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February 15, 2021

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

Re: PUC Docket No. M-2015-2515691
Phase III Energy Efficiency and Conservation Program Final Annual Report for June 1, 2019 through May 31, 2020

Dear Secretary Chiavetta:

In accordance with Section IV.E.2 of the Commission's Opinion and Order Letter dated March 17, 2016 (Docket No. M-2015-2515691), enclosed is PECO's Phase III Final Annual Energy Efficiency & Conservation Report for the period June 1, 2019 through May 31, 2020.

This annual report is also being filed in accordance with the extended timeframe as described in the Commission's Secretarial Letter issued on May 26, 2020. In that Secretarial Letter, the Commission, in response to the COVID-19 pandemic, announced changes to its Act 129 Electric Distribution Company (EDC) reporting requirements at Docket No. M-2014-2424864. The reporting deadlines established in the Act 129 Phase III Final Implementation Order were extended. The date for the annual report due on November 15, 2020 was extended to February 15, 2021.

PECO is providing a copy of the report to the Act 129 Statewide Evaluator (NMR Group) and is also posting the report on the PECO website.

As per the stay-at-home orders issued by the Governor and Philadelphia's Mayor, all PECO attorneys and key support staff are working remotely until these restrictions are lifted. Accordingly, PECO will not have its usual access to photocopying and U.S. mail, among other services. PECO requests that all communications with PECO be transmitted by email.

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

Sincerely,

cc: K. G. Sophy, Director, Office of Special Assistants (via email only)
P. T. Diskin, Director, Bureau of Technical Utility Services (via email only)
K. Monaghan, Director, Bureau of Audits (via email only)
R. Kanaskie, Director, Bureau of Investigation & Enforcement (via email only)
Office of Consumer Advocate (via email only)
Office of Small Business Advocate (via email only)
McNees, Wallace & Nurick (via email only)

Enclosures

Guidehouse

Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129

Program Year 11
(June 1, 2019 – May 31, 2020)

For Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared for:

PECO®
An Exelon Company

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PA PUBLIC UTILITY COMMISSION
SECRETARY'S BUREAU

Submitted by:

Guidehouse Inc.
1375 Walnut Street, Suite 100
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February 15, 2021

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Acronyms

AC	Air Conditioner
AHSP	Air Source Heat Pump
C&I	Commercial and Industrial
CACS	Central Air Conditioner Switch
CADR	Clean Air Delivery Rate
CAP	Customer Assistance Program
CF	Coincidence Factor
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
CI	Confidence Interval
CO	Carryover
CSP	Conservation Service Provider, Curtailment Service Provider
CV	Coefficient of Variation
DLC	Direct Load Control
DR	Demand Response
DRA	Demand Response Aggregator
EDC	Electric Distribution Company
EDT	Eastern Daylight Time
EE	Energy Efficiency
EE&C	Energy Efficiency and Conservation
EEMF	Energy Efficiency Marketing Firm
EISA	Energy Independence and Security Act of 2007
EM&V	Evaluation, Measurement, and Verification
EPA	US Environmental Protection Agency
EUL	Effective Useful Life
FPL	Federal Poverty Level
G/E/NP	Government/Education/Nonprofit
HER	Home Energy Report
HERS	Home Energy Rating System
HIM	High Impact Measure
HOU	Hours of Use
HSPF	Heating Seasonal Performance Factor
HVAC	Heating, Ventilating, and Air Conditioning
ICSP	Implementation Conservation Service Provider
IMEF	Integrated Modified Energy Factor
IMP	Interim Measure Protocols
KFVSD	Kitchen Fan Variable Speed Drive
kW	Kilowatt
kWh	Kilowatt-Hour

L	Liter
LAH	Lighting, Appliances & HVAC
LDV	Lagged Dependent Variable
LED	Light-Emitting Diode
LIURP	Low-Income Usage Reduction Program
M&V	Measurement and Verification
MMBtu	Million British Thermal Units
MSRP	Manufacturer Suggested Retail Price
MW	Megawatt
MWh	Megawatt-Hour
MWh/yr	Megawatt-Hour per Year
NPV	Net Present Value
NTG	Net-to-Gross
O&M	Operations and Maintenance
P3TD	Phase III to Date
PA PUC	Pennsylvania Public Utility Commission
PILD	PECO Instant Lighting Discounts
PSA	Phase III to Date Preliminary Savings Achieved; equal to VTD + PYRTD
PSA+CO	PSA Savings plus Carryover from Phase II
PSD	*Performance Systems Development*
PUF	Part-Use Factor
PY	Program Year—e.g., PY8, from June 1, 2016, to May 31, 2017
PYRTD	Program Year Reported to Date
PYTD	Program Year to Date
PYVTD	Program Year Verified to Date
QC	Quality Control
RCT	Randomized Control Trial
RCx	Retrocommissioning
RTD	Phase III to Date Reported Gross Savings
RTO	Regional Transmission Organization
RUL	Remaining Useful Lifetime
SEER	Seasonal Energy Efficiency Ratio
SF	Single-Family
SIDS	Smart Ideas Data System
SKU	Stock Keeping Unit
SSMVP	Site-Specific Measurement and Verification Plan
SWE	Statewide Evaluator
T&D	Transmission and Distribution
TRC	Total Resource Cost
TRM	Technical Reference Manual
UEC	Unit Energy Consumption

VFD	Variable Frequency Drive
VTD	Phase III to Date Verified Gross Savings
VTD + CO	Phase III to Date Verified Gross Savings plus Carryover from Phase II
W	Watt

Stratum Structure

Program	Solution	Stratum Name	Abbreviated Stratum Name
Residential Energy Efficiency (EE)	**Lighting, Appliances & HVAC (LAH)**	ENERGY STAR® Dehumidifier	Dehumidifier
		ENERGY STAR Clothes Washer – Residential	Clothes Washer
		ENERGY STAR Refrigerators	Refrigerator
		ENERGY STAR Air Purifier	Air Purifier
		Other – Appliances	Other – Appliances
		Furnace High Efficiency Fan	Furnace High Efficiency Fan
		Central Air Conditioner (AC)	Central AC
		Air Source Heat Pump (ASHP)	ASHP
		Ductless Mini-Split Heat Pumps	Ductless Mini-Split Heat Pumps
		Other – HVAC	Other – HVAC
		Marketplace – Strata 1 – Smart/Learning Thermostat	Marketplace: Thermostats
		Marketplace – Strata 2 – LED Lighting	Marketplace: Lighting
		Marketplace – Strata 3 – Smart Strip Plug Outlets	Marketplace: Smart Strips
		Specialty Lighting	Specialty Lighting
		Standard Lighting	Standard Lighting
	Appliance Recycling	Refrigerators	Refrigerators
		Freezers	Freezers
		Room ACs	Room ACs
	Whole Home	Large Projects (>1,874 kWh)	Large
		Medium Projects (1,330 kWh-1,874 kWh)	Medium
		Small Projects (308 kWh-1,329 kWh)	Small
		Very Small Projects (<308 kWh)	Very Small
	New Construction	Large (>3,477 kWh)	Large
		Medium (2,314 kWh-3,477 kWh)	Medium
		Small (<2,314 kWh)	Small
	Behavioral	Solution Total	Solution Total
	Multifamily	Large – Residential: Buildings in Residential market sector with a single decision maker for all projects in the building	Large Residential

Program	Solution	Stratum Name	Abbreviated Stratum Name
		Small – Residential: Projects in Residential market sector with individual decision makers	Small Residential
		Multisector – Commercial and Industrial (C&I) and Residential: Buildings with common areas in the C&I sectors and units in Residential sector (residential portion of savings)	Multisector
Residential Low-Income EE	**Low-Income Whole Home**	Large Single-Family (SF) (>1,692 kWh)	Large SF
		Medium SF (1,015 kWh-1,691 kWh)	Medium SF
		Small SF (282 kWh-1,014 kWh)	Small SF
		Very Small SF (<282 kWh)	Very Small SF
		Multifamily (all buildings)	Multifamily
		Giveaways	Giveaways
		Refrigerator Retirement	Refrigerator Retirement
		Freezer Retirement	Freezer Retirement
		Room AC Retirement	Room AC Retirement
Small C&I EE	**Equipment and Systems**	High impact or high uncertainty projects (125 MWh-999 MWh)	Large
		Medium impact or medium uncertainty projects (50 MWh-124 MWh)	Medium
		Low impact projects (above the bottom 2% of solution savings – 49 MWh per project)	Small
		Very low impact projects (bottom 2% of solution savings)	Extra Small
		Midstream high impact measures (≥25 MWh)	Midstream Large
		Midstream low impact measures (above the bottom 2% of solution savings – 24 MWh)	Midstream Small
		Midstream very low impact measures (bottom 2% of solution savings)	Midstream Very Small
	New Construction	Very high impact projects (≥200 MWh)	Very Large
		High impact or high uncertainty projects (80 MWh-199 MWh)	Large
		Low impact projects (above the bottom 2% of solution savings – 79 MWh per project)	Small
		Very low impact projects (bottom 2% of solution savings)	Very Small
	Whole Building	Medium impact projects (≥70 MWh)	Medium
		Low impact projects (6.75 MWh-69 MWh)	Small

Program	Solution	Stratum Name	Abbreviated Stratum Name
		Very low impact projects (bottom 2% of solution savings)	Very Small
	Data Centers	All Projects	All Projects
		Small – C&I: Buildings in Small C&I sector	Small
	Multifamily Targeted	Multisector – C&I: Buildings with common areas in the C&I sectors and units in Residential sector	Multisector
Large C&I EE	**Equipment and Systems**	Very high impact projects (≥2,000 MWh)	Very Large
		High impact or high uncertainty projects (650 MWh-1,999 MWh)	Large
		Medium impact or medium uncertainty projects (270 MWh-649 MWh)	Medium
		Low impact projects (above the bottom 2% of solution savings – 269 MWh per project)	Small
		Very low impact measures (bottom 2% solution savings)	Extra Small
		Midstream high impact measures (≥35 MWh)	Midstream Large
		Midstream low impact measures (above the bottom 2% of solution savings – <35 MWh)	Midstream Small
		Midstream very low impact measures (bottom 2% solution savings)	Midstream Very Small
		Retrocommissioning projects	Retrocommissioning (RCx)
		Non-Kitchen Fan Variable Speed Drives	Non-KFVSD
	New Construction	High impact or high uncertainty projects (1,000 MWh-4,999 MWh)	Large
		Low impact projects (above the bottom 2% of solution savings – 999 MWh per project)	Small
		Very low impact projects (bottom 2% of solution savings)	Very Small
	Data Centers	All Projects	All Projects
	Multifamily Targeted	Large – C&I: Buildings in Large C&I market sector	Large
Combined Heat and Power	**CHP**	All Projects	All Projects

Types of Savings

Gross Savings: The change in energy consumption and peak demand that results directly from program-related actions taken by participants in an Energy Efficiency and Conservation (EE&C) program, regardless of why they participated.

Net Savings: The total change in energy consumption and peak demand that is attributable to an EE&C program. Depending on the program delivery model and evaluation methodology, the net savings estimates may differ from the gross savings estimate due to adjustments for the effects of free riders, changes in codes and standards, market effects, participant and nonparticipant spillover, and other causes of change in energy consumption or demand not directly attributable to the EE&C program.

Reported Gross: Also referred to as ex ante (Latin for "beforehand") savings. The energy and peak demand savings values calculated by the electric distribution company (EDC) or its program implementation conservation service providers (ICSPs) and stored in the program tracking system.

Unverified Reported Gross: The Phase III Evaluation Framework allows EDCs and the evaluation contractors the flexibility to not evaluate each program every year. If an EE&C program is being evaluated over a multiyear cycle, the reported savings for a program year where evaluated results are not available are characterized as unverified reported gross until the impact evaluation is completed and verified savings can be calculated and reported.

Verified Gross: Also referred to as ex post (Latin for "from something done afterward") gross savings. The energy and peak demand savings estimates reported by the independent evaluation contractor after the gross impact evaluation and associated measurement and verification (M&V) efforts have been completed.

Verified Net: Also referred to as ex post net savings. The energy and peak demand savings estimates reported by the independent evaluation contractor after applying the results of the net impact evaluation. Typically calculated by multiplying the verified gross savings by a net-to-gross (NTG) ratio.

Annual Savings: Energy and demand savings expressed on an annual basis or the amount of energy and peak demand an EE&C measure or program can be expected to save over the course of a typical year. Annualized savings are noted as MWh/yr or MW/yr. The Pennsylvania Technical Reference Manual (TRM) provides algorithms and assumptions to calculate annual savings, and Act 129 compliance targets for consumption reduction are based on the sum of the annual savings estimates of installed measures or behavior change.

Lifetime Savings: Energy and demand savings expressed in terms of the total expected savings over the useful life of the measure. Typically calculated by multiplying the annual savings of a measure by its effective useful life. The total resource cost (TRC) test uses savings from the full lifetime of a measure to calculate the cost-effectiveness of EE&C programs.

Program Year Reported to Date (PYRTD): The reported gross energy and peak demand savings achieved by an EE&C program or portfolio within the current program year. Program year to date (PYTD) values for energy efficiency will always be reported gross savings in a semiannual or preliminary annual report.

Program Year Verified to Date (PYVTD): The verified gross energy and peak demand savings achieved by an EE&C program or portfolio within the current program year as determined by the impact evaluation findings of the independent evaluation contractor.

Phase III to Date (P3TD): The energy and peak demand savings achieved by an EE&C program or portfolio within Phase III of Act 129. Reported in several permutations described below.

1. **Phase III to Date Reported (RTD):** The sum of the reported gross savings recorded to date in Phase III of Act 129 for an EE&C program or portfolio.
2. **Phase III to Date Verified (VTD):** The sum of the verified gross savings recorded to date in Phase III of Act 129 for an EE&C program or portfolio, as determined by the impact evaluation finding of the independent evaluation contractor.
3. **Phase III to Date Preliminary Savings Achieved (PSA):** The sum of the verified gross savings (VTD) from previous program years in Phase III where the impact evaluation is complete plus the reported gross savings from the current program year (PYTD).
4. **Phase III to Date Preliminary Savings Achieved + Carryover (PSA+CO):** The sum of the verified gross savings from previous program years in Phase III plus the reported gross savings from the current program year plus any verified gross carryover savings from Phase II of Act 129. This is the best estimate of an EDC's progress toward the Phase III compliance targets.
5. **Phase III to Date Verified + Carryover (VTD + CO):** The sum of the verified gross savings recorded to date in Phase III plus any verified gross carryover savings from Phase II of Act 129.

Per guidance from the Pennsylvania Statewide Evaluator (SWE), all demand savings that were achieved from energy efficiency measures are shown in this report without line losses (i.e., at the meter). All demand savings that were achieved from demand response (DR) measures are shown in this report with line losses (i.e., at the generator).

Note that all values in the report are summed prior to rounding. Therefore, table totals may not equal the sum of all rows.

1. Introduction

Pennsylvania Act 129 of 2008, signed on October 15, 2008, mandated energy savings and demand reduction goals for the largest electric distribution companies (EDCs) in Pennsylvania for Phase I (2008-2013). Phase II of Act 129 began in 2013 and concluded in 2016. In late 2015, each EDC filed a new Energy Efficiency and Conservation (EE&C) Plan[1] with the Pennsylvania Public Utilities Commission (PA PUC) detailing the proposed design of its portfolio for Phase III. These plans were updated based on stakeholder input and subsequently approved by the PA PUC in 2016.

Implementation of Phase III of the Act 129 programs began on June 1, 2016. This report documents the progress and effectiveness of the Phase III EE&C accomplishments for PECO in program year 11 (PY11), as well as the cumulative accomplishments of the Phase III programs since inception. This report also documents the energy savings carried over from Phase II. The Phase II carryover savings count toward EDC savings compliance targets for Phase III.

This report details the participation, spending, reported gross, verified gross, and verified net impacts of the energy efficiency (EE) programs in PY11. Compliance with Act 129 savings goals is ultimately based on verified gross savings. This report also includes estimates of cost-effectiveness according to the total resource cost (TRC) test.[2] PECO has retained Guidehouse Inc. (Guidehouse)[3] as an independent evaluation contractor for Phase III of Act 129. Guidehouse is responsible for the measurement and verification (M&V) of the savings and the calculation of gross verified and net verified savings.

For select program solution offerings (solutions), Guidehouse also performed targeted process evaluation activities to examine specific research areas. This report presents relevant key findings and recommendations identified by the process evaluation and documents any changes to EE&C program delivery for PECO to consider based on the recommendations.

Phase III of Act 129 includes a demand response (DR) goal for PECO. DR events are limited to the months of June through September, which are the first 4 months of the Act 129 program year. Because the DR season is completed early in the program year, it is possible to complete the independent evaluation of verified gross savings for DR sooner than for the EE programs. PECO reported the verified gross DR impacts for PY11 and the cumulative DR performance of the EE&C program to date for Phase III of Act 129 in the *Semiannual Report to the Pennsylvania Public Utility Commission*[4] filed July 15, 2020. Section 3.6 of this report includes PECO's previously reported DR performance results for PY11.

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[1] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan*. Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

[2] The Pennsylvania TRC test for Phase I was adopted by PUC order at Docket No. M-2009-2108601 on June 23, 2009 (2009 PA TRC Test Order). The TRC Test Order for Phase I was later refined in the same docket on August 2, 2011 (2011 PA TRC Test Order). The 2013 TRC Order for Phase II of Act 129 was issued on August 30, 2012. The 2016 TRC Test Order for Phase III of Act 129 was adopted by PUC order at Docket No. M-2015-2468992 on June 11, 2015.

[3] On October 11, 2019, Guidehouse LLP completed its acquisition of Navigant Consulting, Inc. and its operating subsidiaries. For more information, see: https://guidehouse.com/news/corporate-news/2019/guidehouse-completes-acquisition-of-navigant.

[4] PECO. *Semiannual Report to the Pennsylvania Public Utility Commission*. July 15, 2020. http://www.puc.pa.gov/pcdocs/1670274.pdf.

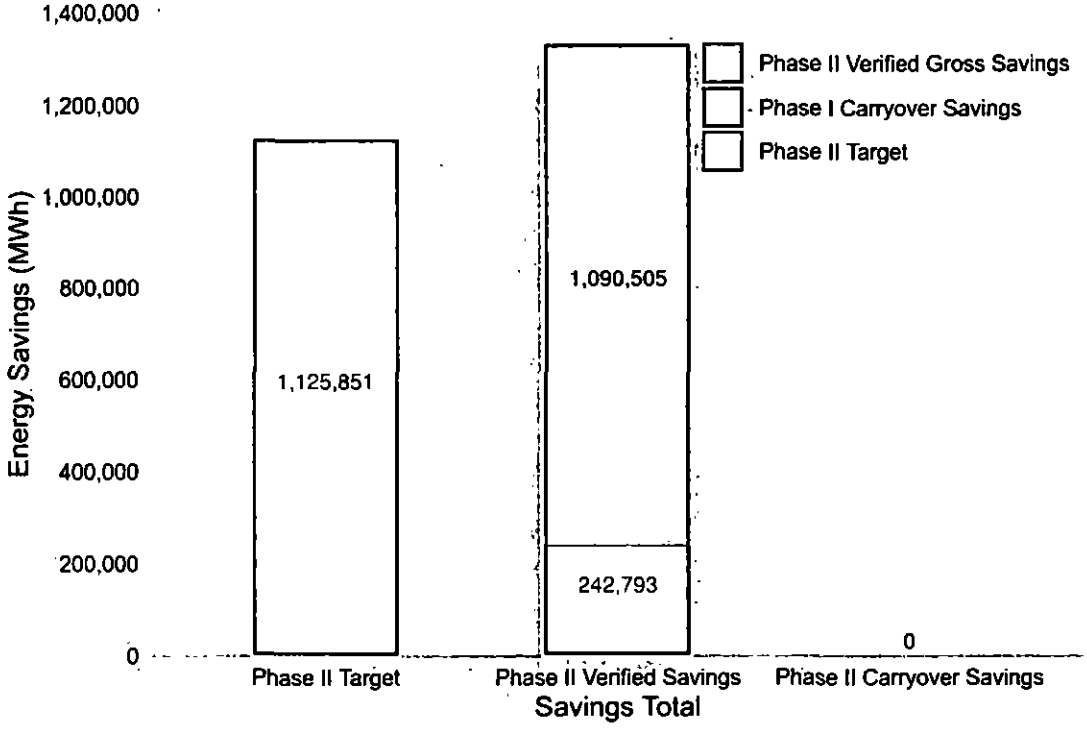
Guidehouse worked with the Statewide Evaluator (SWE) throughout the report's development to address questions related to compliance as they arose and appreciates the SWE's collaboration to confirm this final report is accurate and agreeable to relevant parties.

