 METHODS

Figure E-2 presents a generic framework for understanding the components of the NTGR, put into the terms used in this analysis. While gross saturation can be estimated from program tracking data, net saturation must be calculated using information about the NOB and market effects. The NOB includes free riders and naturally occurring non-participants (NONPs). In this NTG analysis for PECO's CFL programs, Navigant applies CFL saturation information (as opposed to annual CFL sales) to the framework in Figure E-2. Using saturation data allows for the examination of NTG under a longer-term market transformation framework.

Figure E-2: Generic Framework for Net-To-Gross Terminology



Source: Navigant analysis

To estimate the NTG ratio using this framework, Navigant took the following steps:

Step 1: Model the PECO NOB by (a) estimating PECO NONPs and (b) estimating PECO free ridership, and adding them together, as shown in equation 1 below.

$$\text{PECO NOB} = \text{PECO NONPs} + \text{PECO Free Ridership} \quad (1)$$

Step 2: Calculate PECO *net* saturation based on total PECO saturation and the estimate of the PECO NOB, as shown in equation 2 below.

$$\text{PECO Net Saturation} = \text{PECO Total Saturation} - (\text{PECO NOB}) \quad (2)$$

Step 3: Calculate PECO PIPs based on PECO gross saturation and PECO free ridership, as shown in equation 3 below.

$$\text{PECO PIPs} = \text{PECO Gross Saturation} - \text{PECO Free Ridership} \quad (3)$$

Step 4: Calculate PECO market effects based on PECO net saturation and PECO PIPs, as shown in equation 4 below.

$$\text{PECO Market Effects} = \text{PECO Net Saturation} - \text{PECO PIPs} \quad (4)$$

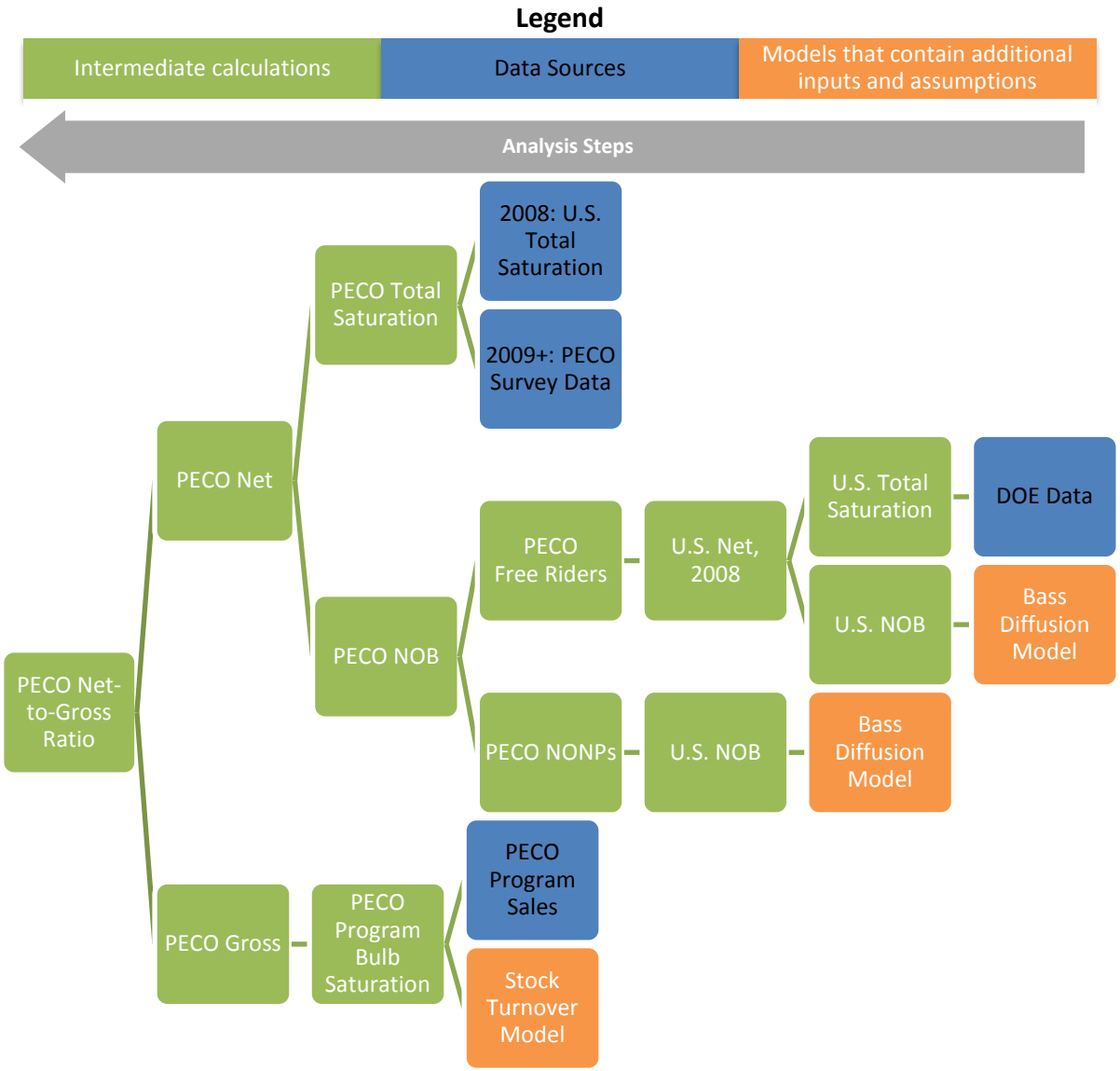
E.3 DATA SOURCES

Data availability naturally influenced Navigant's approach to calculating PECO's NTG ratio. As shown in Figure E-3, PECO's gross saturation was calculated based on PECO program bulb sales and a stock accounting model; however, PECO's net saturation required many more inputs and calculation steps. The most direct method to determine PECO's net saturation is to subtract the PECO NOB saturation from the PECO total saturation (Step 2). A framework for using national data to inform PECO NOB saturation was generated, as seen in Figure E-5: Mapping National Saturation Data to PECO Saturation Data Figure E-6:. This framework was necessary because no pre-2009 CFL data for PECO territory is available, and without this data a PECO NOB cannot be directly derived. Navigant assumed that in 2008, the year before PECO programs started, PECO territory had the same total CFL saturation as in the rest of the United States (7.6%, a conservatively high assumption for the purpose of this analysis).[62] Data from two baseline studies were used as the basis for estimating total saturation for the PECO electric service territory (17% in 2010[63] and 19% in 2013[64]).

[63] 2011 PECO Baseline Study

[64] PECO-specific data from the 2014 PA Statewide Study

Figure E-3: Calculating PECO NTGR from Available Data



Source: Navigant analysis

E.4 DETAILED METHODS

Step 1: Model PECO's Naturally Occurring Baseline

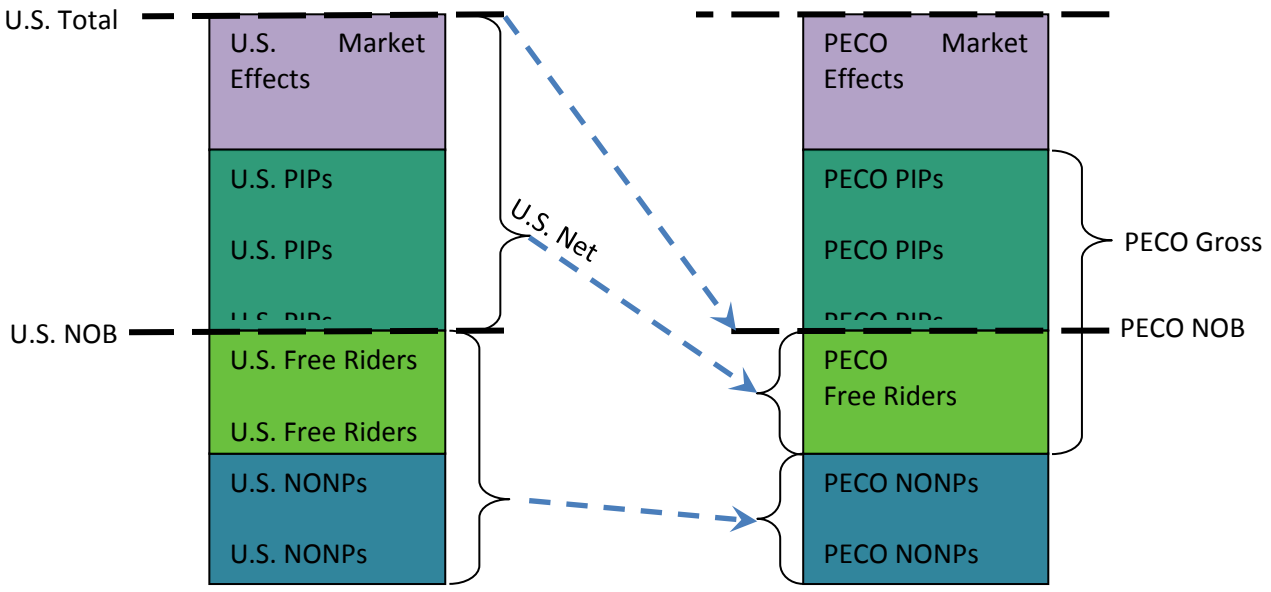
PECO's NOB is comprised of two parts – PECO NONPs and PECO free riders. As demonstrated in Figure E-5: Mapping National Saturation Data to PECO Saturation Data

Figure E-6:, Navigant used the following methods to estimate PECO NONPs and PECO free riders.

- **PECO NONPs**: U.S. NOB is used as a proxy for PECO NONPs. CFL saturation due to PECO NONPs is assumed to be equal to the CFL saturation that would have occurred in the absence of national programs (U.S. NOB). To calculate the U.S. NOB, pre-2000 U.S. sales data was fed into a Bass diffusion model and projected forward to estimate the national CFL sales without the effect of U.S. programs. This U.S. NOB was run through a stock accounting model to calculate the resulting saturation. The stock accounting model calculates saturation from annual sales by combining information about the size of the market, bulb lifetime, and installation practices to model the actual installation of purchased bulbs.
- **PECO Free Riders**: PECO customers that were influenced by national or other utilities' programs to install a CFL in 2008 or before (prior to PECO programs) are assumed to participate in PECO programs when PECO programs start in 2009. Because these participants were not influenced by PECO's programs, they are considered free riders to PECO's programs. To calculate PECO free riders, the U.S. NOB in 2008 (before PECO programs started) was subtracted from the U.S. total CFL saturation in 2008 to calculate U.S. net saturation. The amount of U.S. net saturation was then assumed to increase at a nominal rate of 1.3% per year from 2009 through 2014 (explained in greater detail in Section 0) to produce a value for PECO free ridership in 2013.

The methods and assumptions used to calculate PECO NONPs and PECO free riders are documented in greater detail below.

Figure E-8: Mapping National Saturation Data to PECO Saturation Data

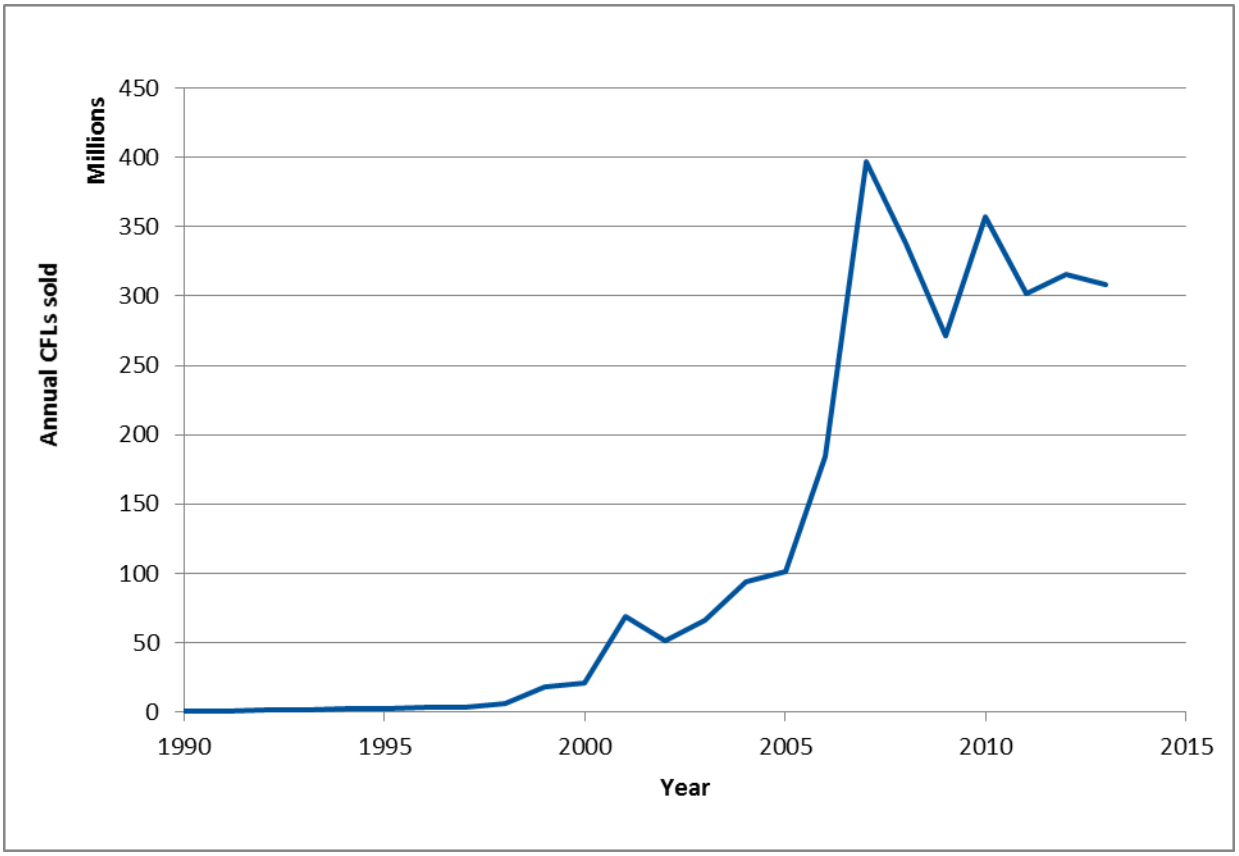


Source: Navigant analysis

Step 1A: Estimate PECO Naturally-Occurring Non-Participants (NONPs)

Historical CFL sales data was used to calculate the U.S. NOB.[65] As part of this analysis, Navigant determined, from historical data, the pivot point at which U.S. programs began to affect the CFL market, so that the calculation of the U.S. NOB would exclude these influences. Though CFLs entered the market in 1980, CFLs have only seen market success in the last decade. Technology improvements and decreasing prices made them a viable option for utility incentive programs, starting with California investor-owned utility (IOU) programs in 1989. ENERGY STAR criteria for CFLs became available in 1999, and California IOUs used this criteria exclusively starting in 2001. This is also the year in which the program incentive structure was changed to incent upstream market participants – manufacturers and retailers – rather than end-use consumers. This shift in incentive structure and increased utility program spending across the United States increased manufacturing volumes and brought bulb costs and prices down across the board. These factors helped set the stage for Walmart to surpass its 2007 goal to sell 100 million CFLs, resulting in the peak seen in Figure E-7: . From this historical perspective, Navigant chose the year 2000 as the national pivot point, since little program activity had occurred anywhere in the country up to this point.