2. Summary of Achievements

2.1 The Carryover Savings from Phase II of Act 129

PECO reported 0 MWh/yr of portfolio-level carryover savings from Phase II to Phase III. The PA PUC's Phase III Implementation Order[5] allowed EDCs to carry over savings achieved within Phase II that were in excess of the Phase II portfolio savings target. Phase I carryover savings cannot be counted in the calculation of Phase II carryover savings. Figure 2-1 compares PECO's Phase II verified gross savings total to the Phase II compliance target to illustrate the carryover calculation. Because PECO's Phase II verified gross savings did not exceed PECO's Phase II target, it was not eligible to carry over savings from Phase II toward its Phase III overall compliance target.[6]

Figure 2-1. Carryover Savings from Phase II of Act 129



Sources: Smart Ideas Data System (SIDS) database, conservation service provider (CSP) tracking data

The PA PUC's Phase III Implementation Order[7] also allowed EDCs to carry over savings in excess of the Phase II Government, Educational, and Nonprofit (G/E/NP) savings goal and excess savings from the Low-Income customer segment.[8] PECO carried over 0 MWh/yr of

[5] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

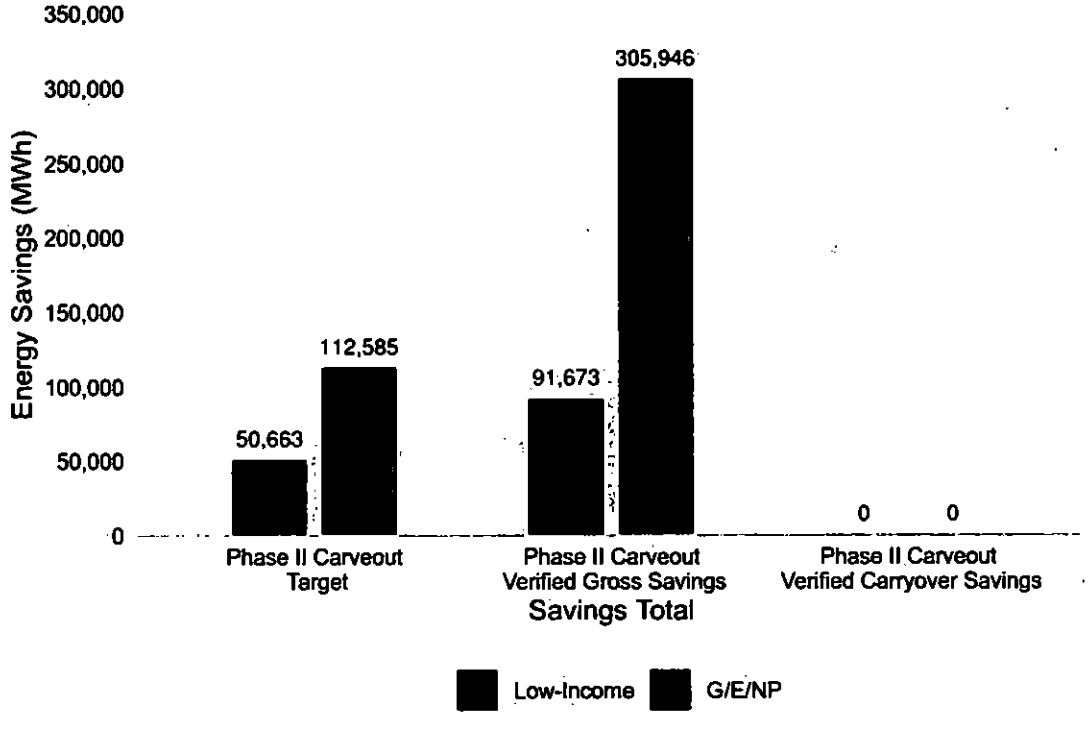
[6] PA PUC. *Energy Efficiency and Conservation Program Compliance Order* at Docket No. M-2012-2289411 (*Phase II Compliance Determination Order*). Entered August 3, 2017.

[7] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

[8] Proportionate to those savings achieved by dedicated low-income programs in Phase III.

G/E/NP and 0 MWh/yr of Low-Income customer segment savings.[9] Figure 2-2 shows the calculation of carryover savings for the low-income and G/E/NP targets.[10]

Figure 2-2. Customer Segment-Specific Carryover from Phase II



Source: Guidehouse analysis

2.2 Phase III EE Achievements to Date

In PY11, starting June 1, 2019 and ending May 31, 2020, PECO has claimed the following savings:

- 466,447 MWh/yr of reported gross electric energy savings (PYRTD)
- 54.88 MW of reported gross peak demand savings (PYRTD) from EE programs
- 479,702 MWh/yr of verified gross electric energy savings (PYVTD)
- 69.17 MW of verified gross peak demand savings (PYVTD) from EE programs

Since the beginning of Phase III of Act 129 on June 1, 2016, PECO has achieved the following savings:

- 1,520,448 MWh/yr of reported gross electric energy savings (RTD)
- 166.65 MW of reported gross peak demand savings (RTD) from EE programs

[9] Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program Compliance Order* at Docket No. M-2012-2289411 (*Phase II Compliance Determination Order*). Entered August 3, 2017.

[10] Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program Compliance Order.*

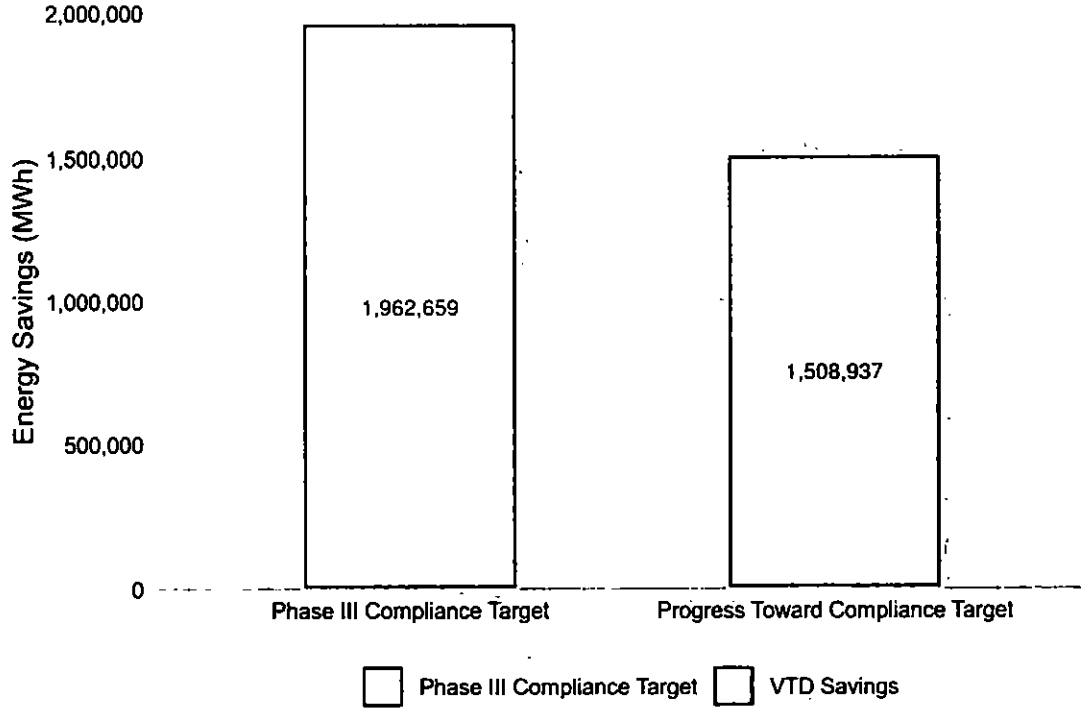
- 1,508,937 MWh/yr of verified gross electric energy savings (VTD)
- 205.75 of verified gross peak demand savings (VTD) from EE programs

Including carryover savings from Phase II, PECO has achieved:

- 1,508,937 MWh/yr of VTD plus portfolio-level carryover (CO) energy savings
    - Represents 76.9% of the May 31, 2021 energy savings compliance target of 1,962,659 MWh/yr

Figure 2-3 summarizes PECO's progress toward the Phase III portfolio compliance target.

Figure 2-3. EE&C Plan Performance toward Phase III Portfolio Compliance Target



Source: Guidehouse analysis

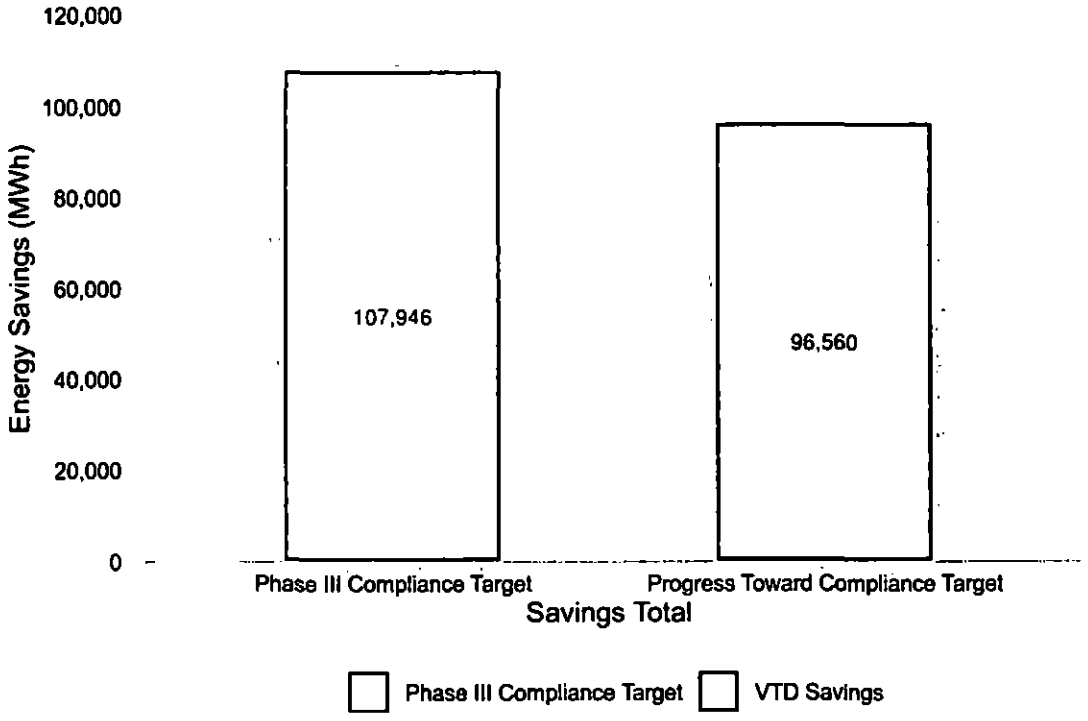
The Phase III Implementation Order[11] directed EDCs to offer conservation measures to the Low-Income customer segment based on the proportion of electric sales attributable to low-income households. The proportionate number of measures targeted for PECO is 8.8%. PECO offers 269 EE&C measures to its Residential and Nonresidential customer classes. Of the 269 measures, 117 are available to the Low-Income customer segment at no cost to the customer. This number represents 43.5% of the total measures offered in the EE&C Plan[12] and exceeds the proportionate number of measures targeted.

[11] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

[12] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

The PA PUC also established a low-income energy savings target of 5.5% of the portfolio savings goal. The verified gross low-income savings target for PECO is 107,946 MWh/yr. Figure 2-4 compares the VTD performance for the Low-Income customer segment to the Phase III savings target. Based on the latest available information, PECO has achieved 89.5% of the Phase III low-income energy savings target.

Figure 2-4. EE&C Plan Performance toward Phase III Low-Income Compliance Target

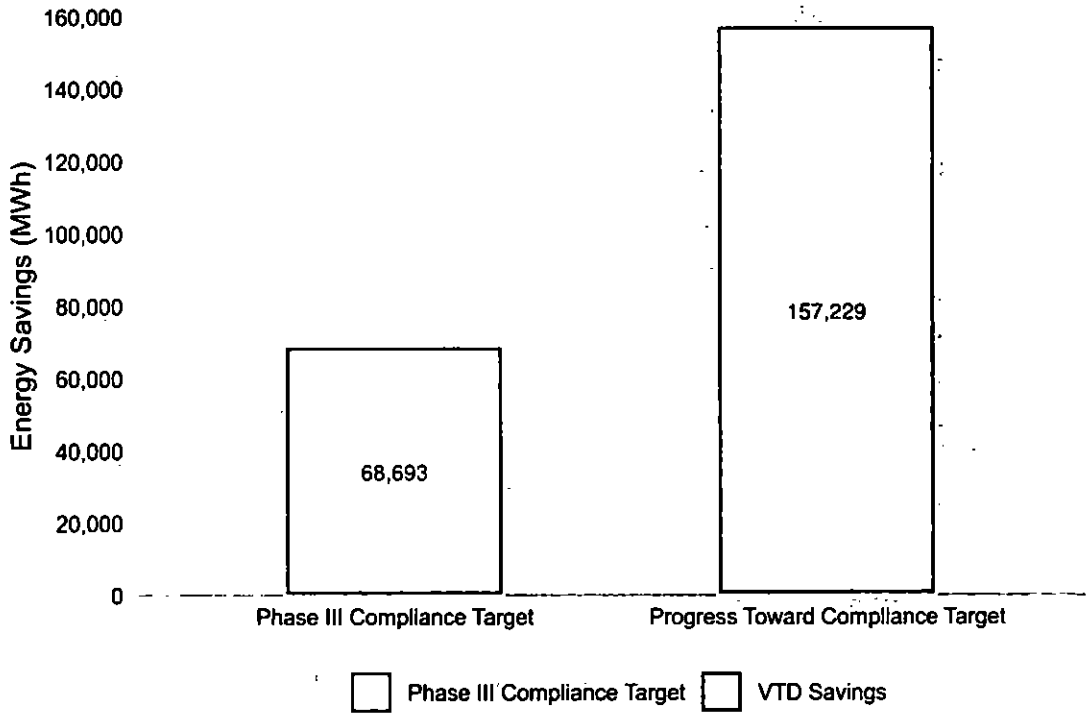


Source: Guidehouse analysis

The Phase III Implementation Order[13] established a G/E/NP energy savings target of 3.5% of the portfolio savings goal. The verified gross G/E/NP savings target for PECO is 68,693 MWh/yr. Figure 2-5 compares the VTD performance for the G/E/NP customer segment to the Phase III savings target. Based on the latest available information, PECO has achieved 228.9% of the Phase III G/E/NP energy savings target.

[13] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

Figure 2-5. EE&C Plan Performance against Phase III G/E/NP Compliance Target



Source: Guidehouse analysis

2.3 Phase III DR Achievements to Date

The Phase III DR performance target for PECO is 161 MW. Compliance targets for DR programs are based on average performance across events and are established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution (T&D) losses.

Act 129 DR events are triggered by PJM's day-ahead load forecast. When the day-ahead forecast is above 96% of the peak load forecast for the year, a DR event is initiated for the following day.

In PY11, PECO called four DR events in the summer of 2019: July 17, July 18, July 19, and August 19. The average performance for all events to date is presented in Table 2-1. The full methodology is available in the standalone PY11 DR report, submitted to the SWE on January 15, 2020.[14] Verified impacts for the Large Commercial and Industrial (C&I) DR Program for PY9, PY10, and PY11 have been revised based on corrected interval data provided by PECO. In January 2020, PECO notified Guidehouse of potential issues with the interval data provided for the PY9 through PY11 evaluations, where certain data may not represent actual consumption because of unique meter configurations at different participant sites. After a review of all sites and activities to date, the evaluation team found that 16, 25, and six sites were affected in PY9, PY10, and PY11, respectively. At the request of PECO and in consultation with the SWE,

[14] PECO. *Annual Report to the Pennsylvania Public Utility Commission Demand Response Performance Report Only*. January 15, 2020. https://www.peco.com/SiteCollectionDocuments/PhaseIIIEECPsemiannualreportDRs.pdf

Guidehouse applied evaluation methods prescribed for PY11 to revise verified impacts for the affected sites; impacts for unaffected sites remain unchanged. These revisions increased PYVTD by 1.11 MW (0.75%) and Phase III to date (P3TD) by 1.62 MW (0.98%). Table 2-1 shows a revised summary of DR performance to date.[15] Given the PY12 DR season is voluntary,[16] PECO has achieved its Phase III DR requirements with the PY9 through PY11 events. Additionally, PECO voluntarily implemented PY12 DR activities and will report those results to the PA PUC in subsequent filings.

Table 2-1. P3TD DR Performance by Event

PY	Event Date	Residential DR (MW)	Small C&I DR (MW)	Large C&I DR (MW)	Portfolio (MW)	Relative Precision at 90% Confidence
PY9	June 13, 2017	39.53	0.00	118.21	157.74	8.8%
PY9	July 20, 2017	33.48	0.00	107.88	141.36	9.6%
PY9	July 21, 2017	23.34	0.00	125.82	149.16	8.9%
PY10	July 2, 2018	38.93	0.00	155.98	194.92	10.0%
PY10	July 3, 2018	33.84	0.00	146.76	180.60	10.8%
PY10	August 6, 2018	25.07	1.15	180.12	206.34	10.4%
PY10	August 28, 2018	30.69	0.92	160.76	192.36	11.3%
PY10	September 4, 2018	29.99	0.77	142.69	173.45	11.1%
PY10	September 5, 2018	29.52	0.84	131.75	162.12	11.8%
PY11	July 17, 2019	34.36	0.86	120.04	155.26	6.1%
PY11	July 18, 2019	11.06	1.02	121.63	133.71	5.9%
PY11	July 19, 2019	34.93	1.18	120.89	157.00	5.8%
PY11	August 19, 2019	24.90	0.98	126.17	152.05	5.6%
PYVTD – Average PY11 DR Event Performance		**26.31**	**1.01**	**122.18**	**149.50**	**5.9%**
P3TD – Average Phase III DR Event Performance		**29.97**	**0.59**	**136.56**	**167.13**	**10.0%**

Note: P3TD impacts are based on an average of all events and not an average of program years.
Source: Guidehouse analysis

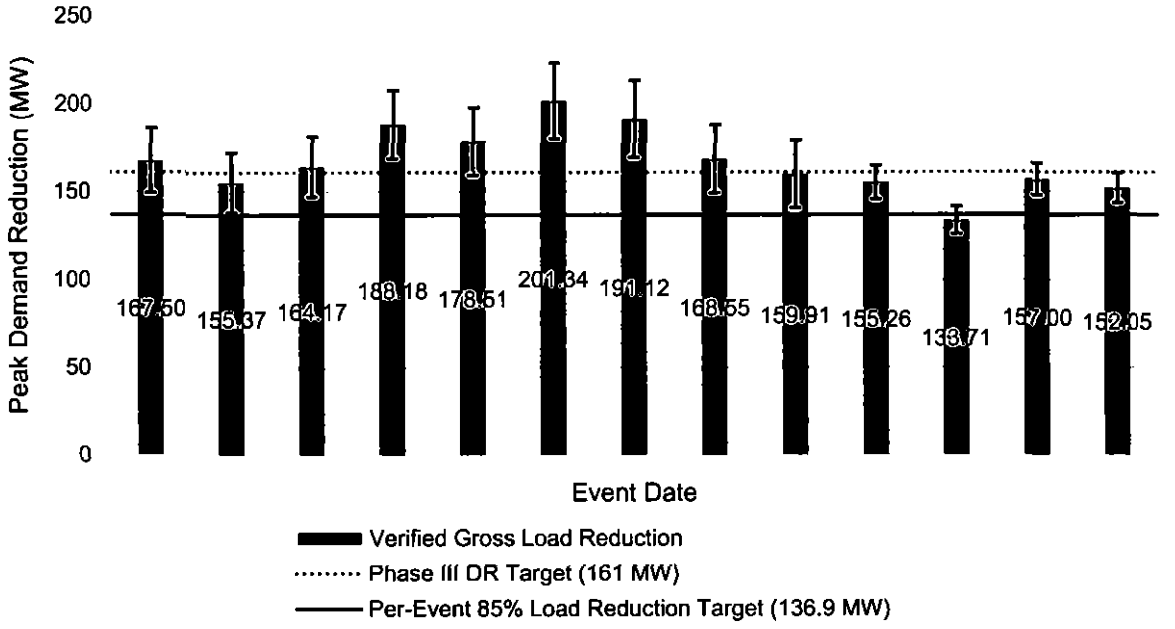
The PA PUC's Phase III Implementation Order[17] also established a requirement that EDCs achieve at least 85% of the Phase III compliance reduction target in each DR event. For PECO, this translates to a 136.85 MW minimum for each DR event. Figure 2-6 compares the performance of each of the DR events in PY11 to the event-specific minimum and average targets.