Figure E-12: Historical National CFL Sales



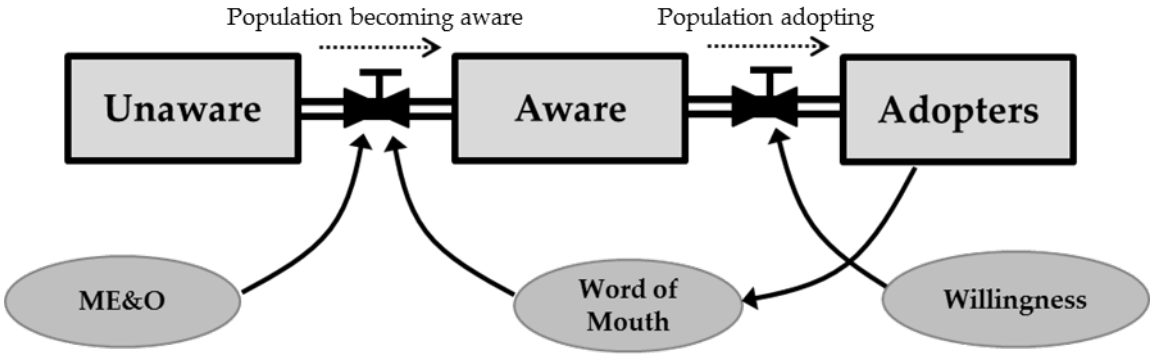
Source: Navigant analysis

Building on this historical bulb sales data through 2000, a Bass diffusion model was used to project the U.S. NOB from 2001 through 2013. The model is calibrated to data prior to the pivot point to allow the model to forecast national CFL market activity in the absence of any utility, regional, or national

[65] U.S. International Trade Commission – Import Statistics and DOE Shipments Data

programs and other influences. The Bass diffusion model is a dynamic approach to simulate market adoption that accounts for the parameters shown in Figure E-8: .

Figure E-13: Illustration of Bass Diffusion Approach to Forecasting CFL Adoption



Source: Adapted from John Sterman. Business Dynamics: Systems Thinking and Modeling for a Complex World. McGraw-Hill, 2000

- **Marketing, education, and outreach (ME&O)** moves customers from the unaware group to the aware group at a consistent rate annually. Unaware customers, as the name implies, have no knowledge of CFLs. Aware customers are those that have knowledge of CFLs and understand their attributes. ME&O may be conducted by manufacturers and distributors of a product, as well as utilities or by other groups. ME&O is often referred to as the Advertising Effect in Bass diffusion modeling. In the context of calculating NONPs in this analysis, the ME&O effect represents marketing efforts by CFL manufacturers and retailers only. This NONP case assumes utility programs and other national programs do not exist; thus, the ME&O component is not subject to influences from utility program spending.

- **Word of mouth** represents the influence of adopters (or other aware consumers) on the unaware population by informing them of CFLs and their attributes. This influence increases the rate at which customers move from the unaware to the aware group. The word of mouth influence occurs in addition to the ongoing ME&O. When a product is new to the market with few installations, ME&O is often the main source driving unaware customers to the aware group. As more customers become aware and adopt, however, word of mouth can have a greater influence on awareness than ME&O, and leads to exponential growth. This exponential growth is ultimately dampened by the saturation of the market, leading to an S-shaped adoption curve, which has been repeatedly observed for new technology diffusion.

  ME&O and word of mouth factors are constant values in Bass diffusion modeling. Historic analysis of new technology diffusion provides a range and average for each of these terms. Navigant used an average word of mouth factor for electric appliances as documented in literature.[66] The ME&O factor was exogenously set by Navigant during a calibration process. The calibration process sought to match modeled U.S. CFL sales to actual U.S. CFL sales from 1990 to 2000. The calibrated ME&O value (0.005) falls within the range of historically observed ME&O values from literature.[67]

[66] Mahajan, Muller, Wind. *New Product Diffusion Models*. © 2000. Springer Science + Business Media.

[67] Mahajan, Muller, Wind. *New Product Diffusion Models*. © 2000. Springer Science + Business Media.

- **Willingness** is the key factor affecting the move from an aware customer to an adopter. Once customers are aware of the measure, they consider adopting the technology based on the financial attractiveness of the measure, as modeled using a payback acceptance curve and other qualitative reasons modeled by a percent adjustment.

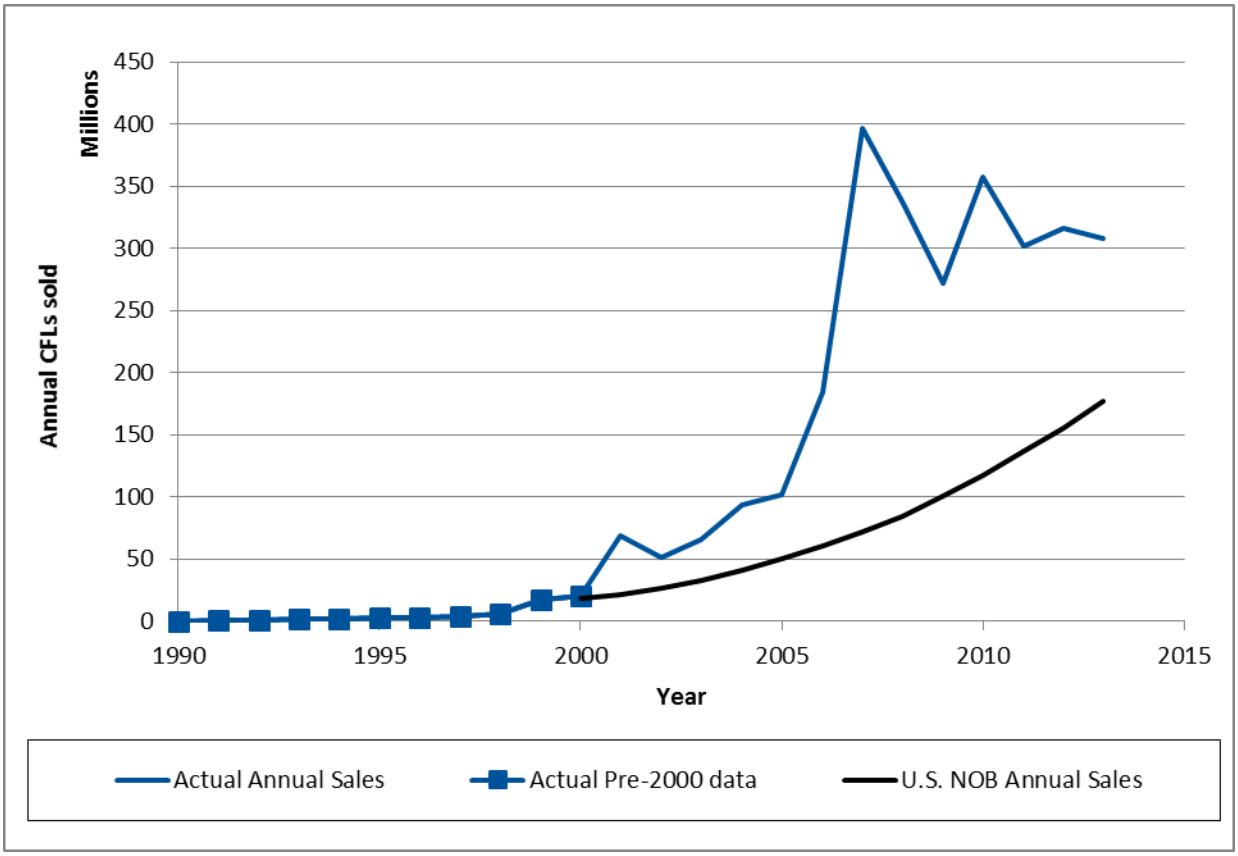
  Willingness is determined using a payback acceptance curve that assesses a customer's willingness to purchase based on the simple payback of a CFL. The payback acceptance curve was developed specific to PECO territory based on a PECO Price Elasticity Study completed in May 2014. Navigant assumed 100% financial acceptance of a CFL when CFL price per bulb was equal to half the price of an incandescent bulb. An additional 50% factor was applied to represent qualitative reasons customers may avoid CFLs, such as perceived quality and resistance to change. CFL price is also a key component in assessing the payback of a CFL. This analysis used pre-2000 national CFL price and sales data to develop a technology learning curve to project CFL prices in the U.S. NOB case.[68]

[68] The methodology for forecasting CFL prices is adapted from: U.S. DOE. "Using the Experience Curve Approach for Appliance Price Forecasting." February 2011.

Navigant's projected U.S. NOB of CFL annual sales, using the PECO-specific payback acceptance parameters, is illustrated in Figure E-9: relative to actual U.S. CFL sales. To calculate the U.S. NOB in terms of saturation, annual sales were run through a stock accounting model that accounted for the number of households, number of sockets per household, percent of sales that went to the residential sector, percent of bulbs installed the year of purchase, the expected lifetime of a CFL and an incandescent bulb, and the rate at which CFLs are taken out of storage for installation.[69] Finally, because saturation is expressed as a percentage, this U.S. NOB can be used directly as PECO NONPs.

Step 1A Conclusion: Using the CFL Market Model, Navigant estimates that in 2013 in PECO's service territory, 10.4% CFL saturation results from PECO NONPs.

Figure E-14: Comparison of Projected U.S. NOB Annual Sales to Actual U.S. Annual CFL Sales



Source: Navigant analysis

Step 1B: Estimate PECO Free Riders

As noted previously, for the purposes of this model, PECO customers influenced by national CFL programs before PECO CFL programs began fall into the category of PECO free riders. The U.S. NOB was subtracted from the 2008 U.S. total saturation, as shown in Figure E-10: , to estimate U.S. net saturation. For the purposes of calculating PECO free riders over time, we assume a rate of increase of 1.3% per year over the life of the programs. This value is obtained from the 2009 and 2010 U.S. saturation datapoints (also illustrated in Figure E-10:). U.S. total saturation from 2009 to 2010 increase

[69] Specific details can be provided upon request.

from 22.5% to 22.8% (a 1.3% year-to-year change). The assumptions made in developing free ridership are conservative and reasonable:

- Using national CFL total saturation data as an estimate of PECO territory CFL total saturation for 2008 is a conservative assumption. National saturation is most likely higher than PECO territory saturation in 2008, at least in part because utility program bulbs in other states are included in this saturation level, whereas PECO had not had any utility program to date. Using this larger value for 2008 saturation results in a larger PECO free ridership value, and ultimately, a lower NTG ratio. Thus, Navigant's assumption creates a more conservative result.
- Our assumption that PECO free- idership grows at a nominal rate from 2008 through 2013 is reasonable, as national CFL sales have stayed relatively flat from 2008 through 2013 (see Figure E-9:). The largest transformation of the national CFL market occurred between 2002 and 2007, during which time many CFL programs started and expanded. It is safe to assume that the largest external influence on the PECO territory CFL market also occurred prior to 2007. As CFL sales flattened starting in 2008, it is also safe to assume the level of external influence on the PECO territory CFL market flattened at this time.
- National saturation was low in 2008 and increased significantly in 2009. Nevertheless, this increase is likely due to the delayed installation of CFLs that were purchased in high volumes in the years leading up to 2009. Although national sales are relatively flat, Navigant recognized saturation can grow at a nominal rate as CFLs see continued installation.

PECO Free Riders = 2008 U.S. Net * (1.013 ^ (2013 - 2008))

PECO Free Riders = 2.7% * (1.013 ^ (2013 - 2008))

Step 1B Conclusion: Using the CFL Market Model, Navigant estimates that in PECO's service territory, PECO free riders constitute 2.9% CFL saturation in 2013.

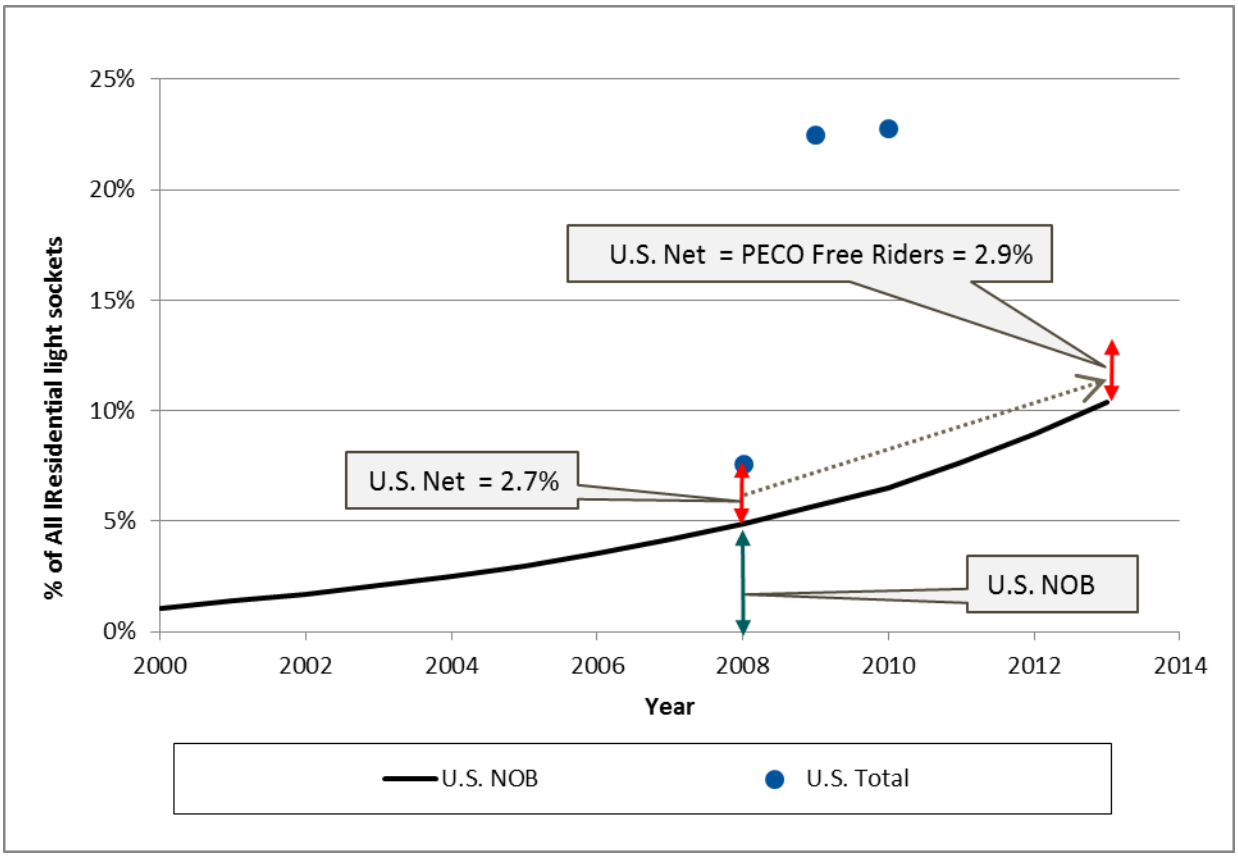
Using the results of these modeling efforts to estimate PECO's NONPs and free riders, Navigant calculates the PECO NOB in 2013 using equation 1, below.