[15] Per SWE feedback, Guidehouse also revised PY11 Large C&I verified impacts to exclude holidays from estimation data for all sites. This revision results in a <1% change in impacts relative to prior results.

[16] PY12 DR is voluntary: PA PUC. *Petition to Amend the Commission's June 19, 2015 Implementation Order. M-2014-2424864.* May 21, 2020. https://www.puc.pa.gov/pcdocs/1665150.docx

[17] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

Figure 2-6. Event Performance Compared to 85% Per-Event Target



Source: Guidehouse analysis

2.4 Phase III Performance by Customer Segment

Table 2-2 through Table 2-5 present the participation, savings, and spending results by customer sector for PY11 and Phase III. The Residential, Small C&I, and Large C&I sectors (also referred to as customer segments or rate classes) are defined by PECO tariff. The Residential Low-Income and G/E/NP customer segments (Table 2-4 and Table 2-5) are defined by statute (66 Pa. C.S. § 2806.1). The Residential Low-Income segment is primarily a subset of the Residential customer class; however, it also includes low-income-qualified residents in master-metered buildings in the Small and Large C&I sectors. The G/E/NP segment is a subset of the Small and Large C&I sectors.

Table 2-2 provides the PY11 participation counts and spending totals for PECO's programs for the three sectors (Residential, Small C&I, and Large C&I) inclusive of all low-income and G/E/NP segments.

Table 2-2. PY11 Summary Statistics by Customer Sector

Parameter	Residential	Small C&I	Large C&I	Total
No. of Participants	1,682,841	5,286	2,602	**1,690,729**
PY11 Energy Realization Rate	0.98	1.12	1.08	**1.03**
PYVTD MWh/yr	273,078	78,935	127,689	**479,702**
PY11 Demand Realization Rate	1.29	1.25	1.22	**1.26**
PYVTD MW (EE)	34.13	14.05	20.99	**69.17**
PYVTD MW (DR)	26.31	1.01	122.18	**149.50**
Incentives ($1,000)	$11,410	$4,233	$7,123	**$22,767**

Source: Guidehouse analysis

Table 2-3 provides the P3TD participation counts and spending totals for PECO's programs for the three sectors (Residential, Small C&I, and Large C&I) inclusive of all low-income and G/E/NP segments.

Table 2-3. Phase III Summary Statistics by Customer Sector

Parameter	Residential	Small C&I	Large C&I	Total
No. of Participants	4,857,032	10,414	4,296	**4,871,742**
P3TD Energy Realization Rate	0.98	1.06	1.00	**0.99**
VTD MWh/yr	954,655	208,971	345,311	**1,508,937**
P3TD Demand Realization Rate	1.36	1.11	1.09	**1.23**
VTD MW (EE)	120.65	33.03	52.07	**205.75**
VTD MW (DR)	29.97	0.59	136.56	**167.13**
Incentives ($1,000)	$42,179	$10,525	$18,146	**$70,851**

Source: Guidehouse analysis

Table 2-4 summarizes the savings, spending, and participation values for the low-income and G/E/NP customer segment carveouts only. PECO tracks activities for two low-income segments that contribute to the low-income carveout:

- PECO customers at 50% or below the federal poverty level (FPL)
- PECO customers at 51% to 150% of the FPL

The low-income totals correspond to achievements shown in Figure 2-4, and the G/E/NP totals correspond to achievements shown in Figure 2-5.

Table 2-4. PY11 Summary Statistics by Carveout

Parameter	Low-Income (0%-50% FPL)	Low-Income (51%-150% FPL)	Low-Income Total	G/E/NP Total
No. of Participants	2,935	11,601	**14,536**	**3,911**
PY11 Energy Realization Rate	0.91	0.97	**0.96**	**1.35**
PYVTD MWh/yr	3,029	32,859	**35,888**	**62,969**
Incentives ($1,000)	$0	$172	**$172**	**$3,476**
Program (Non-Incentive) Costs ($1,000)	$561	$7,236	**$7,797**	**$210**

Source: Guidehouse analysis

Table 2-5 summarizes the carveout performance since the beginning of Phase III.

Table 2-5. Phase III Summary Statistics by Carveout

Parameter	Low-Income (0%-50% FPL)	Low-Income (51%-150% FPL)	Low-Income Total	G/E/NP Total
No. of Participants	11,151	208,974	**220,125**	**5,401**
P3TD Energy Realization Rate	0.87	0.87	**0.87**	**1.09**
VTD MWh/yr	12,478	84,080	**96,558**	**157,229**
Incentives ($1,000)	$1	$1,206	**$1,207**	**$9,303**
Program (Non-Incentive) Costs ($1,000)	$3,640	$22,874	**$26,514**	**$406**

Source: Guidehouse analysis

2.5 Summary of Participation by Program

Participation is defined differently for each program and solution depending on the program delivery channel and data tracking practices. Appendix E includes an overview of the different participation definitions for each solution, and Table 2-6 provides the current participation totals by program and solution for PY11 and for P3TD.

Table 2-6. EE&C Portfolio Participation by Program and Solution

Program and Solution	PY11 Participation	P3TD Participation
Lighting, Appliances & HVAC (LAH)	1,198,349	4,000,925
Appliance Recycling	17,518	59,264
Whole Home	5,230	19,158
New Construction	885	2,462
Behavioral[1] [2]	384,670	466,381
Multifamily Targeted	8,315	28,759
Residential EE Program	**1,614,967**	**4,576,949**
Whole Home	14,536	53,067
Lighting	0	167,058
Low-Income EE Program	**14,536**	**220,125**
Equipment and Systems	3,013	5,920
New Construction	93	216
Whole Building	242	967
Data Centers Targeted	0	2
Multifamily Targeted	96	449
Small C&I EE Program	**3,444**	**7,554**
Equipment and Systems	2,126	3,430
New Construction	42	143
Data Centers Targeted	0	4

Program and Solution	PY11 Participation	P3TD Participation
Multifamily Targeted	37	157
Large C&I EE Program	**2,205**	**3,734**
Combined Heat and Power (CHP) Program	**1**	**6**
Residential DR[2] Program	**53,924**	**61,440**
Small C&I DR[2] Program	**1,312**	**1,586**
Large C&I DR[2] Program	**340**	**348**
Portfolio Total	**1,690,729**	**4,871,742**

[1] Behavioral participation was updated from 372,724 in the PECO PY11 Semiannual Report[18] to 384,670 in this report. Behavioral participation in the PY11 Semiannual Report was based on 11 months of PY11 program delivery, whereas the updated number is based on the full 12 months of PY11 program delivery.

[2] DR participation and Behavioral participation is not additive like other programs because the same participants tend to remain in the program with only small attrition. Therefore, total participation in the Behavioral and DR programs for Phase III is equal to the highest program year participation count for each of the programs.

Source: Guidehouse analysis

2.6 Summary of Impact Evaluation Results

During PY11, Guidehouse completed impact evaluations for all active EE programs and solutions in the PECO portfolio. Table 2-7 summarizes the realization rates and net-to-gross (NTG) ratios by program and solution.

Table 2-7. Impact Evaluation Results Summary

Program and Solution	Energy Realization Rate	Demand Realization Rate	NTG Ratio
LAH	1.00	1.01	0.51
Appliance Recycling	1.07	1.03	0.53
Whole Home	0.95	0.95	0.97
New Construction	0.88	0. 96	0.92
Behavioral	0.93	N/A	1.00
Multifamily Targeted	0.98	0.96	0.92
Residential EE Program	**0.98**	**1.34**	**0.67**
Whole Home	0.96	0.96	1.00
Low-Income EE Program	**0.96**	**0.96**	**1.00**
Equipment and Systems	1.18	1.38	0.77
New Construction	1.05	0.95	0.33
Whole Building	0.93	1.02	0.90
Data Centers Targeted	N/A	N/A	N/A
Multifamily Targeted	0.98	1.01	0.81
Small C&I EE Program	**1.13**	**1.26**	**0.76**
Equipment and Systems	1.09	1.20	0.60
New Construction	1.11	1.67	0.48

[18] PECO. *Semiannual Report to the Pennsylvania Public Utility Commission*. July 15, 2020. http://www.puc.pa.gov/pcdocs/1670274.pdf

Program and Solution	Energy Realization Rate	Demand Realization Rate	NTG Ratio
Data Centers Targeted	N/A	N/A	N/A
Multifamily Targeted	0.99	0.95	0.81
Large C&I EE Program	**1.09**	**1.23**	**0.60**
CHP Program	**1.09**	**0.65**	**0.87**
Portfolio Total	**1.03**	**1.26**	**0.69**

Note: For the Residential Behavioral Solution, the implementer does not report demand savings; however, the SWE requires PECO to verify demand savings. As a result, there is no demand realization rate for the Behavioral Solution. The verified demand savings do get added to the Residential EE Program savings. As a result, the demand realization rate for the Residential EE Program is greater than the demand realization rate for each individual solution in the program.

Source: Guidehouse analysis

Guidehouse conducted NTG research, including analysis of high impact measures (HIMs), in PY11 for the Residential, Small C&I, and Large C&I market sectors. The evaluation team applied the PY10 NTG results to the Multifamily Targeted Market Segment and Combined Heat and Power (CHP) Program. Findings from NTG research are not used to adjust compliance savings in Pennsylvania. Instead, NTG research provides directional information for program planning purposes. Table 2-8 presents NTG findings for the HIMs studied in PY11.[19]

Guidehouse gathered HIM data for refrigerator and freezer retirement, smart thermostats, efficient furnace fans, and light-emitting diode (LED) bulbs for the Residential sector; LED lighting, lighting power density, and delamping for the Small C&I sector; and LED lighting, custom projects, and retrocommissioning (RCx) projects for the Large C&I sector.

Table 2-8. HIM NTG Summary

HIM	Free Ridership	Spillover	NTG Ratio	Associated Program and Solution
Refrigerator retirement	0.52	0.00	0.48	Residential EE – Appliance Recycling
Smart/learning thermostats	0.37	0.03	0.66	Residential EE – Marketplace
Freezer retirement	0.67	0.00	0.33	Residential EE – Appliance Recycling
High efficiency furnace fans	0.47	0.47	1.00	Residential EE – LAH
LED bulbs	0.18	0.01	0.84	Residential EE – Marketplace
Small C&I LED lighting	0.40	0.32	0.92	Small C&I EE – Equipment and Systems
Lighting power density	0.63	0.00	0.37	Small C&I EE – New Construction
Delamping	0.47	0.00	0.53	Small C&I EE – Equipment and Systems

[19] The NTG estimates provided for HIMs are based on findings from surveys conducted with Residential, Small C&I, and Large C&I solution participants in PY11 and in alignment with guidance provided in Section 3.4.1.4 of the Phase III Evaluation Framework indicating that HIM research should focus on measures in downstream programs only.

HIM	Free Ridership	Spillover	NTG Ratio	Associated Program and Solution
Large C&I LED lighting	0.48	0.01	0.53	Large C&I EE – Equipment and Systems
Custom projects	0.50	0.01	0.51	Large C&I EE – Equipment and Systems
RCx projects	0.44	0.00	0.56	Large C&I EE – Equipment and Systems

Source: Guidehouse analysis

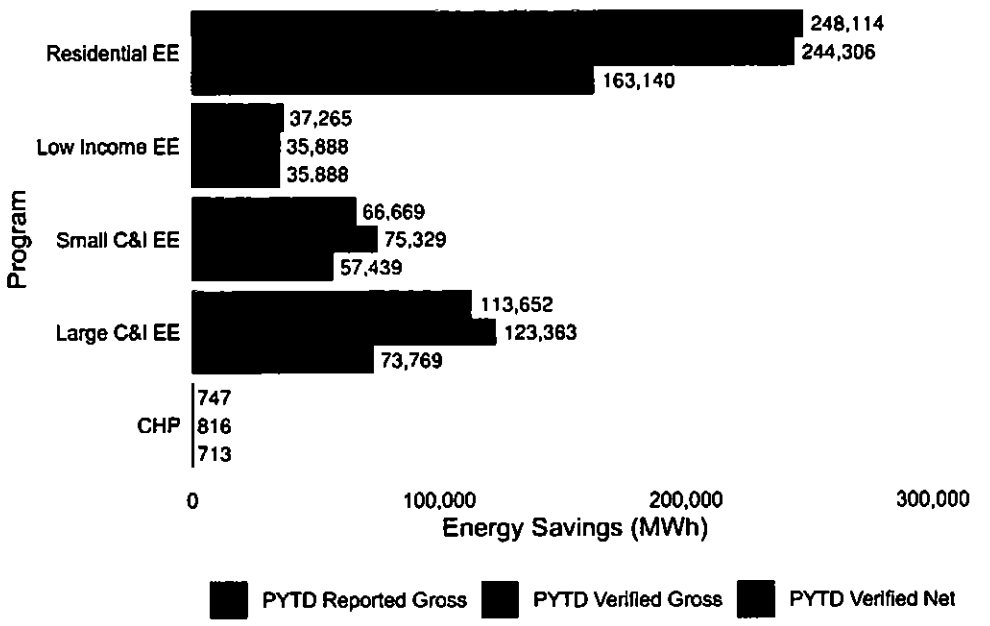
2.7 Summary of Energy Impacts by Program

Act 129 compliance targets are based on annualized savings estimates (MWh/yr). Each program year the annual savings achieved by EE&C program activity are recorded as incremental annual—or first-year—savings and are added to EDCs' progress toward compliance. Incremental annual savings estimates are presented in Section 2.7.1. Lifetime energy savings incorporate the effective useful life (EUL) of installed measures and estimate the total energy savings associated with EE&C program activity. Lifetime savings are used in the TRC test by program participants when assessing the economics of upgrades and by the SWE when calculating the emissions benefits of Act 129 programs. Section 2.7.2 presents the lifetime energy savings by program.

2.7.1 Incremental Annual Energy Savings by Program

Figure 2-7 summarizes the PYTD energy savings by program for PY11. The energy impacts in this report are presented at the meter level and do not reflect adjustments for T&D losses. The verified gross savings are adjusted by the energy realization rate, and the verified net savings are adjusted by both the realization rate and the NTG ratio.

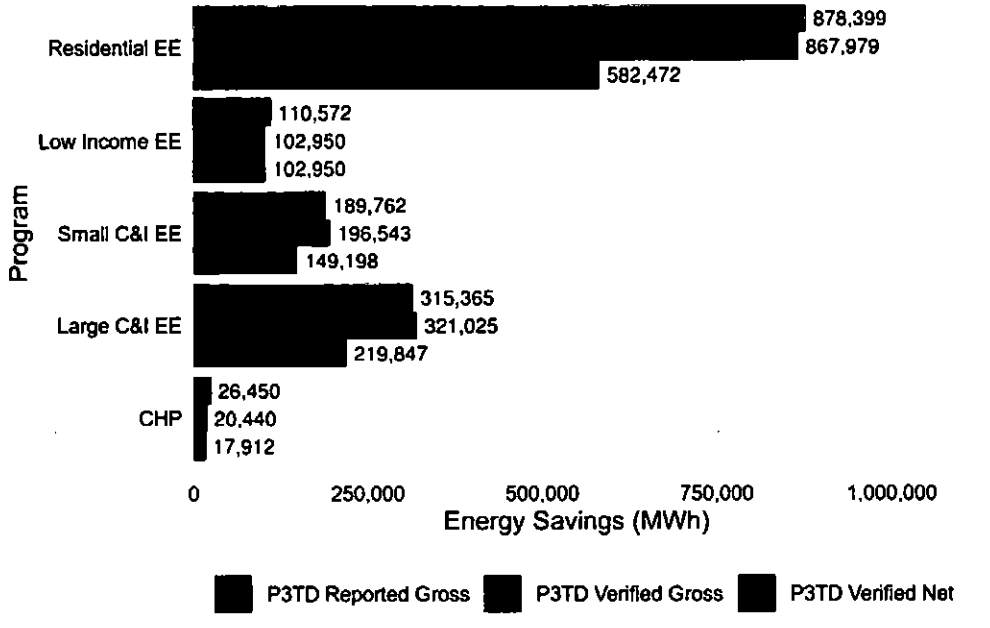
Figure 2-7. PYTD Energy Savings by Program



Source: Guidehouse analysis

Figure 2-8 summarizes the energy savings by program for Phase III of Act 129.

Figure 2-8. P3TD Energy Savings by Program



Source: Guidehouse analysis

Table 2-9 summarizes the energy impacts by program through PY11.

Table 2-9. Summary of Incremental Annual Energy Savings by EE Program

Program and Solution	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
LAH	147,546	147,755	75,984	482,653	489,817	243,249
Appliance Recycling	17,645	18,924	10,056	59,060	59,575	24,958
Whole Home	6,209	5,875	5,712	23,562	22,208	20,138
New Construction	2,093	1,851	1,709	6,155	5,921	4,969
Behavioral	71,728	67,056	67,056	294,115[1]	277,963	277,963
Multifamily Targeted	2,894	2,846	2,622	12,755	12,495	11,195
Residential EE Program	**248,114**	**244,306**	**163,140**	**878,299**	**867,979**	**582,472**
Whole Home	37,265	35,888	35,888	101,486	93,869	93,869
Lighting	0	0	0	9,086	9,081	9,081
Low-Income EE Program	**37,265**	**35,888**	**35,888**	**110,572**	**102,950**	**102,950**
Equipment and Systems	49,349	58,472	45,297	139,129	147,318	112,774
New Construction	4,514	4,737	1,581	12,330	12,907	3,846
Whole Building	9,249	8,628	7,739	26,594	25,895	24,593
Data Centers Targeted	0	0	0	119	50	46
Multifamily Targeted	3,558	3,492	2,822	11,590	10,373	7,940
Small C&I EE Program	**66,669**	**75,329**	**57,439**	**189,762**	**196,543**	**149,198**
Equipment and Systems	98,745	107,245	64,824	275,670	281,058	197,914
New Construction	11,206	12,437	5,970	26,940	27,382	12,491
Data Centers Targeted	0	0	0	546	529	418
Multifamily Targeted	3,701	3,682	2,975	12,208	12,056	9,025
Large C&I EE Program	**113,652**	**123,363**	**73,769**	**315,365**	**321,025**	**219,847**
CHP Program	**747**	**816**	**713**	26,450	20,440	17,912
Portfolio Total	**466,447**	**479,702**	**330,948**	**1,520,448**	**1,508,937**	**1,072,379**

Note: Behavioral reported savings was 66,173 MWh in the PY11 Semiannual Report;[20] this number was based on an estimate provided by the implementer because full data for the program year was not yet available. The reported savings in this annual report are updated to reflect the full data for PY11.

[1] Behavioral RTD savings previously excluded some reported savings from early in Phase III due to an inconsistency in the savings program period reported in eTrack. The RTD savings now include all invoiced savings from PY8 through PY11.

Source: Guidehouse analysis

[20] PECO. *Semiannual Report to the Pennsylvania Public Utility Commission.* July 15, 2020. http://www.puc.pa.gov/pcdocs/1670274.pdf

For the following programs, the previously reported VTD savings from prior years have changed since Guidehouse submitted the PY10 final annual report.[21] SWE audit activities recommended an adjustment to increase savings by 623 MWh/yr for the PY10 verified gross savings because of discrepancies found in its review (described in Table 2-10). These adjustments represent a 0.15% increase of the PY10 verified gross energy savings.