$$\text{PECO NOB} = \text{PECO NONPs} + \text{PECO Free Ridership} \quad (1)$$

$$\text{PECO NOB} = 10.4\% + 2.9\%$$

Step 1 Conclusion: Using the CFL Market Model, Navigant estimates that the 2013 NOB is 13.3% in PECO's service territory.

Figure E-15: National CFL Saturation



Source: Navigant analysis

Step 2: Calculate PECO Net Saturation

Using the results of the modeling effort to estimate PECO's NOB and total saturation, Navigant calculates PECO net saturation in 2013 using equation 2 below.

$$\text{PECO Net Saturation} = \text{PECO Total Saturation} - \text{PECO NOB} \quad (2)$$

$$\text{PECO Net Saturation} = 19\% - 13.3\%$$

Step 2 Conclusion: Using the CFL Market Model, Navigant estimates that 2013 CFL net saturation is 5.7% in PECO's service territory.

Step 3: Calculate PECO PIPs

Using an estimate of gross saturation based on program sales data and a stock accounting model, Navigant calculates PECO PIPs using equation 3 below.

$$\text{PECO PIPs} = \text{PECO Gross Saturation} - \text{PECO Free Ridership} \quad (3)$$

$$\text{PECO PIPs} = 12.8\% - 2.9\%$$

Step 3 Conclusion: Using the CFL Market Model, Navigant estimates that in PECO's service territory in 2013, 9.9% CFL saturation can be attributed to PECO PIPs.

Step 4: Calculate Market Effects

Using the results from Steps 2 and 3, Navigant calculates market effects using equation 4 below.

$$\text{PECO Market Effects} = \text{PECO Net Saturation} - \text{PECO PIPs} \qquad (4)$$

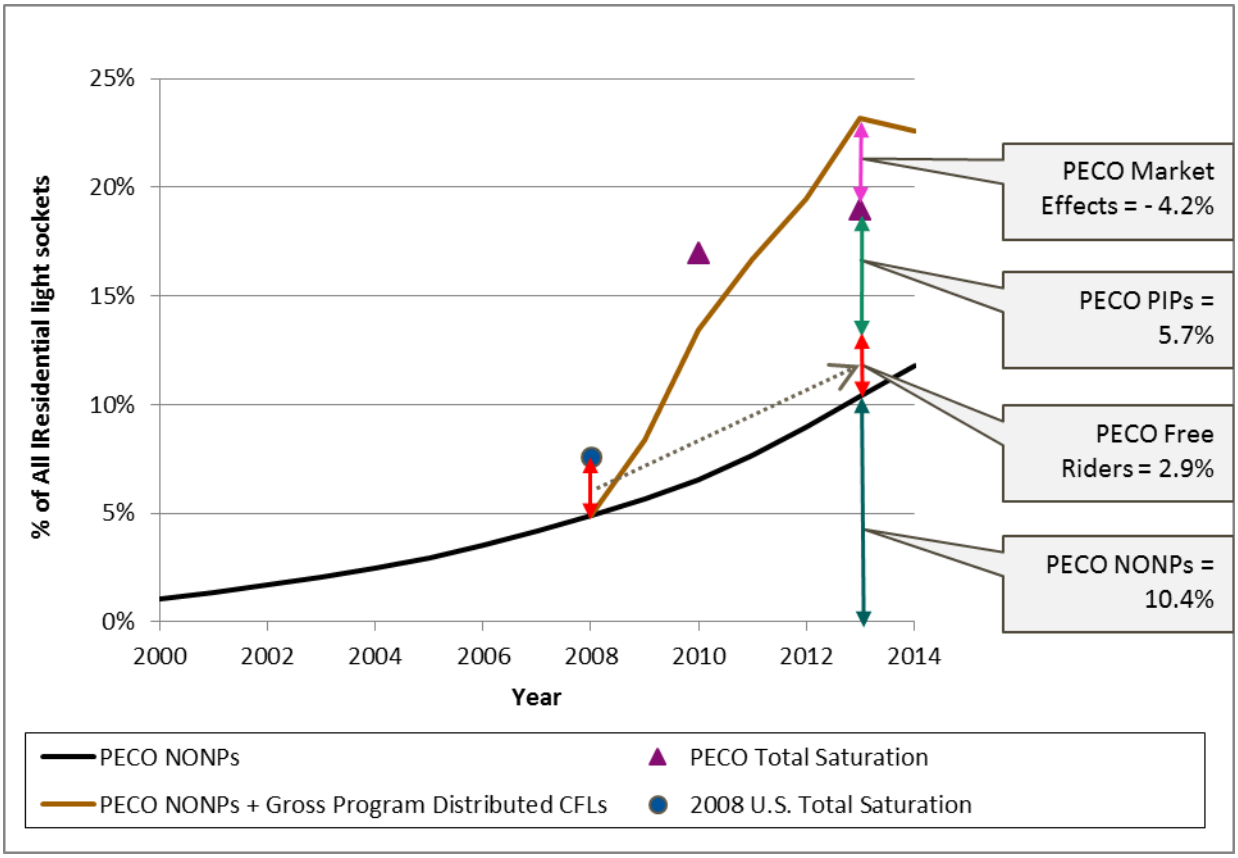
$$\text{PECO Market Effects} = 5.7\% - 9.9\%$$

Step 4 Conclusion: Using the CFL Market Model, Navigant estimates that in PECO Electric's service territory in 2014, -4.2% CFL saturation can be attributed to PECO market effects.

E.5 SUMMARY OF FINDINGS

Figure E-11: brings all of the pieces together. It illustrates PECO CFL program gross saturation (gold line) stacked on top of the PECO NONPs projection (black line) to allow for a visual correlation that matches up with the original framework presented in Figure E-1. What does not match the original framework is that the effect of gross program savings when stacked on top of the projected NONPs rises above the total saturation of CFLs in PECO territory (purple triangle). Mathematically, this results in negative market effects, and PECO PIPs account for only 5.7% saturation (9.9%, as reported above, plus the negative 4.2% market effects). This means that PECO programs in 2013 were incentivizing this negative market effects segment as free riders who would otherwise have been PECO NONPs (below the black line).

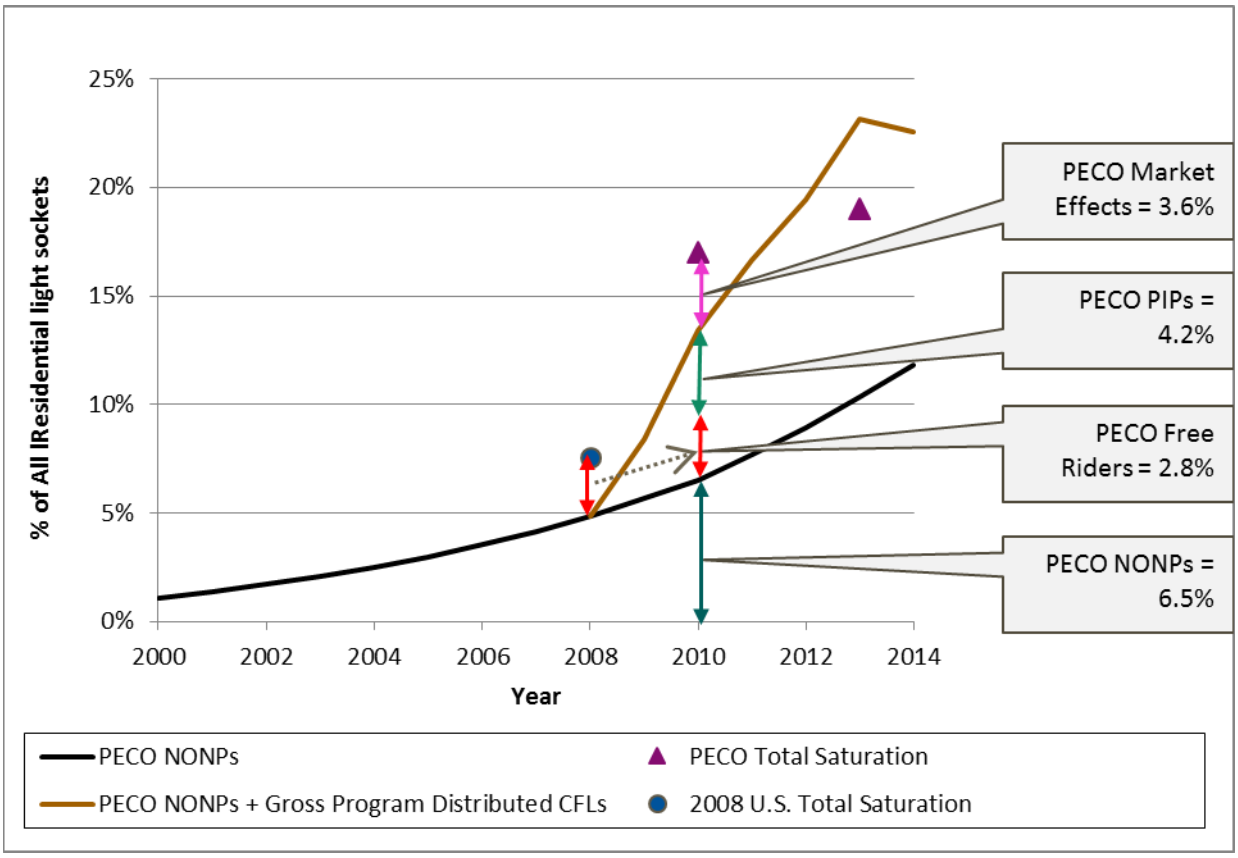
Figure E-16: 2013 PECO CFL Saturation Components as Related to NTGR Terminology



Source: Navigant analysis

From Figure E-11: , we can see that the total saturation in 2010 is greater than the gross program activity plus the NONPs. The 2010 analysis is detailed in Figure E-12: , where we can see that PECO programs were having a greater impact on the market than could be accounted for by program bulbs alone.

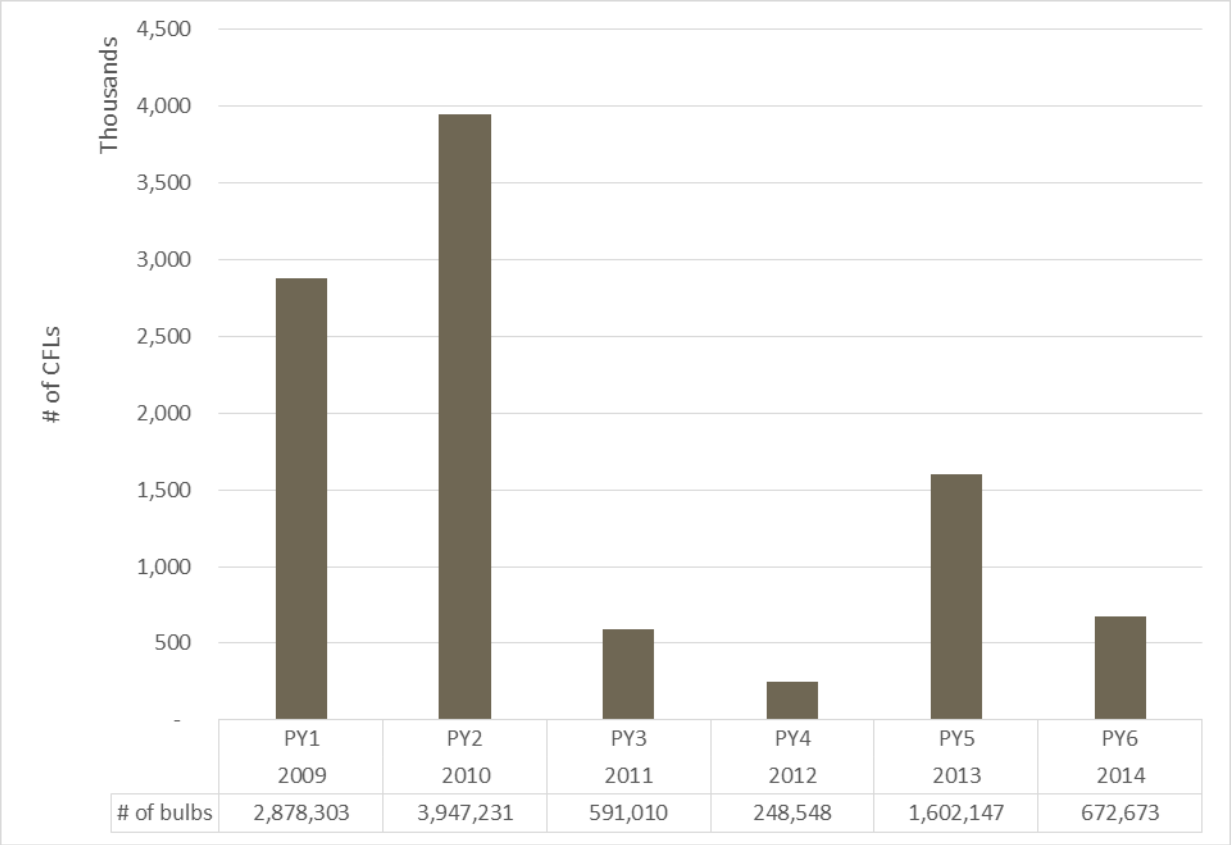
Figure E-17: 2010 PECO CFL Saturation Components as Related to NTGR Terminology