Table 2-10. Summary of Changes to VTD Savings from PY10

Program	Solution	VTD Adjustment (MWh/yr)	Explanation
Residential EE	LAH	749.7	Application of Clean Air Delivery Rate (CADR) variable for ENERGY STAR® purifiers; incorrect application of volume of heat pump dryers; incorrect baseline wattage for ~8% of models, in one-quarter of these instances the Energy Independence and Security Act of 2007 (EISA)-compliant baseline applied for EISA-exempt bulb; incorrect efficient wattage for ~2% of models.
	New Construction	-56.9	Application of conventional electric water heaters to claim savings; incorrect savings claimed on non-ENERGY STAR-qualified dishwashers; lighting value explained by Guidehouse and adjusted in this report.
	Whole Home	-2.0	Calculating air source heat pump (ASHP) savings (incorrect default seasonal energy efficiency ratio [SEER] rating).
Low-Income EE	Whole Home	-67.5	Thermostatic restrictor shower valve: incorrect default temperature out; thermostats: suspect efficiency and capacity values (only updated two instances); insulation: incorrect base R-value (used 3.75 instead of 5).
Total		**623.3**	

Source: SWE audit

2.7.2 Lifetime Energy Savings by Program

Table 2-11 presents the PYVTD and VTD lifetime energy savings by program. Lifetime energy savings are calculated by multiplying the annual energy savings by the EUL. Per the PA 2016 TRC Order,[22] the measure EUL does not exceed 15 years for any measure in the portfolio. Additionally, early replacement measures are subject to a dual baseline calculation, leading to modified lifetime savings. For these measures, savings relative to the in-place baseline equipment are used for the remaining useful lifetime (RUL) of the baseline equipment. After the RUL, savings relative to code equipment are used for the remainder of the efficient measure's EUL.

[21] PECO. *Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129.* November 15, 2019. https://www.puc.pa.gov/pcdocs/1645979.pdf

[22] PA PUC. *2016 Total Resource Cost (TRC) Test Order* at Docket No. M-2015-2468992. Entered June 11, 2015. https://www.puc.pa.gov/pcdocs/1367195.docx

Table 2-11. Summary of Lifetime Energy Savings by EE Program

Program	PYVTD Gross Lifetime Energy (MWh/yr)	PYVTD Net Lifetime Energy (MWh/yr)	VTD Gross Lifetime Energy (MWh/yr)	VTD Net Lifetime Energy (MWh/yr)
Residential EE	972,386	568,752	5,181,100	2,808,556
Low-Income EE	259,675	259,675	757,284	757,284
Small C&I EE	769,365	580,236	2,032,606	1,535,884
Large C&I EE	1,360,271	806,622	3,754,904	2,524,046
CHP	12,239	10,688	306,595	268,673
Portfolio Total	**3,378,745**	**2,230,782**	**11,982,300**	**7,899,252**

Source: Guidehouse analysis

For the following programs, the previously reported VTD lifetime savings from prior years have changed since Guidehouse submitted the PY10 Annual Report[23]. These VTD lifetime savings adjustments are directly related to the details provided in Table 2-10:

- **Residential EE:** PY10 PYVTD gross lifetime energy increased by 6,024 MWh and net lifetime energy increased by 2,645 MWh, representing a 0.37% and 0.30% change respectively.
- **Low-Income EE:** PY10 PYVTD gross and net lifetime energy decreased by 506 MWh, representing a -0.32% change.

2.8 Summary of Demand Impacts by Program

PECO's Phase III EE&C programs achieve peak demand reductions in two primary ways. The first is through coincident reductions from EE measures, and the second is through dedicated DR offerings that exclusively target temporary demand reductions on peak days. EE reductions coincident with system peak hours are reported and used to calculate benefits in the TRC test but do not contribute to Phase III peak demand reduction compliance goals. Phase III peak demand reduction targets are exclusive to DR programs.

The two types of peak demand reduction savings are also treated differently for reporting purposes. Peak demand reductions from EE are generally additive across program years, meaning that the P3TD savings reflect the sum of the first-year savings in each program year. Conversely, DR goals are based on average portfolio impacts across all events, so cumulative DR performance is expressed as the average performance of each of the DR events called in Phase III to date. Because of these differences, demand impacts from EE and DR are reported separately in the following subsections.

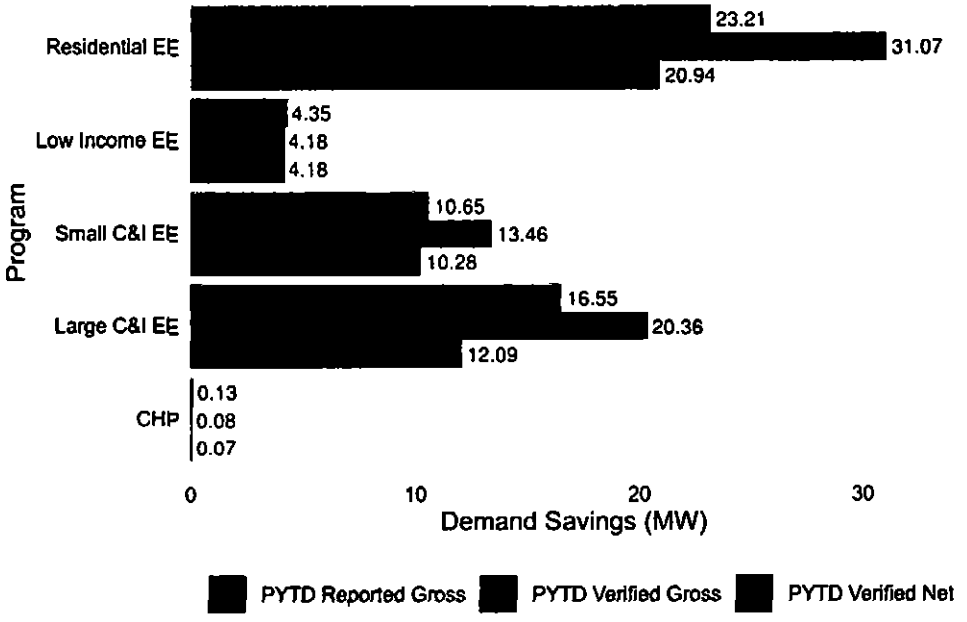
2.8.1 Energy Efficiency

Act 129 defines peak demand savings from EE as the average expected reduction in electric demand from 2:00 p.m. to 6:00 p.m. EDT on non-holiday weekdays from June through August. The peak demand impacts from EE in this report are presented at the meter level and do not

[23] PECO. *Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129.* November 15, 2019. https://www.puc.pa.gov/pcdocs/1645979.pdf

reflect adjustments for T&D losses. Figure 2-9 summarizes the PYTD demand savings by EE program for PY11.

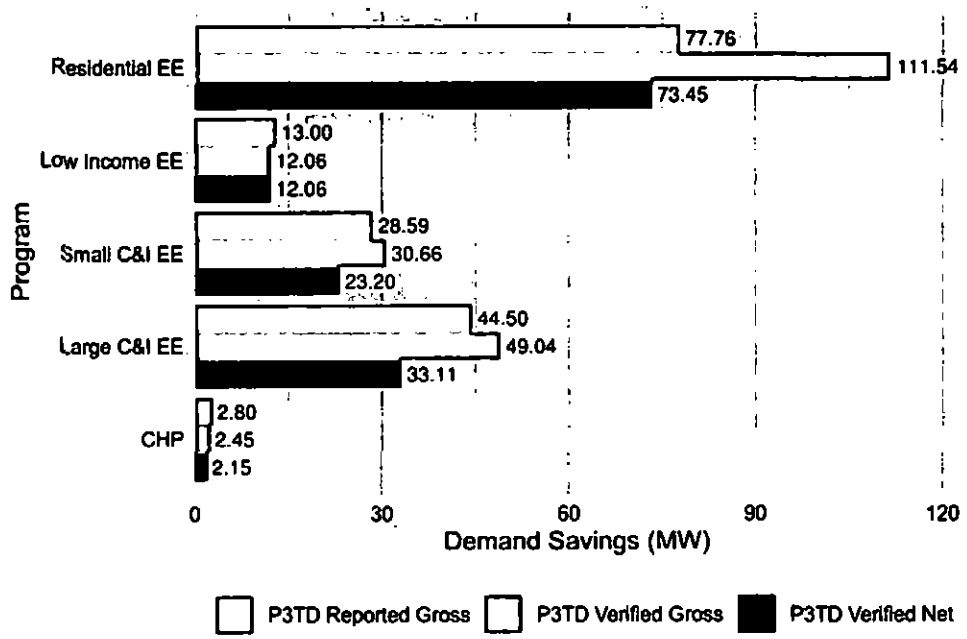
Figure 2-9. PYTD Demand Savings by EE Program



Source: Guidehouse analysis

Figure 2-10 summarizes the P3TD demand savings by EE program for Phase III of Act 129.

Figure 2-10. P3TD Demand Savings by EE Program



Source: Guidehouse analysis.

A summary of the peak demand impacts by EE program through the current reporting period is presented in Table 2-12.

Table 2-12. Summary of Demand Savings by EE Program

Program and Solution	PYRTD (MW)	PYVTD Gross (MW)	PYVTD Net (MW)	RTD (MW)	VTD Gross (MW)	VTD Net (MW)
LAH	18.74	18.96	10.18	62.69	65.23	32.79
Appliance Recycling	2.45	2.53	1.29	8.56	8.43	3.45
Whole Home	0.85	0.80	0.78	2.85	2.68	2.44
New Construction	0.80	0.77	0.71	2.02	1.93	1.65
Behavioral	0.00	7.65	7.65	0.00	31.73	31.73
Multifamily Targeted	0.37	0.36	0.33	1.63	1.54	1.38
Residential EE Program	**23.21**	**31.07**	**20.94**	**77.76**	**111.54**	**73.45**
Whole Home	4.35	4.18	4.18	11.93	10.99	10.99
Lighting	0.00	0.00	0.00	1.07	1.07	1.07
Low-Income EE Program	**4.35**	**4.18**	**4.18**	**13.00**	**12.06**	**12.06**
Equipment and Systems	7.42	10.25	7.90	19.68	22.90	17.52
New Construction	0.89	0.85	0.28	2.24	2.23	0.67
Whole Building	1.95	1.98	1.78	5.47	4.46	4.20
Data Centers Targeted	0.00	0.00	0.00	0.02	0.01	0.01
Multifamily Targeted	0.38	0.39	0.31	1.18	1.06	0.81

Program and Solution	PYRTD (MW)	PYVTD Gross (MW)	PYVTD Net (MW)	RTD (MW)	VTD Gross (MW)	VTD Net (MW)
Small C&I EE Program	**10.65**	**13.46**	**10.28**	**28.59**	**30.66**	**23.20**
Equipment and Systems	14.76	17.68	10.67	39.60	42.72	29.81
New Construction	1.37	2.29	1.10	3.34	4.82	2.18
Data Centers Targeted	0.00	0.00	0.00	0.04	0.04	0.03
Multifamily Targeted	0.42	0.40	0.32	1.52	1.47	1.09
Large C&I EE Program	**16.55**	**20.36**	**12.09**	**44.50**	**49.04**	**33.11**
CHP Program	**0.13**	**0.08**	**0.07**	**2.80**	**2.45**	**2.15**
Portfolio Total	**54.88**	**69.17**	**47.57**	**166.65**	**205.75**	**143.96**

Source: Guidehouse analysis

For the following programs, the previously reported VTD demand savings from prior years have changed since Guidehouse submitted the PY10 Annual Report.[24] SWE audit activities recommended an adjustment to decrease savings by 0.076 MW for the PY10 verified gross demand savings because of discrepancies found in its review (described in Table 2-13; explanations are identical to Table 2-10). These adjustments represent a 0.13% reduction of the PY10 verified gross demand savings. These adjustments did not affect any of the carveouts.

Table 2-13. Summary of Changes to VTD Demand Savings from PY10

Program	Solution	VTD Adjustment (MW/yr)	Explanation
Residential EE	LAH	0.080	Application of CADR variable for ENERGY STAR purifiers; incorrect application of volume of heat pump dryers; incorrect baseline wattage for ~8% of models, in one-quarter of these instances the EISA-compliant baseline applied for EISA-exempt bulb; incorrect efficient wattage for ~2% of models.
	New Construction	-0.007	Application of conventional electric water heaters to claim savings; incorrect savings claimed on non-ENERGY STAR-qualified dishwashers; lighting value explained by Guidehouse and adjusted in this report.
	Whole Home	-0.001	Calculating ASHP savings (incorrect default SEER rating).
Low-Income EE	Whole Home	0.004	Thermostatic restrictor shower valve: incorrect default temperature out; thermostats: suspect efficiency and capacity values (only updated two instances); insulation: incorrect base R-value (used 3.75 instead of 5).
Total		**0.076**	

Source: SWE audit

[24] PECO. *Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129.* November 15, 2019. https://www.puc.pa.gov/pcdocs/1645979.pdf

2.8.2 Demand Response

Act 129 defines peak demand savings from DR as the average reduction in electric demand during the hours when a DR event is initiated. Phase III DR events are initiated according to the following guidelines:[25]

- Curtailment events shall be limited to the months of June through September.
- Curtailment events shall be called for the first 6 days of each program year (starting in PY9) in which the peak hour of PJM's day-ahead forecast for the PJM regional transmission organization (RTO) is greater than 96% of the PJM RTO summer peak demand forecast for the months of June through September.
- Each curtailment event shall last 4 hours.
- Each curtailment event shall be called such that it will occur during the day's forecasted peak hour(s) above 96% of the PJM RTO summer peak demand forecast.
- Once six curtailment events have been called in a program year, the peak demand reduction program shall be suspended for that program year.

Phase III DR programs began operating in PY9; therefore, no DR program savings were reported for PY8. Starting in PY9, the peak demand impacts from DR are presented at the system level and reflect adjustments to account for T&D losses. PECO uses the following line loss percentages/multipliers by sector:[26]

- Residential = 107.99% or 1.0799
- Small C&I = 107.99% or 1.0799
- Large C&I = 107.99% or 1.0799

Table 2-14 (also shown as Table 2-1) summarizes the demand reductions for each of the DR programs in PECO's EE&C Plan[27] and for the DR portfolio.[28] Verified gross demand savings are the average performance across all Phase III DR events independent of how many events occurred in a given program year. The P3TD – Average Phase III DR Event Performance row is calculated as an average of all events to date, so years with more or fewer events will not be weighted disproportionately.

[25] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

[26] PA PUC. "Section 1.14 Transmission and Distribution System Losses." *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards.* Dated June 2016, errata update February 2017.

[27] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

[28] Verified impacts for the Large C&I DR Program for PY9, PY10, and PY11 have been revised based on corrected interval data provided by PECO. In January 2020, PECO notified Guidehouse of potential issues with the interval data provided for the PY9 through PY11 evaluations, where certain data may not represent actual consumption because of unique meter configurations at different participant sites. After a comprehensive review of all sites and activities to date, the evaluation team found that 16, 25, and six sites were affected in PY9, PY10, and PY11, respectively. At the request of PECO and in consultation with the SWE, Guidehouse applied evaluation methods *prescribed for PY11 to revise verified impacts for affected sites; impacts for unaffected sites remain unchanged.* These revisions increased PVTD by 1.1 MW (0.7%) and P3TD by 1.6 MW (1.0%).

Table 2-14. Summary of Demand Savings for DR Programs by Customer Segment and Event

PY	Event Date	Residential DR (MW)	Small C&I DR (MW)	Large C&I DR (MW)	Portfolio (MW)	Relative Precision at 90% Confidence
PY9	June 13, 2017	39.53	0.00	127.97	167.50	10.9%
PY9	July 20, 2017	33.48	0.00	121.89	155.37	11.0%
PY9	July 21, 2017	23.34	0.00	140.83	164.17	10.3%
PY10	July 2, 2018	38.93	0.00	149.25	188.18	10.2%
PY10	July 3, 2018	33.84	0.00	144.67	178.51	10.7%
PY10	August 6, 2018	25.07	1.15	175.12	201.34	10.6%
PY10	August 28, 2018	30.69	0.92	159.52	191.12	11.3%
PY10	September 4, 2018	29.99	0.77	137.79	168.55	11.4%
PY10	September 5, 2018	29.52	0.84	129.54	159.91	11.9%
PY11	July 17, 2019	34.36	0.86	120.04	155.26	6.1%
PY11	July 18, 2019	11.06	1.02	121.63	133.71	5.9%
PY11	July 19, 2019	34.93	1.18	120.89	157.00	5.8%
PY11	August 19, 2019	24.90	0.98	126.17	152.05	5.6%
PYVTD – Average PY11 DR Event Performance		**26.31**	**1.01**	**122.18**	**149.50**	**5.9%**
P3TD – Average Phase III DR Event Performance		**29.97**	**0.59**	**136.56**	**167.13**	**10.0%**

Note: P3TD impacts are based on an average of all events and not an average of program years.
Source: Guidehouse analysis

2.9 Summary of Fuel Switching Impacts

Act 129 allows EDCs to achieve electric savings by converting electric equipment to non-electric equipment. Table 2-15 lists the fuel switching measures offered in Phase III, while Table 2-16 provides the key fuel switching metrics to date.

Table 2-15. List of Fuel Switching Measures

Fuel Switching Measures Implemented in PY9
Electric clothes dryer to ENERGY STAR gas clothes dryer
Electric range to gas range
Electric baseboard to ENERGY STAR fossil fuel furnace
Electric furnace to ENERGY STAR fossil fuel furnace
Electric water heater to ENERGY STAR gas water heater
CHP

Source: Guidehouse analysis

Table 2-16. Summary of Fuel Switching Measure Portfolio Impacts

Parameter	PYVTD	VTD
Total No. of Units Implemented	301	874
Gross Energy Savings via Fuel Switching (MWh/yr)	1,112	22,324
Fossil Fuel Consumption Change (MMBtu/yr)	14,401	191,055
P3TD Incentive Spending ($1,000)	$122.03	$1,394.29

Source: Guidehouse analysis

2.10 Summary of Cost-Effectiveness Results

A detailed breakdown of portfolio finances and cost-effectiveness is presented in Table 2-17. The TRC benefits in Table 2-17 are calculated using gross verified impacts. Net present value (NPV) PY11 costs and benefits are expressed in 2019 dollars. NPV costs and benefits for P3TD financials are expressed in 2016 dollars.

Table 2-17. Summary of Portfolio Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$31,633	$90,137
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$81,172	$190,947
	Cost Subtotal	**$112,805**	**$281,084**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$867	$2,996
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$9,659	$30,636
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$9,545	$34,436
	Program Delivery (CSP Costs) [5]	$26,878	$85,517
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$46,950**	**$153,585**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$676	$7,620
	Cost Subtotal	**$676**	**$7,620**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$160,431**	**$442,289**

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$105,327	$311,133
	Lifetime Electric Capacity Benefits	$47,720	$137,163
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, Operations & Maintenance [O&M])	$24,616	$68,173
	Benefits Total	**$177,663**	**$516,469**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**1.11**	**1.17**

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management, legal, and technical assistance.

[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. EDC program delivery costs include crosscutting portfolio costs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

TRC benefit-cost ratios are calculated by comparing total NPV TRC benefits and total NPV TRC costs. TRC costs are materially different from the EDC spending and cost recovery tables presented in Section 4. TRC costs include estimates of the full cost incurred by program participants to install efficient equipment, not just the portion covered by the EDC rebate. Table 2-18 through Table 2-21 show the gross and net TRC ratios by program and for the portfolio. Guidehouse calculated the benefits using gross and net verified impacts, where appropriate. Costs and benefits for PY11 results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 2-18. Summary PY11 Gross TRC Results by Program ($1,000) [1]

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Residential EE	$63,159	$43,000	1.47	$20,159
Low-Income EE	$19,213	$8,393	2.29	$10,820
Small C&I EE	$32,164	$32,168	1.00	-$5
Large C&I EE	$54,403	$58,795	0.93	-$4,391
CHP	$424	$670	0.63	-$245
Residential DR	$2,435	$3,188	0.76	-$753
Small C&I DR	$93	$115	0.82	-$21
Large C&I DR	$5,771	$4,557	1.27	$1,213
Portfolio Total [2]	**$177,663**	**$160,431**	**1.11**	**$17,231**

[1] Costs and benefits are expressed as follows: PY8 = 2016, PY9 = 2017, PY10 = 2018, PY11 = 2019, PY12 = 2020.
[2] The portfolio total benefits include crosscutting costs.
Source: Guidehouse analysis

Table 2-19. Summary PY11 Net TRC Results by Program ($1,000) [1]

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Residential EE	$36,036	$32,059	1.12	$3,978
Low-Income EE	$19,213	$8,393	2.29	$10,820
Small C&I EE	$24,313	$25,185	0.97	-$872
Large C&I EE	$32,244	$37,190	0.87	-$4,946
CHP	$371	$586	0.63	-$215
Residential DR	$2,435	$3,188	0.76	-$753
Small C&I DR	$93	$115	0.82	-$21
Large C&I DR	$5,771	$4,557	1.27	$1,213
Portfolio Total [2]	**$120,477**	**$120,819**	**1.00**	**-$342**

[1] Costs and benefits are expressed as follows: PY8 = 2016, PY9 = 2017, PY10 = 2018, PY11 = 2019, PY12 = 2020.
[2] The portfolio total benefits include crosscutting costs.
Source: Guidehouse analysis

Table 2-20. Summary P3TD Gross TRC Results by Program ($1,000)[1]

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Residential EE	$241,595	$134,073	1.80	$107,522
Low-Income EE	$40,931	$29,635	1.38	$11,295
Small C&I EE	$71,792	$74,401	0.96	-$2,609
Large C&I EE	$124,420	$130,306	0.95	-$5,887
CHP	$9,369	$16,239	0.58	-$6,869
Residential DR	$7,235	$11,631	0.62	-$4,396
Small C&I DR	$124	$416	0.30	-$292
Large C&I DR	$21,003	$11,152	1.88	$9,852
Portfolio Total [2]	**$516,469**	**$442,289**	**1.17**	**$74,180**

[1] Costs and benefits are expressed as follows: PY8 = 2016, PY9 = 2017, PY10 = 2018, PY11 = 2019, PY12 = 2020.

[2] The portfolio total benefits include crosscutting costs.

Source: Guidehouse analysis

Table 2-21. Summary P3TD Net TRC Results by Program ($1,000)[1]

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Residential EE	$131,144	$99,740	1.31	$31,404
Low-Income EE	$40,931	$29,635	1.38	$11,295
Small C&I EE	$54,109	$58,834	0.92	-$4,725
Large C&I EE	$84,863	$94,351	0.90	-$9,488
CHP	$8,212	$14,314	0.57	-$6,102
Residential DR	$7,235	$11,631	0.62	-$4,396
Small C&I DR	$124	$416	0.30	-$292
Large C&I DR	$21,003	$11,152	1.88	$9,852
Portfolio Total [2]	**$347,385**	**$354,509**	**0.98**	**-$7,124**

[1] Costs and benefits are expressed as follows: PY8 = 2016, PY9 = 2017, PY10 = 2018, PY11 = 2019, PY12 = 2020.

[2] The portfolio total benefits include crosscutting costs.

Source: Guidehouse analysis

The previously reported TRCs from PY10 have changed since Guidehouse submitted the PY10 Annual Report.[29] These changes to TRCs relate directly to the SWE's recommended adjustments for verified energy and demand impacts, previously detailed in Figure 2-10 and Table 2-13, respectively. Correcting these issues resulted in minor updates (less than 0.01) to program TRC ratios for PY10.

[29] [29] PECO. *Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129*. November 15, 2019. https://www.puc.pa.gov/pcdocs/1645979.pdf

2.11 Comparison of Performance to Approved EE&C Plan

Table 2-22 compares PY11 expenditures by program to the budget estimates set forth in the EE&C Plan[30] for PY11. All dollar values in Table 2-22 are presented in 2019 dollars.

Table 2-22. Comparison of PY11 Expenditures to Phase III EE&C Plan ($1,000)

Program	PY11 Budget from EE&C Plan	PY11 Actual Expenditures	Ratio (Actual/Plan)
Residential EE	$20,206	$27,035	1.34
Low-Income EE	$7,307	$8,563	1.17
Small C&I EE	$8,994	$11,286	1.25
Large C&I EE	$11,080	$13,583	1.23
CHP	$6,101	$60	0.01
Residential DR	$2,884	$3,815	1.32
Small C&I DR	$190	$139	0.73
Large C&I DR	$6,733	$4,557	0.68
Portfolio Total	**$63,494**	**$60,038**	**0.95**

Source: Guidehouse analysis

Table 2-23 compares program year and P3TD expenditures by program to the budget estimates set forth in the EE&C Plan. All values shown are the sum of nominal dollars.

Table 2-23. Comparison of Expenditures to Phase III EE&C Plan by Program ($1,000)

Program	Phase III Budget from EE&C Plan through PY11	P3TD Actual Expenditures	Ratio (Actual/Plan)
Residential EE	$79,484	$98,797	1.24
Low-Income EE	$28,270	$32,694	1.16
Small C&I EE	$36,047	$34,421	0.95
Large C&I EE	$43,428	$39,122	0.90
CHP	$22,830	$1,236	0.05
Residential DR	$10,727	$15,699	1.46
Small C&I DR	$751	$577	0.77
Large C&I DR	$20,422	$13,297	0.65
Portfolio Total	**$241,960**	**$253,843**	**1.05**

Source: Guidehouse analysis

Table 2-24 compares PY11 verified gross program savings to the energy savings projections set forth in the EE&C Plan.

[30] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

Table 2-24. Comparison of PY11 Actual Program Savings to EE&C Plan Projections for PY11

Program	EE&C Plan Projections for PY11 (MWh/yr)	PY11 VTD Gross Savings (MWh/yr)	Ratio (Actual/Plan)
Residential EE	151,861	244,306	1.61
Low-Income EE	23,818	35,888	1.51
Small C&I EE	85,491	75,329	0.88
Large C&I EE	96,256	123,363	1.28
CHP	88,471	816	0.01
Portfolio Total	**445,899**	**479,702**	**1.08**

Source: Guidehouse analysis

Table 2-25 compares Phase III verified gross program savings to the energy savings projections filed in the EE&C Plan.

Table 2-25. Comparison of Energy Savings to Phase III EE&C Plan by Program

Program	EE&C Plan through PY11 (MWh/yr)	VTD Gross Savings (MWh/yr)	Ratio (Actual/Plan)
Residential EE	569,464	867,979	1.52
Low-Income EE	91,744	102,950	1.12
Small C&I EE	324,142	196,543	0.61
Large C&I EE	382,590	321,025	0.84
CHP	334,044	20,440	0.06
Portfolio Total	**1,701,988**	**1,508,937**	**0.89**

Source: Guidehouse analysis

The list below briefly discusses key reasons why programs exceeded or fell short of projected gross energy savings in PY11.

- For the fourth consecutive year of Phase III and in spite of the COVID-19 pandemic, the Residential EE Program exceeded its annual targets specified in the PECO EE&C Plan. Similar to previous years, the Lighting channel of the Lighting, Appliances & HVAC (LAH) Solution, including lighting sold through the PECO Marketplace, and the Behavioral Solution were significant contributors to the portfolio in PY11. The remaining Residential EE Program solutions represent approximately 20% of PY11 gross verified energy savings achievements. This program is discussed in Section 3.1 of this report.
- The Low-Income EE Program attained most of its targeted savings in PY11 and to date for the phase. PECO discontinued the Low-Income Lighting offering prior to PY9, so the Low-Income Whole Home Solution is the sole contributing solution to the Low-Income EE Program. Since that change, PECO has adjusted implementation tactics to increase Whole Home Solution savings, including expanding partnerships with other utility and income-eligible programs to identify and comprehensively serve households. PECO also expanded the lighting giveaway component of the Low-Income Whole Home Solution. This program is discussed in Section 3.2 of this report.
- The Large and Small C&I Programs combined exceeded the PY11 target by 9%. The Small C&I Program was negatively affected by the pandemic and fell short of its target.

The Large C&I Program exceeded its target for PY11 by 28%, buoying the C&I sector overall. These programs are discussed in Sections 3.3 and 3.4 of this report.

- The CHP Program reported savings for one project in PY11, bringing the total for Phase III to six projects. Verified energy savings for CHP in PY11 fell short of its target. This program is discussed in Section 3.5 of this report.
- All four DR events in PY11 performed below the 161 MW curtailment target, though PECO's average DR performance to date is 167.13 MW, which exceeds the Phase III compliance reduction target of 161 MW by 3.8% (103.8% of target achieved to date). The lower performance in PY11 was primarily due to underperformance in the Large C&I DR Program compared to PY10, as well as unexpectedly cool weather on the July 18 DR event day. PECO's DR Programs are discussed in Section 3.6 of this report. Given the PY12 DR season is voluntary,[31] PECO has achieved its Phase III DR requirements as of the conclusion of PY11.

Guidehouse and PECO are working together to conduct targeted evaluation activities on an ongoing basis to identify potential changes to the Phase III programs and to support Phase IV portfolio design.[32] There are no official significant program changes to report at this time; however, Guidehouse has made program-specific recommendations, which are discussed in subsequent sections of this report.

[31] PY12 DR is voluntary: PA PUC. *Petition to Amend the Commission's June 19, 2015 Implementation Order. M-2014-2424864.* May 21, 2020. https://www.puc.pa.gov/pcdocs/1665150.docx

[32] Per PECO's Phase IV EE&C Plan (PECO Energy Co. - Docket No. M-2020-3020830, PHASE IV EE& C PLAN - PECO ENERGY), PECO implemented a process in Phase III to observe program and portfolio performance, record learnings, and adjust programs as needed to improve outcomes. The learnings gained from this continuous improvement process and Guidehouse's knowledge of the regulatory environment in Pennsylvania helped inform the Phase IV Plan.

2.12 Findings and Recommendations

The PY11 impact and process evaluation activities Guidehouse completed led to a variety of recommendations for program improvement. Table 2-26 shows the overarching recommendations that affect more than one program, the evaluation activity(s) that uncovered the finding, and Guidehouse's recommendation(s) to PECO to address the finding.

Table 2-26. Summary of Evaluation Recommendations

Evaluation Activity	Finding	Recommendation
Program Tracking Database	Guidehouse identified discrepancies in the PECO tracking system (eTrack) data structures, including blank savings (kWh and kW), missing calculations, improper rounding, and missing data fields. These discrepancies resulted in additional follow-up data requests from the evaluator to PECO and from PECO to the CSPs.	Take advantage of lessons learned from data management practices in Phase III. For example, PECO should develop a design file that includes minimum data requirements for CSPs to provide for a project to be accepted into the tracking system. PECO and evaluators should check that minimum data requirements from the design file are met.
Customer Satisfaction	Guidehouse observed increased satisfaction across the phase for both the Residential and Commercial programs. This rise in satisfaction corresponded with changes made to the implementation of individual solutions over the course of the phase to improve the participant experience.	Continue to implement process improvements identified over the course of Phase III in PY12 and in Phase IV to maintain high levels of customer satisfaction.

Source: Guidehouse analysis

3. Evaluation Results by Program

This section documents the gross impact, net impact, and process evaluation activities conducted in PY11 along with the outcomes of those activities. Not every program receives an evaluation every program year. Table 3-1 breaks down the evaluation activity plan, with a check indicating the type of evaluation Guidehouse will conduct for each program each year.

Table 3-1. Evaluation Activity Matrix

Program	Solution	PY8			PY9			PY10			PY11			PY12		
		Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process
Residential EE	LAH	√	√	√	√		√	√			√	√	√	√		
	Appliance Recycling	√	√	√	√			√			√	√	√	√		
	Whole Home	√			√	√	√	√			√	√	√			
	New Construction				√	√	√	√			√	√	√	√		
	Behavioral	√		√	√			√			√			√		
	Multifamily Targeted	√	√	√	√			√	√	√	√					
Residential Low-Income EE	Whole Home	√		√	√			√			√			√		
	Lighting	√		√												
Small C&I EE	Equipment and Systems	√			√	√	√	√			√	√	√	√		
	New Construction	√			√	√	√	√			√	√	√			
	Whole Building				√	√	√				√	√	√			
	Behavioral															
	Data Centers Targeted	√			√	√	√	√			√			√		
	Multifamily Targeted	√	√	√	√			√	√	√	√					
Large C&I EE	Equipment and Systems	√			√	√	√	√			√	√	√	√		
	New Construction	√			√	√	√	√			√	√	√			
	Data Centers Targeted	√			√	√	√	√			√			√		

Program	Solution	PY8			PY9			PY10			PY11			PY12		
		Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process
	Multifamily Targeted	√	√	√	√			√	√	√	√					
CHP	CHP	√			√	√	√	√	√	√	√			√	√	√
	Residential DR	√		√	√	√	√	√	√		√	√		√	√	
DR	Small C&I DR	√		√	√	√	√	√	√		√	√		√	√	
	Large C&I DR				√	√	√	√	√		√	√		√	√	

Source: Guidehouse analysis

3.1 Residential EE Program

The PECO Residential EE Program is designed to offer residential customers opportunities to save energy across all their electric end uses and to market those opportunities in ways that minimize lost savings opportunities. The program encompasses a series of solutions designed to influence customer behavior and purchasing decisions.

The Residential EE Program represents more than half of PECO's PY11 portfolio-reported energy savings and consists of six solutions, or initiatives, that contribute to those savings. Savings are achieved through a range of delivery mechanisms and methods including upstream incentives (e.g., manufacturer buy-downs), downstream incentives (e.g., mail-in rebates), appliance removal and recycling, in-home audits, direct install measures, efficient building construction, and changes in household behaviors. PECO relies on five CSPs to deliver the program, listed here with its corresponding solution:

- Lighting, Appliances & HVAC (LAH) Solution – CLEAResult
- Appliance Recycling Solution – ARCA Recycling
- Whole Home Solution – CLEAResult
- New Construction Solution – Performance Systems Development (PSD)
- Behavioral Solution – Oracle
- Multifamily Targeted Market Segment – Franklin

Marketing for the six solutions in the Residential EE Program is handled through a separate energy efficiency marketing firm (EEMF), ICF. ICF markets PECO's range of Residential EE Program offerings delivered through the six solutions with consistent approaches and messaging. Marketing from a crosscutting perspective is intended to promote all savings opportunities available to residential customers.

3.1.1 Participation and Reported Savings by Customer Segment

This section provides the total Residential EE Program results for PY11, including participation, energy and demand savings, and incentive costs. Table 3-2 presents the participation counts and incentive payments for the Residential EE Program in PY11 by customer segment.

Table 3-2. Residential EE Program Summary by Customer Segment

Parameter	Residential	Small C&I	Large C&I
PYTD No. of Participants	1,614,422	498	47
PYRTD MWh/yr[1]	247,421	658	36
PYRTD MW	23.11	0.09	0.01
PY11 Incentives ($1,000)	$8,733.98	$58.07	$3.44

[1] The Residential segment PYRTD was updated from the PY11 Semiannual Report as a result of a change in reported Behavioral savings.

Source: Guidehouse analysis

3.1.2 Gross Impact Evaluation

The Residential EE Program's gross impact evaluation activities involved different approaches tailored to each solution's characteristics to verify the reported gross savings values for PY11. First, Guidehouse reviewed each solution's program tracking data to verify proper application of the Pennsylvania Technical Reference Manual (TRM)[33] algorithms in reported savings values. The evaluation team completed these reviews for the full population of PY11's implemented Residential EE Program measures. Next, the team identified appropriate evaluation activities for each solution depending on the nature of the participants, implementation strategies, and the level of information accompanying the reported savings. A goal of the evaluation activities was to verify a given measure was implemented. Additionally, for partially deemed measures, the evaluation verified certain measure characteristics that inform gross energy and demand impact estimations—in particular, those characteristics where the TRM does not provide default or deemed values for EDCs to use for savings estimations. The evaluation activities varied for each solution and for specific strata within some solutions. Activities included engineering file reviews of program applications and invoices, participant phone verifications, billing and regression analyses, or a combination of these activities.

In consultation with the SWE, Guidehouse adjusted some evaluation activities in response to health concerns related to the pandemic. Alternate verification methods for two solutions were used in place of onsite verifications. The Residential Whole Home Solution conducted phone survey verifications, which had also been conducted in PY10. The Multifamily Targeted Market Segment conducted onsite verification in PY10; Guidehouse applied the PY10 verification realization rates to the PY11 Multifamily reported savings.

Guidehouse drew samples from each solution for gross impact evaluation activities according to the sampling plans. The evaluation team developed and sought approval for representative samples that complied with the Phase III Evaluation Framework, the TRM, and industry standards, as well as those that helped PECO meet the SWE and PA PUC requirements.

Table 3-3 summarizes the activities conducted for each solution and for specific components or sampled strata within a given solution. Appendix F contains additional detail on the gross impact evaluation approaches used for the Residential EE Program's individual solutions.

Table 3-3. Residential EE Impact Evaluation Activities

Solution	Engineering File Reviews	Online Survey Verification	TRM Savings Calculation Review	Other
LAH (Lighting)				Invoice reviews and record-level savings calculations ENERGY STAR® Certification verification
LAH (Appliances and HVAC)	√ [1]	√		
LAH (Marketplace)				Tracking system review
Appliance Recycling		√	√	Regression analysis
Whole Home	√		√	Phone verification

[33] PA PUC. *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards.* Dated June 2016, errata update February 2017.

Solution	Engineering File Reviews	Online Survey Verification	TRM Savings Calculation Review	Other
New Construction	√		√	Building simulation modeling
Behavioral				Billing analysis: • For home energy report (HER) *participants in the test and control* groups, used a lagged dependent variable (LDV) model. • For AC Saver cohort recipients included in the Behavioral Solution, used a regression with preprogram matching method to estimate savings related to HERs. Peak demand impacts: Accounting for average peak demand impacts resulting from HERs.[2] Double counting (dual participation) analysis: Accounting for Behavioral Solution participant activities within other PECO EE solutions.
Multifamily Targeted	√ [3]			Applied PY10 verification realization rate

[1] HVAC only.
[2] The Behavioral Solution implementer, Oracle, does not report demand savings. Guidehouse completes this analysis as part of its annual reporting, as required by the SWE. A realization rate cannot be calculated due to the lack of reported demand savings.
[3] For residential projects that contribute to the Residential EE Program.

Source: Guidehouse analysis

Table 3-4 provides the sampling frame for the gross impact evaluation of the Residential EE Program in PY11.

Table 3-4. Residential EE Program Gross Impact Sample Design for PY11

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
LAH	Furnace High Efficiency Fan	4,616	6	16	Engineering file review and online survey verification
	Central AC	4,232	5	17	Engineering file review and online survey verification
	ASHP	978	5	7	Engineering file review and online survey verification
	Ductless Mini-Split Heat Pumps	420	5	10	Engineering file review and online survey verification
	Other – HVAC	2,132	5	20	Engineering file review and online survey verification
	Dehumidifier	2,954	6	30	Engineering file review and online survey verification
	Clothes Washer	3,098	5	53	Engineering file review and online survey verification

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
	Refrigerator	3,112	5	36	Engineering file review and online survey verification
	Air Purifier	536	5	7	Engineering file review and online survey verification
	Other – Appliances	2,287	5	11	Engineering file review and online survey verification
	Specialty Lighting	535,543	0	0	Engineering file review and online survey verification
	Standard Lighting	626,607	0	0	Engineering file review and online survey verification
	Solution Total	**1,201,625**	**92**	**207**	
Appliance Recycling	Freezers	2,680	30	38	Engineering file review and online survey verification
	Room ACs	1,361	20	14	Engineering file review and online survey verification
	Refrigerators	15,236	150	162	Engineering file review and online survey verification
	Solution Total	**19,277**	**200**	**214**	
Whole Home	Large	812	5	7	Engineering file review and phone survey verification
	Medium	1,197	5	5	Engineering file review and phone survey verification
	Small	2,630	8	5	Engineering file review and phone survey verification
	Very Small	581	0	0	Engineering file review and phone survey verification
	Solution Total	**5,220**	**18**	**17**	
New Construction	Small	476	5	5	Engineering file reviews and building simulation modeling
	Medium	245	5	5	Engineering file reviews and building simulation modeling
	Large	164	5	5	Engineering file reviews and building simulation modeling
	Solution Total	**885**	**15**	**15**	
Behavioral	**Solution Total**	**N/A**	**N/A**	**N/A**	
Multifamily Targeted	Multisector	25	5	0	PY11 engineering file reviews; PY10 onsite verification results
	Large Residential	38	6	0	PY11 engineering file reviews; PY10 Onsite verification results
	Small Residential	3,073	6	0	PY11 engineering file reviews; PY10 onsite verification results
	Solution Total	**3,136**	**17**	**0**[1]	
Total Program	**All**	**1,230,144**	**342**	**454**	

[1] Field sites were not visited in PY11 due to impacts of the pandemic.