Source: Navigant analysis

The phenomenon of baseline NONP growth outpacing total saturation growth in PECO territory between 2010 and 2013 can be illuminated by Figure E-13: . The strength of PECO CFL programs in 2009 and 2010 is evidenced by the positive market effects in Figure E-11: . At this point, PECO determined that it had achieved its regulatory target, so the program was cut back in 2011. In response, the market slowed almost to a halt (2% growth in CFL saturation over the 3 years from 2010 to 2013). This demonstrates that PECO's programs were instrumental to moving the market forward in their territory from 2009 to 2010, and when programs were cut back, the overall market responded by significantly reducing CFL installations. Had PECO been incentivized to continue its CFL programs and the savings it was achieving, CFL saturation would likely have continued to outperform gross program activity, resulting in a continued NTG ratio of greater than 1 from positive market effects.

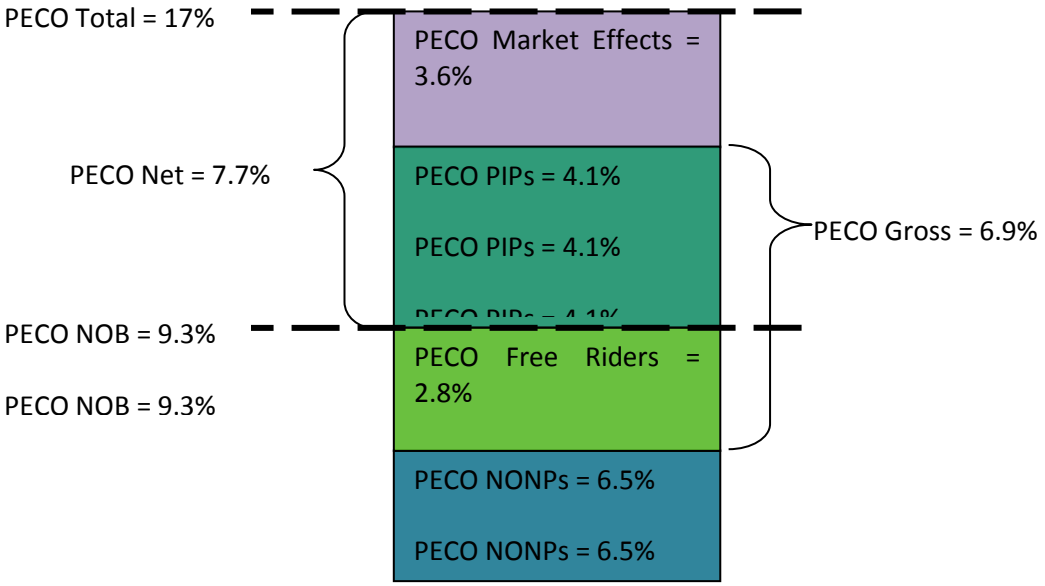
Figure E-18: PECO Program Annual CFL Sales



Source: Navigant analysis

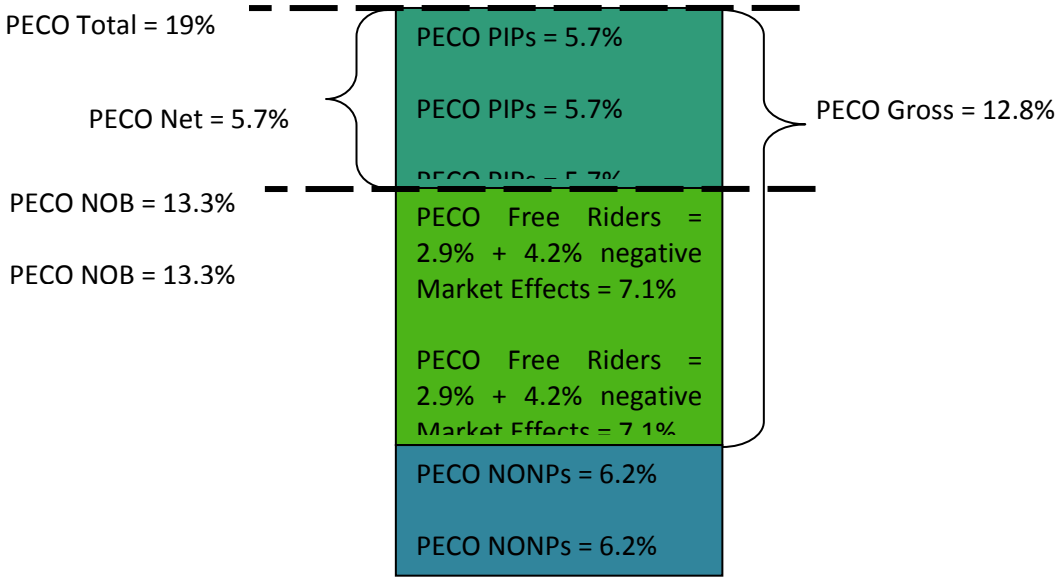
Applying the framework to PECO's CFL programs can be illustrated for 2010 by Figure E-14 and for 2013 by Figure E-15:. These visualizations show the positive market effects in 2010 as in the original framework and then the way negative market effects are representative of additional free ridership in 2013, decreasing the saturation associated with NONPs.

Figure E-19: 2010 PECO Territory CFL Saturation Results



Source: Navigant analysis

Figure E-20: 2013 PECO Territory CFL Saturation Results



Source: Navigant analysis

The NTG ratio components, expressed in saturation percentage points, are translated into ratios common to NTG ratios in Table E-1:. This method estimates a free ridership of 40% for 2010 with 52% market effects resulting in a 111% NTG ratio. (Numbers do not appear to add up due to rounding.) These values are reflective of cumulative PECO program activity from 2009 and 2010. Therefore, 40% of the

cumulative CFLs that were discounted by PECO's programs in those 2 years would have been installed in the absence of the program and are considered free riders. Meanwhile, PECO's CFL programs influenced the installation of additional non-discounted CFLs (equal to 52% of the CFLs discounted by PECO in 2009 and 2010); this is PECO's effect on the local market for CFLs. Some of these non-discounted CFLs may be counted in traditional NTG research as participant spillover, while others would be purchases by non-participants influenced by the program and typically missed in CFL NTG research.[70] The net activity generated by PECO's CFL programs is thereby equal to 111% of PECO's gross CFL activity in the program's first 2 years.

The 2013 numbers reflect a difference balance. This method estimates a 2013 free ridership of 56% (23% free riders plus the 33% negative market effects) resulting in a 45% NTG ratio. (Numbers do not appear to add up due to rounding.) These values are reflective of cumulative PECO program activity from 2009 through 2013. Therefore, 56% of the cumulative CFLs that were discounted by PECO's programs over this time period would have been installed in the absence of the program and are considered free riders. The net activity generated by PECO's CFL programs is equal to 45% of PECO's gross CFL activity in the first 5 program years.