Source: Guidehouse analysis

Guidehouse shows the PY11 verified energy and demand savings in Table 3-5 and Table 3-6, respectively. These tables also include the realization rates on a stratum and solution level, which is calculated by dividing the total verified savings by the reported savings.

Table 3-5 summarizes the reported and verified energy savings results along with the coefficient of variation (CV) and relative precision for each stratum sampled for the Residential EE Program in PY11.

Table 3-5. Residential EE Program Gross Results for Energy

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
LAH	Furnace High Efficiency Fan	1,901	1,901	1.00	0.00	0.0%
	Central AC	1,290	1,290	1.00	0.00	0.0%
	ASHP	913	798	0.87	0.00	0.0%
	Ductless Mini-Split Heat Pumps	762	762	1.00	0.00	0.0%
	Other – HVAC	325	325	1.00	0.00	0.0%
	Dehumidifier	591	367	0.62	0.00	0.0%
	Clothes Washer	288	217	0.76	0.00	0.0%
	Refrigerator	175	184	1.05	0.04	1.0%
	Air Purifier	129	413	3.21	0.00	0.0%
	Other – Appliances	145	145	1.00	0.00	0.0%
	Marketplace: Thermostats	2,359	2,481	1.05	0.00	0.0%
	Marketplace: Lighting	854	913	1.07	0.00	0.0%
	Marketplace: Smart Strips	62	62	1.00	0.00	0.0%
	Specialty Lighting	66,941	65,898	0.98	0.00	0.0%
	Standard Lighting	70,812	71,999	1.02	0.00	0.0%
	Solution Total	**147,546**	**147,755**	**1.00**	**0.00**	**0.0%**
Appliance Recycling	Freezers	2,280	1,677	0.74	0.54	12.8%
	Room ACs	273	273	1.00	0.00	0.0%
	Refrigerators	15,092	16,974	1.12	0.20	2.2%
	Solution Total	**17,645**	**18,924**	**1.07**	**0.23**	**2.3%**
Whole Home	Large	2,303	2,118	0.92	0.22	13.8%
	Medium	1,790	1,774	0.99	0.11	8.7%
	Small	2,013	1,886	0.94	0.08	6.1%
	Very Small	103	96	0.94	0.00	100.0%

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
	Solution Total	**6,209**	**5,875**	**0.95**	**0.15**	**5.6%**
New Construction	Small	697	658	0.94	0.19	15.3%
	Medium	695	532	0.77	0.18	14.3%
	Large	701	660	0.94	0.10	7.8%
	Solution Total	**2,093**	**1,851**	**0.88**	**0.16**	**6.3%**
Behavioral	**Solution Total**	**71,728**	**67,056**	**0.93**	**0.00**	**0.0%**
Multifamily Targeted	Multisector	314	312	0.99	0.06	4.9%
	Large Residential	1,499	1,405	0.94	1.18	113.8%
	Small Residential	1,081	1,129	1.04	0.13	8.8%
	Solution Total	2,894	2,846	0.98	**1.13**	44.6.%
Total Program	**All**	**248,11**	**244,306**	**0.98**	**0.11**	**0.9% [90% CI]**

CI = confidence interval

Source: Guidehouse analysis

Table 3-6 summarizes the reported and verified demand savings results along with the CV and relative precision for each stratum sampled for the Residential EE Program in PY11.

Table 3-6. Residential EE Program Gross Results for Demand

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
LAH	Furnace High Efficiency Fan	0.36	0.36	1.00	0.00	0.0%
	Central AC	1.13	1.13	1.00	0.00	0.0%
	ASHP	0.26	0.14	0.54	0.00	0.0%
	Ductless Mini-Split Heat Pumps	0.15	0.15	1.00	0.00	0.0%
	Other – HVAC	0.26	0.26	1.00	0.00	0.0%
	Dehumidifier	0.15	0.09	0.62	0.00	0.0%
	Clothes Washer	0.03	0.02	0.76	0.00	0.0%
	Refrigerator	0.02	0.02	1.05	0.04	0.9%
	Air Purifier	0.01	0.05	3.22	0.00	0.0%
	Other – Appliances	0.03	0.03	1.00	0.00	0.0%

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
	Marketplace: Thermostats	0.00	0.00	0 1.00	0.00	0.0%
	Marketplace: Lighting	0.10	0.11	1.07	0.00	0.0%
	Marketplace: Smart Strips	0.01	0.01	1.00	0.00	0.0%
	Specialty Lighting	7.89	8.02	1.02	0.00	0.0%
	Standard Lighting	8.34	8.57	1.03	0.00	0.0%
	Solution Total	**18.74**	**18.96**	**1.01**	**0.00**	**0.0%**
Appliance Recycling	Freezers	0.26	0.19	0.72	0.54	12.8%
	Room ACs	0.45	0.45	1.00	0.00	0.0%
	Refrigerators	1.74	1.90	1.09	0.20	2.2%
	Solution Total	**2.45**	**2.53**	**1.03**	**0.19**	**1.9%**
Whole Home	Large	0.25	0.22	0.87	0.31	19.5%
	Medium	0.32	0.32	1.00	0.08	6.0%
	Small	0.26	0.25	0.95	0.07	5.6%
	Very Small	0.02	0.02	0.95	0.00	100.0%
	Solution Total	**0.85**	**0.80**	**0.95**	**0.16**	**6.0%**
New Construction	Small	0.26	0.26	0.98	0.06	4.5%
	Medium	0.27	0.25	0.91	0.05	4.2%
	Large	0.26	0.26	0.98	0.03	2.4%
	Solution Total	**0.80**	**0.77**	**0.96**	**0.05**	**1.9%**
Behavioral	**Solution Total**	**0.00**	**7.65**	**-** [1]	**0.00**	**0.0%**

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Multifamily Targeted	Multisector	0.04	0.04	0.95	0.06	4.6%
	Large Residential	0.20	0.18	0.93	1.05	101.4%
	Small Residential	0.14	0.14	1.00	0.09	6.2%
	Solution Total	**0.37**	**0.36**	**0.96**	**1.04**	**40.7%**
Total Program	**All**	**23.21**	**31.07**	**1.34**	**0.10**	**0.8% [90% CI]**

[1] For the Residential Behavioral Solution, the implementer does not report demand savings; however, the SWE requires PECO to verify demand savings. As a result, there is no demand realization rate for the Behavioral Solution. However, the verified demand savings are added to the Residential EE Program savings. As a result, the demand realization rate for the Residential EE Program is greater than the demand realization rate for each individual solution in the program.

Source: Guidehouse analysis

For each solution, factors leading to variations between the reported and verified savings and the observed realization rates for the Residential EE Program are detailed in Appendix F. Overall, the LAH Solution and the Behavioral Solution are the most significant drivers of the program-level results and realization rates—these two solutions represent almost 90% of the program's savings.

3.1.3 Net Impact Evaluation

The Residential EE Program's net impact evaluation uses several methods to estimate free ridership, spillover, and NTG ratios for the solutions evaluated in PY11. The team conducted primary NTG research in PY11 for Appliance Recycling, the downstream channel of LAH, the PECO Marketplace, Residential New Construction, and Whole Home.

The primary objective of the net savings analysis is to determine the program's net effect on customer electricity usage. The evaluation team derived net program impacts by estimating NTG ratios that quantify the percentage of the gross program impacts that can reliably be attributed to the program.

Free ridership is defined as those participants who would have implemented a measure or purchased equipment anyway, without program support or a rebate. The questions determining free ridership focus on the influence of key program interventions and customer perception of what they would most likely have done in the absence of the program. Interventions vary by solution but can include discounted prices, program information regarding efficient products, and placement of program-discounted products in stores.

Spillover is defined as those participants who were influenced by the program to purchase and install additional energy efficient equipment that saves electricity without a rebate or other program support. Guidehouse analyzed participant responses to a battery of spillover questions. The intent of these questions was to identify what types and amounts of equipment customers

purchased and installed on their own to inform a quantitative estimate of program spillover within the overall NTG calculation.

Guidehouse surveyed PECO program participants using online surveys to gather information about free ridership and spillover. The evaluation team developed survey instruments consistent with the Phase III Evaluation Framework's guidance on net impact evaluation techniques[34] and guidance from the Uniform Methods Project on estimating net savings.[35] Survey instruments also captured feedback about customer experiences from participants to inform the process evaluation.[36]

Table 3-7 provides the sampling frame for the net impact evaluation of the Residential EE Program in PY11, where sampling occurred. Guidehouse experienced better-than-anticipated response rates to the online surveys, often achieving more completes than the required 85/15 confidence and precision targets.

Table 3-7. Residential EE Program PY11 Net Impact and Process Survey Sample Design

Solution	Stratum Name	Population	Target Sample Size	Achieved Sample Size[1]	Response Rate	Verification Method
LAH	Furnace High Efficiency Fan	4,616	25	25	8%	Online survey
	Central AC	4,232	10	33	7%	Online survey
	ASHP	978	10	14	6%	Online survey
	Ductless Mini-Split Heat Pumps	420	10	22	12%	Online survey
	Other HVAC	2,132	10	19	7%	Online survey
	Dehumidifier	2,954	16	28	6%	Online survey
	Clothes Washer	3,098	12	29	6%	Online survey
	Refrigerator	3,112	12	42	11%	Online survey
	Air Purifier	536	10	11	8%	Online survey
	Other – Appliances	2,287	10	18	12%	Online survey
	Marketplace: Thermostats	11,115	25	48	2%	Online survey
	Marketplace: Lighting	3,142	20	107	6%	Online survey
	Marketplace: Smart Strips	853	10	8	8%	Online survey
	Solution Total	**39,475**	**180**	**404**	**8%**	
Appliance Recycling	Refrigerators	15,273	150	177	10%	Online survey
	Freezers	2,680	30	43	17%	Online survey
	Room ACs	1,361	20	21	22%	Online survey
	Solution Total	**19,314**	**200**	**241**	**12%**	
Whole Home	Large Projects	812	28	34	13%	Online survey
	Medium Projects	1,197	34	30	9%	Online survey

[34] PA PUC. "Section 3.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[35] The Uniform Methods Project. *Estimating Net Savings: Common Practices.* National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy14osti/62678.pdf

[36] Guidehouse screened survey participants and only collected NTG data from tenants who reported having a choice to participate in the Multifamily Targeted Market Segment. Of the 65 survey participants, 15 provided NTG results.

Solution	Stratum Name	Population	Target Sample Size	Achieved Sample Size[1]	Response Rate	Verification Method
	Small Projects	2,630	34	39	12%	Online survey
	Very Small Projects	581	12	9	8%	Online survey
	Solution Total	**5,220**	**108**	**112**	**11%**	
New Construction	**All Builders**	**21**	**10**	**8**	**38%**	Online survey
Total Program	**All**	**64,030**	**498**	**765**	**17%**	

[1] The achieved sample targets listed are for participants who answered NTG-related questions; the sample targets achieved for the number of participants who answered process questions are listed in process evaluation section.

Source: Guidehouse analysis.

Table 3-8 summarizes the reported and verified energy savings results, the calculated NTG results, and the CV and relative precision for each stratum sampled for the Residential EE Program in PY11.

Table 3-8. Residential EE Program Net Energy Savings Impact Evaluation Results for PY11

Solution	Stratum Name	Verified Gross Energy Savings (MWh/yr)	Verified Net Energy Savings (MWh/yr)	Free Ridership Rate	Spillover Rate	NTG Ratio[1]	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
LAH	Furnace High Efficiency Fan	1,901	1,901	0.47	0.47	1.00	1.15	34.1%
	Central AC	1,290	1,042	0.47	0.28	0.81	1.04	26.6%
	ASHP	798	783	0.40	0.39	0.98	0.99	40.3%
	Ductless Mini-Split Heat Pumps	762	465	0.42	0.03	0.61	0.90	28.6%
	Other – HVAC	325	262	0.47	0.28	0.81	0.86	29.6%
	Dehumidifier	367	348	0.47	0.42	0.95	1.23	34.5%
	Clothes Washer	217	196	0.65	0.55	0.90	2.79	76.6%
	Refrigerator	184	407	0.52	1.74	2.22	1.43	32.4%
	Air Purifier	413	841	0.39	1.42	2.03	1.02	48.1%
	Other – Appliances	145	306	0.52	1.63	2.10	3.40	120.9%
	Marketplace: Thermostats	2,481	1,645	0.37	0.03	0.66	0.58	12.3%
	Marketplace: Lighting	913	764	0.18	0.01	0.84	0.74	10.4%
	Marketplace: Smart Strips	62	51	0.24	0.06	0.82	0.25	14.2%
	Specialty Lighting	65,898	30,258	0.58	0.04	0.46	0.40	2.6%
	Standard Lighting	71,999	36, 715	0.53	0.04	0.51	0.45	3.4%
	Solution Total	**147,755**	**75,984**	**0.54**	**0.06**	**0.51**	**0.58**	**2.4%**
Appliance Recycling	Freezers	1,677	1,123	0.33	0.00	0.67	0.61	13.7%
	Room ACs	273	107	0.61	0.00	0.39	1.07	34.9%
	Refrigerators	16,974	8,826	0.48	0.00	0.52	0.99	10.8%
	Solution Total	**18,924**	**10,056**	**0.47**	**0.00**	**0.53**	**0.99**	**9.2%**
Whole Home	Large	2,118	1,913	0.19	0.09	0.90	0.26	6.7%
	Medium	1,774	1,654	0.23	0.16	0.93	0.41	11.2%

Solution	Stratum Name	Verified Gross Energy Savings (MWh/yr)	Verified Net Energy Savings (MWh/yr)	Free Ridership Rate	Spillover Rate	NTG Ratio[1]	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
	Small	1,886	1,995	0.21	0.27	1.06	0.48	11.2%
	Very Small	96	150	0.21	0.77	1.56	0.75	40.0%
	Solution Total	**5,875**	**5,712**	**0.21**	**0.18**	**0.97**	**0.40**	**5.5%**
New Construction	Small	658	608	0.08	0.00	0.92	0.35	19.8%
	Medium	532	491	0.08	0.00	0.92		
	Large	660	610	0.08	0.00	0.92		
	Solution Total	**1,851**	**1,709**	**0.08**	**0.00**	**0.92**	**0.35**	**19.8%**
Behavioral	**Solution Total**	**67,056**	**67,056**	**0.00**	**0.00**	**1.00**	**N/A**	**N/A**
Multifamily Targeted	Multisector	312	272	0.13	0.00	0.87	0.20	15.7%
	Large Residential	1,405	1,309	0.07	0.00	0.93	0.18	4.6%
	Small Residential	1,129	1,042	0.08	0.00	0.92	0.23	7.2%
	Solution Total	2,846	2,622	0.08	0.00	0.92	**0.21**	**3.9%**
Total Program	**All**	**244,306**	**163,140**	**0.37**	**0.04**	**0.67**	**0.61**	**2.4% [90% CI]**

[1] Guidehouse conducted NTG research for the Residential Multifamily Targeted Market Segment in PY10 and for specialty and standard LED lighting in PY8; those results are presented in this table.

Source: Guidehouse analysis

The Residential EE Program NTG results for PY11 are on par with results from previous program years. Free ridership increased 5% and spillover increased 2% from the PY8 evaluation. See the Appendix F for solution-specific NTG discussions and findings.

3.1.3.1 High Impact Measure Research

HIMs represent measure categories or technologies of high importance in the PECO portfolio. In Phase III, the SWE suggested EDCs oversample HIMs to help program planners make decisions concerning those measures for downstream programs only.[37] EDCs were to identify three to five measures for study within each program year based on energy impact, level of uncertainty, prospective value, funding, or other parameters.

Guidehouse reviewed program- and solution-level savings, energy impact, and overall value to PECO to identify the HIMs for PY11. The results indicated that refrigerator and freezer retirement (recycling), high efficiency furnace fans, smart/learning thermostats, and LED bulbs sold through the PECO Marketplace held the highest impact for the Residential EE Program. Table 3-9 shows the results of the HIM analysis in PY11.

Table 3-9. Residential EE Program HIM NTG Summary

HIM	Solution	Free Ridership Rate	Spillover Rate	NTG Ratio
Refrigerator retirement	Appliance Recycling	0.48	0.00	0.52
Smart/learning thermostats	LAH – Marketplace	0.37	0.03	0.66
Freezer retirement	Appliance Recycling	0.33	0.00	0.67
High efficiency furnace fans	LAH – Non-Lighting	0.47	0.47	1.00
LED bulbs	LAH – Marketplace	0.18	0.01	0.84

Source: Guidehouse analysis

3.1.4 Process Evaluation

Guidehouse performed targeted process evaluation tasks for the Residential EE Program during PY11 building on PY9 activities. The PY11 process evaluation efforts included in-depth interviews with key PECO and CSP staff and a detailed review of program databases and tracking systems across all solutions. The PY11 evaluation also included residential participant surveys for the Appliance Recycling, LAH (Appliances and HVAC and PECO Marketplace channels), and Whole Home Solutions, and builder surveys for the New Construction Solution. This section summarizes the evaluation methods, data collection techniques, sample design, and key results related to these PY11 activities.

PECO and CSP staff provided essential information about the program design and how the program is experienced compared to the EE&C Plan.[38] Guidehouse conducted in-depth interviews with all PECO solution leads and CSPs as part of the PY11 evaluation and communicated with PECO staff on an ongoing basis as needed. The evaluation team developed

[37] PA PUC. "Section 3.4.1.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[38] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

interview instruments to include questions of interest to the evaluation and to allow for free-flowing conversations to obtain candid feedback from the interviewees.

Guidehouse developed all survey instruments according to SWE requirements; the SWE reviewed and approved each survey instrument in advance of fielding. In general, the evaluation team defined the survey population for each solution's participants based on the program tracking databases provided by PECO. In some cases, demographic and geographic information, data on installed measures, installation dates, and estimated savings were used for sample design and the subsequent analysis of results. The team developed a sample sufficient to provide 85/15 confidence/precision for the survey results at the solution level.

Table 3-10 summarizes the process evaluation activities conducted for each Residential EE Solution.

Table 3-10. Residential EE Solution Process Evaluation Activities

Solution	PECO and CSP Staff Interviews	Program Tracking Data Review	Program Material Review	Online Participant Survey
LAH (Lighting)	√	√		Guidehouse used online surveys to assess how customers heard about the Appliances and HVAC channel, informational sources on ways to save energy, their satisfaction with the solution, and the likelihood to recommend the solution to others. Guidehouse stratified the survey sample by the two non-Lighting measure categories (Appliances and HVAC).
LAH (Appliances and HVAC)	√	√		
LAH (Marketplace)	√	√	√	Guidehouse used online surveys to assess how customers heard about the PECO Marketplace channel, informational sources on ways to save energy, their satisfaction with the Marketplace, and the likelihood to recommend the Marketplace to others. Guidehouse stratified the survey sample by the three measures (smart/learning thermostats, LED lighting, and smart strip plug outlets).
Appliance Recycling	√	√		Guidehouse used online surveys to assess how customers heard about the Appliance Recycling Solution, informational sources on ways to save energy, their satisfaction with the solution, and the likelihood to recommend the solution to others. Guidehouse segmented the survey sample according to participation type: • Refrigerator • Freezer • AC

Solution	PECO and CSP Staff Interviews	Program Tracking Data Review	Program Material Review	Online Participant Survey
Whole Home	√	√		Guidehouse used online surveys to assess how customers heard about the Whole Home Solution, informational sources on ways to save energy, their satisfaction with the solution, and the likelihood to recommend the solution to others. Guidehouse sampled participants based on four project sizes, creating four strata (Large Projects, Medium Projects, Small Projects and Very Small Projects).
New Construction	√			Guidehouse used online surveys to assess how builders heard about the New Construction Solution, their satisfaction with the solution, and challenges builders experience in building to higher standards.
Behavioral	√	√		
Multifamily Targeted	√	√		

Source: Guidehouse analysis

Table 3-11 provides the participant and builder survey sample details for each Residential EE Solution.

Table 3-11. Residential EE Program Customer and Builder Online Survey Sample Design for PY11

Solution	Stratum	Population Size	Target Sample Size	Achieved Sample Size
LAH (Appliances and HVAC)	Appliances Measures	11,987	75	129
	HVAC Measures	12,378	75	113
	Solution Total	**24,365**	**150**	**242**
LAH (Marketplace)	Smart/Learning Thermostat	11,115	25	49
	LED Lighting	3,142	20	113
	Smart Strip Plug Outlets	853	10	5
	Solution Total	**15,110**	**55**	**167**
Appliance Recycling	Refrigerators	15,273	150	207
	Freezers	2,680	30	44
	ACs	1,361	20	19
	Solution Total	**19,314**	**200**	**270**
Whole Home	Large	812	28	36
	Medium	1,197	34	31
	Small	2,630	34	41
	Very Small	581	12	9
	Solution Total	**5,220**	**108**	**117**
New Construction (Participating Builders)	**Solution Total**	**21**	**10**	**8**
Total Program	**All**	**64,030**	**415**	**687**

Notes: Values in tables may not reconcile exactly with the sum of more detailed level results or previously reported results due to rounding; survey samples were designed to achieve 15% relative precision at the 85% confidence level at the solution level for NTG ratios and satisfaction ratings.

Source: Guidehouse analysis

3.1.4.1 Key Findings from Process Evaluation

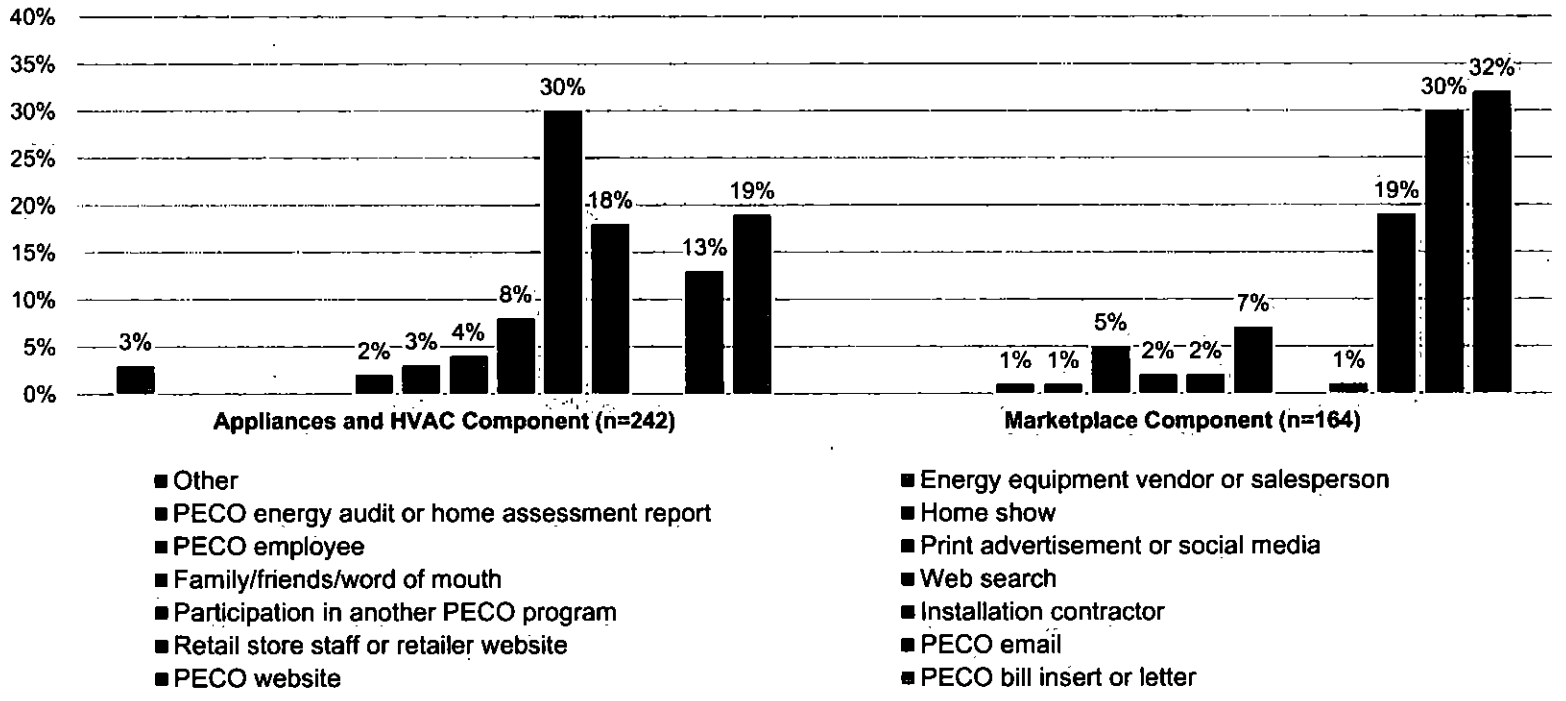
For PY11, Guidehouse surveyed LAH (Appliances and HVAC and PECO Marketplace channels), Appliance Recycling, and Whole Home participants, and New Construction builder participants to measure satisfaction and assess the PECO Residential EE Program's effectiveness at encouraging the participation needed to achieve energy savings and participation goals. This section includes results from several cross-solution metrics including satisfaction and marketing effectiveness. Appendix F includes detailed findings relevant to each specific solution.

The evaluation team's research into key sources of program awareness reveals that PECO bill inserts and the PECO website play an important role in participants learning about the Residential EE Solutions. In PY9, PECO bill inserts and the PECO website likewise drove participation in the surveyed programs (Whole Home and New Construction Solutions), suggesting that PECO can continue to rely on these historically successful marketing channels.

As *Figure 3-1 and Figure 3-2 show, word of mouth drives some participation for the Whole* Home (15%) and Appliance Recycling (12%) Solutions but little for the Appliances and HVAC (3%) and PECO Marketplace channels (2%). Additionally, PY11 builder responses indicated a decrease in builders spreading the word about the New Construction Solution compared to PY9 results. This finding suggests that word of mouth could be a valuable mechanism for the Appliances and HVAC and PECO Marketplace channels and the New Construction Solution if PECO encourages past participants to share their experiences.

Past participation in other PECO programs, web searches, and print advertisements or social media appear to not drive significant participation, similar to PY9 findings.

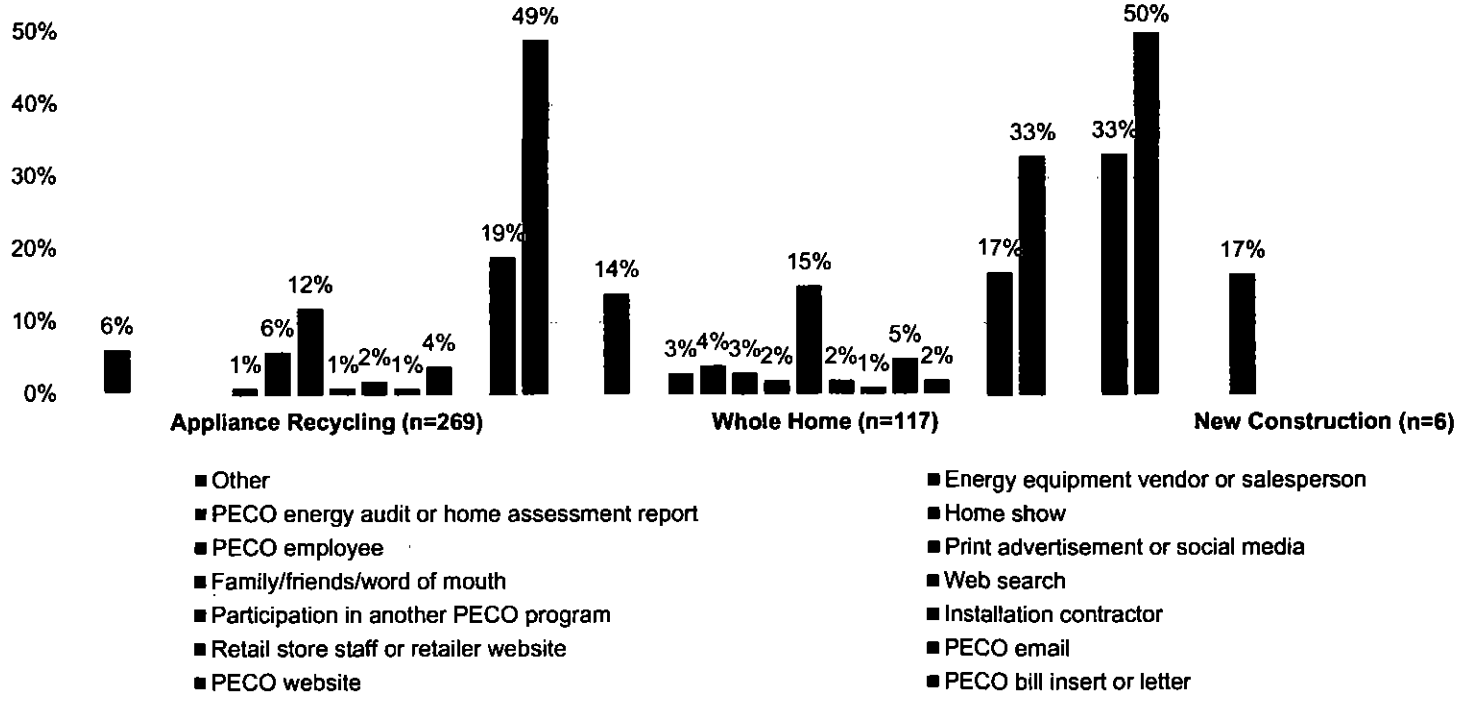
Figure 3-1. Sources of Residential EE Solution Awareness, LAH



Question: "How did you learn about the [SOLUTION] program?"
Notes: PECO employee includes a PECO account representative or a customer service representative.
Other includes the following: advertisements on television, product packaging, and known industry knowledge.
Do Not Know responses have been excluded.

Source: Guidehouse analysis

Figure 3-2. Sources of Residential EE Solution Awareness, Other Solutions



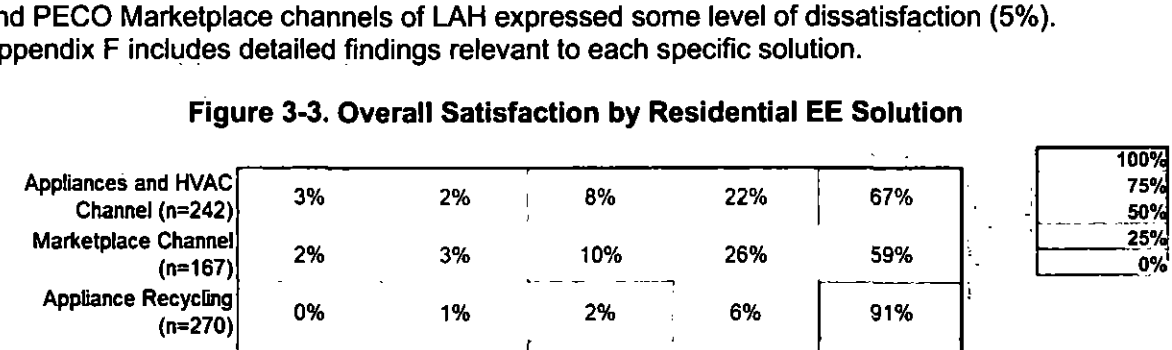
Question: "How did you learn about the [SOLUTION] program?"
Notes: PECO employee includes a PECO account representative or a customer service representative.
Other includes the following: advertisements on television, radio or local news channels, PECO energy audit or home assessment report, past experience, a homeowners association letter, an appliance rebate, Pennsylvania Housing Finance Agency, PSD, and Rater.
Do Not Know responses have been excluded..

Source: Guidehouse analysis

The evaluation team also presented survey questions on overall satisfaction with the relevant solution. Average Residential EE Solution satisfaction was 4.6 on a 5-point scale, with 1 representing extremely dissatisfied and 5 representing extremely satisfied. Average scores ranged from 4.9 (Appliance Recycling) to 4.4 (PECO Marketplace and New Construction), indicating high satisfaction across all programs. As Figure 3-3 shows, participant customers and builders were generally satisfied or extremely satisfied with the programs.

The Appliance Recycling Solution witnessed the highest percentage of satisfied or extremely satisfied respondents (97%), followed by Whole Home (92%) and Appliances and HVAC (the non-Lighting channel of the LAH Solution, 89%). Participants of both the Appliances and HVAC and PECO Marketplace channels of LAH expressed some level of dissatisfaction (5%). Appendix F includes detailed findings relevant to each specific solution.

Figure 3-3. Overall Satisfaction by Residential EE Solution



Question: "Using a scale of 1 to 5, with 1 meaning extremely dissatisfied and 5 meaning extremely satisfied, how would you rate your OVERALL satisfaction with the [Solution] program?"

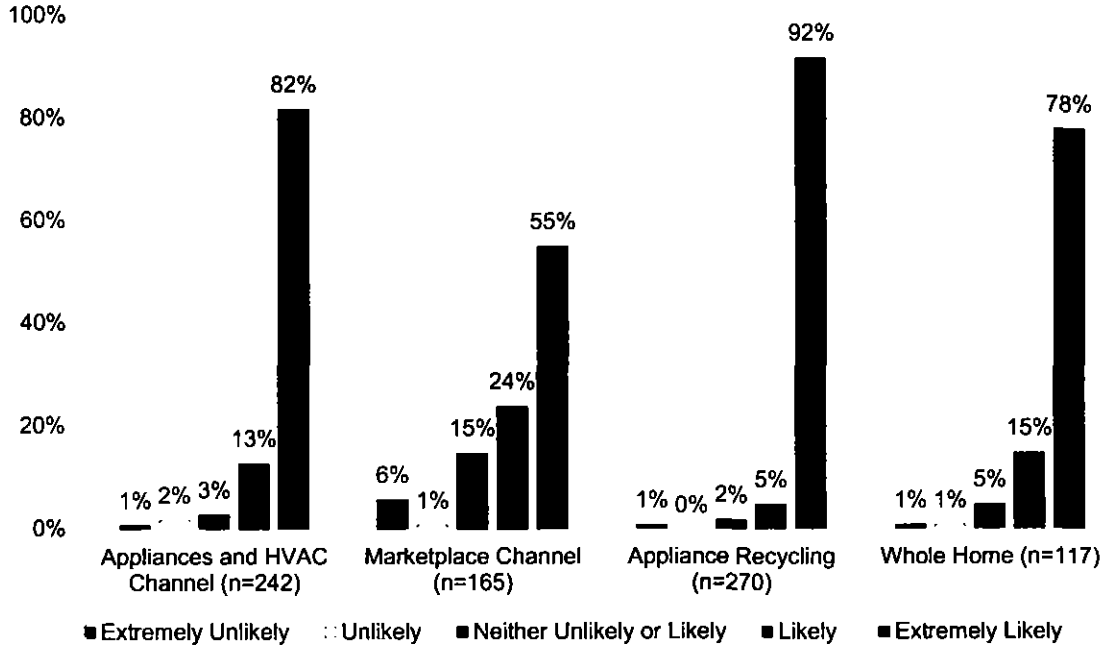
Do Not Know responses have *been excluded.*

Source: Guidehouse analysis

The evaluation team also examined the likeliness of respondents to recommend the programs to others.[39] Across the solutions, the majority of respondents reported they were likely or extremely likely to recommend the program to others. The Appliance Recycling Solution scored the highest, with 97% of respondents likely or extremely likely to recommend the program, followed by the Appliances and HVAC channel (95%) of the LAH Solution. Over three-quarters (79%) of PECO Marketplace respondents were likely to recommend the program to others, the lowest of any solution. On the whole, most participants are satisfied with their participation in the Residential EE Solutions.

[39] New Construction Solution responses are not included in this question as this survey is targeted at builders instead of customers.

Figure 3-4. Overall Likelihood to Recommend by Residential EE Solution



Question: "On a scale of 1-5, with 1 meaning "Extremely Unlikely" and 5 meaning "Extremely Likely," overall, how likely are you to recommend PECO's program to others?"

Do Not Know responses have been excluded.

Source: Guidehouse analysis

3.1.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-12. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-12. Summary of Residential EE Program Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$9,825	$30,121
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$15,835	$46,122
	Cost Subtotal	**$25,661**	**$76,243**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$388	$1,482

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$6,420	$19,205
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$10,401	$36,652
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$17,210**	**$57,339**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$129	$491
	Cost Subtotal	**$129**	**$491**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$43,000**	**$134,073**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$33,880	$138,172
	Lifetime Electric Capacity Benefits	$11,652	$47,177
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$18,627	$56,246
	Benefits Total	**$63,159**	**$241,595**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**1.47**	**1.80**

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management, legal, and technical assistance.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

Table 3-13 presents program financials and cost-effectiveness on a net savings basis.

Table 3-13. Summary of Residential EE Program Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$9,825	$30,121
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$4,876	$11,827
	Cost Subtotal	**$14,702**	**$41,948**

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$388	$1,482
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$6,420	$19,205
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$10,401	$36,652
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$17,210**	**$57,339**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$119	$430
	Cost Subtotal	**$119**	**$430**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$32,030**	**$99,717**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$19,272	$75,837
	Lifetime Electric Capacity Benefits	$6,932	$25,828
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$9,832	$29,242
	Benefits Total	**$36,036**	**$130,907**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**1.12**	**1.31**

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

3.1.6 Status of Recommendations

The impact and process evaluation activities in PY11 led to several findings and recommendations from Guidehouse to PECO. Table 3-14 presents those solution-level findings and recommendations along with a summary of how PECO plans to address the recommendations in program delivery. Additional details on the solution-level analysis activities that led to these findings and recommendations can be found in Appendix F.

Table 3-14. Summary of Findings and Recommendations for the Residential EE Program

Solution	Finding	Recommendation	EDC Status
LAH (Appliances and HVAC)	Savings calculations for five measures were not consistent with the TRM algorithms or the SWE-approved interim measure protocols (IMPs), resulting in discrepancies between reported and verified savings. These discrepancies resulted in the overall energy savings reduction of 245 kWh, which is ~4% decrease for the LAH-non-Lighting Solution. (Measures: ASHPs, ENERGY STAR air purifiers, ENERGY STAR clothes washers, ENERGY STAR dehumidifiers, and ENERGY STAR refrigerators.)	Adjust data collection or savings calculation methodologies to align with TRM algorithms or SWE-approved IMPs as described in Table F-3.	Will Implement. Need to adjust calculations and work with evaluator to streamline the IMP process to account for the latest updates.
LAH (Appliances and HVAC)	Respondents most frequently learned about the PECO Marketplace through a PECO bill insert or letter (32%), the PECO website (30%), or a PECO email (19%).	To increase PECO Marketplace sales, provide Marketplace information, such as follow-up emails and leave-behind cards, to participants in other PECO programs, which could increase Marketplace sales.	Will Implement. PECO is closely monitoring the Marketplace budget in the last program year. Will develop other Marketplace ideas in the next Phase IV.
LAH (Appliances and HVAC)	Customers reported internet searches (56%) and the PECO website (51%) as the top sources of information on ways to save energy.	To increase PECO Marketplace sales, increase internet and social media marketing, as well as paid search promotions.	Will Implement. PECO is closely monitoring the Marketplace budget in the last program year. Will develop other Marketplace ideas in the next Phase IV.
LAH (Appliances and HVAC)	Project file documentation did not align with online verification survey results for ductless mini-split heat pumps, high efficiency fans, and ENERGY STAR refrigerators.	Revisit CSP data collection requirements periodically to confirm they are complete and aligned with program requirements.	Will Implement. PECO will improve the CSP data collection requirements going into Phase IV to ensure completeness and that they are aligned with program requirements.
LAH (Lighting)	Assumption discrepancies were identified with baseline wattages, efficient wattages, and reported stock keeping unit (SKU) parameters.	Confirm LED bulb savings estimates are consistent with TRM assumptions.	Implemented and confirmed LED savings were consistent with TRM assumptions.
Appliance Recycling	The largest contributor to the realization rate of 1.07 came from applying deemed values where reported measure characteristics are available.	Update PY12 reported savings to either use actual appliance specifications or findings (average savings value) from the most recent evaluation. The Phase IV TRM removes nearly all deemed values, so PECO could establish this in PY12 to pilot the Phase IV reporting process.	Under Consideration. PECO will look into the reported savings for PY12 to possibly pilot in the Phase IV reporting process.