Table E-1: Final Calculated Values for PECO, 2010 and 2013

	Saturation Percentage Points		Ratio (to Gross)*	
	2010	2013	2010	2013
Gross Activity	6.9%	12.8%	1.00	1.00
Net Activity	7.7%	5.7%	1.11	0.45
Free Ridership	2.8%	2.9%	0.40	0.23
PECO Market Effects	3.6%	- 4.2%	0.52	- 0.33
**Numbers may not add due to rounding*				

Source: Navigant analysis using the CFL Market Model

The promise of the first 2 years of PECO's CFL programs was hindered by a lack of support thereafter. Without strong PECO programming, the market reverted to pre-program growth rates, which were even slower than the growth of the expected naturally occurring baseline at the time. This indicates that PECO did not transform the CFL market, as the saturation growth rate spurred by the program in 2009 and 2010 proved unsustainable when programming was then cut. Such intermittent support confuses the market and hinders a program's ability to transform it.

The market in PECO's territory still lags behind the national market; the national market reached 22.8% CFL saturation in 2010.[71] Without renewed support for these programs, PECO's territory may continue to fall further and further behind the national market as CFL saturation growth rates may remain low (as observed from 2010 to 2013).

As the lighting market continues to evolve, PECO has the opportunity to influence and transform the market. Two possible actions for PECO include:

[70] Participant spillover only accounts for the additional purchases of non-rebated CFLs after a customer has already purchased a discounted CFL. Traditional measurement of participant spillover does not account for non-rebated CFL purchases that were independently made without a customer ever purchasing a discounted CFL.
[71] DOE 2010 Lighting Market Characterization.

- Continuing to incentivize CFLs until CFL saturation reaches higher, sustainable levels. PECO territory CFL saturation in 2013 fell short of the national average CFL saturation. PECO could continue to rebate CFLs until PECO territory saturation at least matches national saturation.
- Focus lighting market transformation efforts going forward on LEDs. LEDs have long measure lives, better lighting quality, the ability to dim, as well as other favorable features that appeal to residential customers. With a large incandescent base in PECO territory, the opportunities for installing LEDs, and their resulting savings, could be high. Navigant has observed that, in states with high CFL saturation, the potential for LEDs can be low due to the small incremental savings of LEDs replacing CFLs, as well as the long life of CFLs, which decreases the number of installation opportunities.

A key lesson can be learned from past CFL programs. Regardless of the future path taken by PECO, residential lighting programs should be more consistent year-to-year in their funding level so as to not confuse the market with major changes. Consistent programs are key to achieving market transformation.

E.6 STRENGTHS AND LIMITATIONS

Every method used to conduct a NTG analysis has both strengths and limitations; this method is no exception.

The key strengths of this approach include:

- **The method accounts for multi-year program influences.** Traditional evaluations can overestimate free ridership by having a single-year view as opposed a multi-year view that considers the full history of program influences on current program participation. This method estimates the NOB as opposed to just relying on free ridership to account for multi-year program influences.
- **The use of saturation takes into account the multiple cumulative effects of program influence.** Most NTG ratio estimation methods focus only on the program effects during the year in which the analysis is conducted. Those estimation methods do not account for the fact that program activity in one program year will affect market activity in the next program year. Using saturation to reflect how program impacts accumulate allows PECO to claim savings in later program years for those participants influenced by the program since its inception. Furthermore, a focus on saturation facilitates a complete accounting of non-discounted bulbs installed, which are otherwise underrepresented in standard NTG values.
- **The use of saturation more accurately reflects the timing of program impacts, taking into account bulbs that first go into residential storage.** Though sales data reflects when bulbs are purchased, studies have shown that a large number of bulbs first go into storage in the home. Using saturation shifts when savings are claimed from the time of purchase to when the bulbs are actually installed and in use. This method allows for proper accounting of CFLs in storage where other methods may penalize NTG for CFLs that are not installed in the year they are purchased.

The key limitations of this approach include:

- **The assumption that 100% acceptance occurs for a CFL when CFL price per bulb equals half the price of an incandescent bulb and 50% adjustment for qualitative considerations.** While the longer expected life of a CFL and incremental energy savings translate into cost savings, these are not the only factors in residential light bulb purchasing decisions. So, even when the retail

price of a CFL is equal to that of an incandescent bulb, there may be factors, such as familiarity, that interfere with the rational decision presented when both bulb types are equally priced.

- **In translating sales to saturation, the stock turnover model must assume what percent of CFL sales go into the residential sector as opposed to the commercial sector and remove those attributed to the commercial sector.** For the United States, Navigant assumes 94% of CFLs sold go into residential homes, with the remaining 6% going into small businesses (based on customer survey results).[72] When translating PECO program sales into saturation, the commercial program bulbs were removed prior to analysis. Navigant assumes that 92% of CFLs sold in PECO territory went into the residential sector.[73] These assumptions account for small businesses purchasing upstream rebated bulbs from retail outlets and installing them in their commercial facilities.
- **The assumption that CFL saturation in PECO territory before PECO programming is equal to the average U.S. CFL saturation.** This assumption results in a higher free ridership than if national program influences are said to have not fully penetrated PECO's territory and influenced CFL purchases. Given the market lag in PECO's territory as compared to the national average, this is a conservative assumption.

E.7 GLOSSARY

Net-to-gross ratio (NTG) – The ratio of net program activity to gross program activity.

Naturally occurring baseline (NOB) – Reflects the installations of an energy efficient measure that would have happened if the utility intervention never occurred (going all the way back to the inception of a utility program). NOB is the counterfactual to the formation and continued operation of utility programs.

Free rider (free ridership) – Customers purchasing energy efficient equipment discounted through a utility program and who are also part of the naturally occurring baseline. These customers would have purchased the energy efficient equipment in the absence of the formation and continued operation of the utility incentive program, but do take advantage of discounts from the utility when the program is offered.

Naturally occurring non-participants (NONP) – The portion of the NOB that are not free riders. These customers would have purchased energy efficient equipment in the absence of a utility incentive program and do not purchase discounted CFLs even when discounted energy efficient equipment is available.

Program-influenced participants (PIPs) – The participants that install energy efficient equipment as a result of the utility program, taking advantage of discounts in the process. These participants are incremental to the NOB.

Spillover – Spillover accounts for the additional purchases of energy efficiency equipment by a customer, without a program discount, after a customer has already purchased a discounted product.

[72] KEMA. Final Evaluation Report. Upstream Lighting Program, Volume 1. Prepared for the California Public Utilities Commissioner, Energy Division. February, 2010.
[73] Navigant. Quarterly Report to the Pennsylvania Public Utility Commission (Preliminary Annual Report) For the Period March 2013 through May 2013, Program Year 4, Quarter 4. Appendix B. July 2013.

Positive market effects – Consist of untracked installations (installations occurring without a discount from a utility) of energy efficient equipment; untracked efficient equipment purchases include spillover and program-influenced non-participants.

Negative market effects – Additional free riders that result when a program is incentivizing efficient equipment purchases without reaching new adopters. These installations detract from the NONPs.

Net Program Impact – Consists of the sum of PIPs and market effects.

Gross Program Activity – Consists of the sum of PIPs and free riders.

Appendix F. 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: 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 factors 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 spillover, 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% 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% of the savings from their engineering estimates.

Stipulated Values: See *Deemed Savings*.

Stratified Random Sampling: The population is divided into subpopulations, called *strata*, that 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.

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.