Solution	Finding	Recommendation	EDC Status
Whole Home	Savings calculations for six measures were not consistent with TRM algorithms, resulting in discrepancies increasing reported savings by 13,337 kWh, or 0.22%. (Measures: residential air sealing, crawl space insulation, floor insulation, knee wall insulation, duct insulation, rim joist insulation).	Adjust data collection or savings calculation methodologies to align with TRM algorithms as described in Table F-9.	In Process. PECO has implemented the following measures updates: • Residential Air Sealing – CLEAResult recalculated with deemed values for Single Family Attached (SFA) cases • Crawl Space Insulation – CLEAResult corrected the Rearth value reported • Knee Wall Insulation – CLEAResult made changes to calculate Knee Wall Insulation using the calculations as the Ceiling/ Attic and Wall measure.
New Construction	Data discrepancies were identified in the project file documentation: • Lighting forms and REM/Rate models: In two of the sampled sites, the REM/Rate model indicated that LEDs were present, but the lighting forms only specified compact fluorescent lamps (CFLs). • The most updated lighting form was not consistently used. For some projects, model numbers for only a subset of the appliances was.	Revisit CSP data collection requirements and documentation periodically to confirm they are complete and aligned with program requirements.	Under Consideration. PSD has revised and will continue to periodically review the data collection requirements and documentation from the Builders/Raters to confirm they are complete and aligned with program requirements.
Behavioral	Savings for the randomized control trial (RCT) waves prior to the dual participation adjustment are nearly identical to those reported by Oracle. Guidehouse-measured savings for the RCT waves totaled 71,746 MWh, while Oracle reported 71,728 MWh, a difference of less than a tenth of a percent. Final verified savings differ because of dual participation and the addition of the AC Saver wave savings.	If PECO desires a more accurate preliminary reported savings value, apply a small discount factor to the reported savings to account for dual participation. However, because the AC Saver wave is not an RCT, savings are not reported for this wave.	Acknowledged. PECO is not implementing this recommendation at this time.

Solution	Finding	Recommendation	EDC Status
Multifamily Targeted	Reported lighting savings are based on the hours of use (HOU) and coincidence factors (CFs) deemed for the "Overall Household or unknown room," and not on the actual installation location of the lighting measures.	To align reported and verified savings results, consider recording installed room locations or bin installation locations into similar groups (e.g., interior high use, interior low use, exterior).	Under Consideration. PECO will consider a variety of data collection methods to ensure accuracy and validity of gross reported and ultimately verified savings.

Source: Guidehouse analysis

3.2 Residential Low-Income EE Program

The Residential Low-Income EE Program offers an array of participant solutions and activities to achieve PECO's goal of helping income-eligible customers save energy. The Low-Income EE Program targets PECO residential electric customers with a household income of less than or equal to 150% of the FPL to meet the 5.5% low-income energy saving carveout requirement. Additionally, PECO targets Customer Assistance Program (CAP) customers with high usage and incomes of 0%-50% of the FPL per the February 17, 2016 Joint Petition for Settlement[40] agreement.

In PY11, the Low-Income EE Program consisted of the Whole Home Solution. Savings are achieved through a range of delivery mechanisms and methods including product giveaways, in-home audits, and direct install measures. The Low-Income EE Program discontinued a Lighting Solution in PY9 that offered upstream incentives (retailer buy-downs). PECO relies on two CSPs to deliver the program savings: CMC Energy and ARCA Recycling, Inc.

PECO's Low-Income EE Program refers eligible customers to the Residential EE Program's Appliance Recycling Solution when appropriate. Appliance Recycling Solution savings from referred customers who are on the CAP rate and at or below 150% of the FPL are applied toward the low-income carveout and reported through the Whole Home Solution.

PECO's income-qualified customers are also eligible to benefit from the other solutions offered by the Residential EE Program. However, low-income participation in those solutions and the associated savings are reported through the Residential EE Program; they are not applied to the low-income carveout. Rather, only savings from the programs and solutions in this section specifically targeting income-eligible customers count toward the carveout.

3.2.1 Participation and Reported Savings by Customer Segment

This section provides the Low-Income EE Program results for PY11, including participation, energy and demand savings, and incentive costs. Table 3-15 presents the participation counts and incentive payments for the Low-Income EE Program in PY11 by customer segment.

Table 3-15. Low-Income EE Program Summary by Customer Segment

Parameter	Residential	Small C&I	Large C&I
PYTD No. of Participants	14,495	32	9
PYRTD MWh/yr	30,474	3,084	3,706
PYRTD MW	3.26	0.52	0.56
PY11 Incentives ($1,000)	$169.65	$0.00	$0.00

Source: Guidehouse analysis

[40] Petition of PECO Energy Company for approval of its Act 129 Phase III Energy Efficiency and Conservation Plan, Docket No. M-2015-2515691.

3.2.2 Gross Impact Evaluation

The Low-Income EE Program's gross impact evaluation activities started with a review of program tracking data to verify proper application of TRM algorithms in reported savings values. The evaluation team completed these reviews for the full population of implemented PY11 Low-Income EE Program measures. Next, the team identified appropriate evaluation activities based on the nature of the participants, implementation strategies, and the level of information accompanying the reported savings. The primary goal of the evaluation activities was to verify the implementation of a given measure occurred.

In consultation with the SWE, Guidehouse adjusted some evaluation activities in response to health concerns related to the pandemic. Phone survey verifications (which were also conducted in PY10) replaced onsite verifications for the Low-Income Whole Home Solution.

Guidehouse then drew samples for these gross impact evaluation activities. The team developed and sought approval for representative samples that complied with the Phase III Evaluation Framework, the TRM, and industry standards, as well as those that helped PECO meet the SWE and PA PUC requirements.

The Whole Home Solution was verified through engineering file reviews of program applications and invoices and phone verifications for projects with direct installation measures only.

Table 3-16 provides the sampling frame for the gross impact evaluation of the Low-Income EE Program in PY11.

Table 3-16. Low-Income EE Program Gross Impact Sample Design for PY11

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
Whole Home	Large Single-Family (SF)	875	9	8	Engineering file reviews and phone verification
	Medium SF	1,529	9	8	Engineering file reviews and phone verification
	Small SF	3,034	9	9	Engineering file reviews and phone verification
	Very Small SF	900	0	0	N/A
	Multifamily	69	8	7	Engineering file reviews and phone verification
	Refrigerator Retirement	1,905	0	41	Online survey verification
	Freezer Retirement	267	0	6	Online survey verification
	Room AC Retirement	196	0	4	Online survey verification
Total Program	**All**	**8,775**	**35**	**83**	

Source: Guidehouse analysis

Table 3-17 summarizes the reported and verified energy (MWh/yr) savings results, along with the CV and relative precision for each stratum sampled for the Low-Income EE Program in PY11.

Table 3-17. Low-Income EE Program Gross Results for Energy

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Whole Home	Large SF	2,748	2,223	0.81	0.13	7.6%
	Medium SF	3,318	2,856	0.86	0.29	16.6%
	Small SF	3,770	3,626	0.96	0.12	6.1%
	Very Small SF	327	315	0.96	0.00	100.0%
	Multifamily	6,885	6,447	0.94	0.01	0.3%
	Giveaways	18,099	18,099	1.00	0.00	50.0%
	Refrigerator Retirement	1,855	2,089	1.13	0.10	2.3%
	Freezer Retirement	226	197	0.87	0.00	0.0%
	Room AC Retirement	37	37	1.00	0.00	0.0%
	Solution Total	**37,265**	**35,888**	**0.96**	**1.60**	**25.5%**
Total Program	**All**	**37,265**	**35,888**	**0.96**	**1.60**	**29.2% [90% CI]**

Source: Guidehouse analysis

Table 3-18 summarizes the reported and verified demand (MW) savings results, along with the CV and relative precision for each stratum sampled for the Low-Income EE Program in PY11.

Table 3-18. Low-Income EE Program Gross Results for Demand

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Whole Home	Large SF	0.30	0.24	0.80	0.13	7.4%
	Medium SF	0.36	0.30	0.85	0.31	17.5%
	Small SF	0.41	0.39	0.96	0.12	6.1%
	Very Small SF	0.04	0.03	0.96	0.00	100.0%
	Multifamily	1.09	1.04	0.95	0.00	0.2%
	Giveaways	1.86	1.86	1.00	0.00	50.0%
	Refrigerator Retirement	0.21	0.23	1.09	0.10	2.3%
	Freezer Retirement	0.03	0.02	0.86	0.00	0.0%
	Room AC Retirement	0.06	0.06	1.00	0.00	0.0%
	Solution Total	**4.35**	**4.18**	**0.96**	**1.41**	**22.5%**
Total Program	**All**	**4.35**	**4.18**	**0.96**	**1.41**	**25.7% [90% CI]**

Source: Guidehouse analysis

The overall evaluation resulted in a reduction to reported savings.

3.2.3 Net Impact Evaluation

Net impacts were not assessed for the Low-Income EE Program in PY11.

3.2.3.1 High Impact Measure Research

HIM measures were not assessed for the Low-Income EE Program in PY11.

3.2.4 Process Evaluation

As described in the Phase III Evaluation Plan[41] updated for PY11 and approved by the SWE, Guidehouse did not complete any in-depth process evaluation activities for the Low-Income EE Program Whole Home Solution. Instead, the team interviewed the PECO program manager and CSP staff to identify significant implementation changes to inform the impact evaluation activities. No significant changes were found. The team carried out in-depth process evaluations in PY8 and PY9.

3.2.4.1 Key Findings from Process Evaluation

No significant process findings were identified for the Low-Income EE Program in PY11.

3.2.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-19. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-19. Summary of Low-Income EE Program Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$6,337	$18,668
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$170	-$290
	Cost Subtotal	**$6,167**	**$18,378**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$59	$252
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	-$182	$1,392
	Marketing (CSP Costs) [4]	$0	$0

[41] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$2,349	$9,614
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$2,226**	**$11,257**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$8,393**	**$29,635**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$8,302	$20,637
	Lifetime Electric Capacity Benefits	$2,396	$6,085
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$8,515	$14,208
	Benefits Total	**$19,213**	**$40,931**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**2.29**	**1.38**

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

Table 3-20 presents program financials and cost-effectiveness on a net savings basis.

Table 3-20. Summary of Low-Income EE Program Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$6,337	$18,668
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$170	-$290
	Cost Subtotal	**$6,167**	**$18,378**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$59	$252

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	-$182	$1,392
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$2,349	$9,614
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$2,226**	**$11,257**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$8,393**	**$29,635**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$8,302	$20,637
	Lifetime Electric Capacity Benefits	$2,396	$6,085
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$8,515	$14,208
	Benefits Total	**$19,213**	**$40,931**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**2.29**	**1.38**

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

3.2.6 Status of Recommendations

The impact and process evaluation activities in PY11 led to findings and recommendations from Guidehouse to PECO. Table 3-21 presents the solution-level finding and recommendation for the Low-Income EE Program, along with a summary of how PECO plans to address the recommendation in program delivery. Additional details on the solution-level analysis activities that led to this finding and recommendation can be found in Appendix G.

Table 3-21. Summary of Findings and Recommendations for the Residential Low-Income EE Program

Solution	Finding	Recommendation	EDC Status
Whole Home	Savings calculations for six measures were not consistent with TRM algorithms, resulting in discrepancies reducing reported savings by 2,673,269 kWh or 7.6%. (Measures: low flow aerators, low flow showerheads, freezer replacement, refrigerator replacement, floor insulation, packaged terminal heat pumps.)	Adjust data collection or savings calculation methodologies to align with TRM algorithms as described in Table G-1.	In Process. CMC has adjusted internal calculations to align with approved TRM algorithms.

Source: Guidehouse analysis

3.3 Small C&I EE Program

The Small C&I EE Program offers a crosscutting array of opportunities to assist small C&I customers in reducing their energy consumption and costs. The program encompasses a variety of energy solutions and measures to achieve this goal. The Small C&I EE Program is made up of four solutions and two targeted market segments, listed with the implementers below:

- Equipment and Systems Solution – ICF
- New Construction Solution – ICF
- Whole Building Solution – SmartWatt
- Behavioral Solution – Not implemented in PY11
- Data Centers Targeted Market Segment – ICF
- Multifamily Targeted Market Segment – Franklin

Common measures within the Small C&I EE Program include efficient lighting equipment, lighting controls, HVAC equipment, variable frequency drives (VFDs), refrigeration, and building automation systems, among others. Several solutions cut across multiple programs (i.e., Small C&I EE and Large C&I EE), and participation rules vary according to program rules.

The Behavioral Solution was not implemented in PY11 and had no corresponding evaluation activities. Guidehouse also did not conduct any evaluation activities for the Data Centers Targeted Market Segment in PY11 because there was no participation. The pandemic affected the gross impact evaluation activities for the three remaining solutions and Multifamily Targeted Market Segment. Pandemic-related adjustments to evaluation activities are described in Section 3.3.2.

3.3.1 Participation and Reported Savings by Customer Segment

This section provides the Small C&I EE Program results for PY11, including participation, energy and demand savings, and incentive costs. Table 3-22 presents the participation counts and incentive payments for the Small C&I EE Program in PY11 by customer segment.

Table 3-22. Small C&I EE Program Summary by Customer Segment

Parameter	Residential	Small C&I	Large C&I
PYTD No. of Participants	0	3,444	0
PYRTD MWh/yr	0	66,669	0
PYRTD MW	0.00	10.65	0.00
PY11 Incentives ($1,000)	$0	$4,077	$0

Source: Guidehouse analysis

3.3.2 Gross Impact Evaluation

Guidehouse conducted the gross impact evaluation for the Small C&I EE Program following the general approach outlined in its Evaluation Plan for PY11.[42] In cases where the pandemic prevented the planned evaluation activities (in particular, onsite visits and metering), the evaluation team followed the guidance and recommendations provided by the SWE in its June 3, 2020 memo[43] to the EDCs and their evaluation contractors. The team further consulted with the SWE on a case-by-case basis for large or complex projects for which the uniform guidance from the memo did not apply. In all cases, Guidehouse adhered to the SWE's guidance for pandemic-related changes to the evaluation activities.

In PY11, the Small C&I EE Program gross impact evaluation consisted of desk reviews, phone verifications, virtual verifications,[44] onsite verifications, and onsite metering for a sample of projects. Summaries of verification activities for each solution and targeted market segment follow:

- **Equipment and Systems Solution:** The evaluation team conducted ex post verification activities for a sample of 30 projects in the Small C&I Equipment and Systems Solution in PY11, which meets the target set in Guidehouse's sampling design memo.[45]
- **New Construction Solution:** The team conducted ex post verification activities for a sample of 13 projects in the Small C&I New Construction Solution in PY11, which exceeds the target set in the sampling design memo.
- **Whole Building Solution:** The evaluation team conducted ex post verification for a sample of 14 projects in the Whole Building Solution in PY11, which exceeds the target set in the sampling design memo.[46]
- **Data Centers Targeted Market Segment:** There was no participation in the Data Centers Targeted Market Segment in PY11.
- **Multifamily Targeted Market Segment:** The evaluation team conducted engineering file reviews for a sample of 28 projects in the Multifamily Targeted Market Segment as outlined in the revised sample design memo.[47] The pandemic prevented any onsite verification work for this segment, so the team applied PY10 realization rates to the PY11 reported savings, after adjusting for the engineering file review findings.

Table 3-23 provides the sampling frame for the gross impact evaluation of the Small C&I EE Program in PY11.

[42] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

[43] SWE. *PY11 EM&V and the Coronavirus Outbreak.* Dated June 3, 2020.

[44] Virtual verification included virtual tours and interviews using videoconferencing software as allowed by the SWE according to its June 3, 2020 memo.

[45] PECO. *PY11 Small and Large C&I EE Impact Sampling Design.* Dated March 23, 2020.

[46] PECO. *Revisions to PY11 Evaluation Plan for PECO's Small C&I Whole Building Solution.* Dated May 1, 2020.

[47] PECO. *PECO: PY11 Multifamily Targeted Market Segment Sample Revision.* Dated July 17, 2020.

Table 3-23. Small C&I EE Program Gross Impact Sample Design for PY11

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
Equipment and Systems	Large	66	6	6	PY11 engineering file reviews; PY11 onsite and phone verification
	Medium	168	6	6	PY11 engineering file reviews; PY11 onsite and phone verification
	Small	541	6	6	PY11 engineering file reviews; PY11 phone verification
	Extra Small	276	0	0	N/A
	Midstream Large	86	6	6	PY11 engineering file reviews; PY11 onsite and phone verification
	Midstream Small	1,274	6	6	PY11 engineering file reviews; PY11 phone verification
	Midstream Very Small	605	0	0	N/A
	Solution Total	**3,016**	**30**	**30**	
New Construction	Very Large	3	5	3	PY11 engineering file reviews; PY11 onsite verification
	Large	16	3	5	PY11 engineering file reviews; PY11 onsite and phone verification
	Small	47	4	5	PY11 engineering file reviews; PY11 phone verification
	Very Small	27	0	0	
	Solution Total	**93**	**12**	**13**	
Whole Building	Medium	33	5	5	PY11 onsite and phone verification
	Small	172	7	9	PY11 phone and online survey *verification*
	Very Small	37	0	0	N/A
	Solution Total	**242**	**12**	**14**	
Multifamily Targeted[1]	Small	66	6	N/A[1]	PY11 engineering file reviews; PY10 onsite verification results
	Multisector	25	5	N/A[1]	PY11 engineering file reviews; PY10 onsite verification results
	Solution Total	**91**	**11**	**N/A[1]**	
Total Program	**All**	**3,442**	**60**	**57**	

[1] Site visits were not conducted due to the pandemic.

Source: Guidehouse analysis

Table 3-24 summarizes the reported and verified energy savings results, along with the CV and relative precision for each stratum sampled for the Small C&I EE Program in PY11.

Table 3-24. Small C&I EE Program Gross Results for Energy

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems	Large	13,679	13,920	1.02	0.18	12.6%
	Medium	13,149	14,020	1.07	0.15	10.2%
	Small	11,671	12,163	1.04	0.41	28.1%
	Extra Small	755	787	1.04	0.00	100.0%
	Midstream Large	4,040	4,974	1.23	0.46	31.9%
	Midstream Small	5,873	12,229	2.08	0.61	42.4%
	Midstream Very Small	182	379	2.08	0.00	100.0%
	Solution Total	49,349	58,472	1.18	0.38	10.2%
New Construction	Very Large	941	959	1.02	0.00	0.0%
	Large	1,796	2,001	1.11	0.47	37.2%
	Small	1,634	1,634	1.00	0.00	0.0%
	Very Small	143	143	1.00	0.00	100.0%
	Solution Total	4,514	4,737	1.05	0.33	14.0%
Whole Building	Medium	4,490	4,070	0.91	0.11	8.7%
	Small	4,590	4,396	0.96	0.08	4.2%
	Very Small	169	162	0.96	0.00	100.0%
	Solution Total	**9,249**	**8,628**	**0.93**	**0.11**	**4.5%**
Multifamily Targeted	Small	3,152	3,105	0.99	0.10	5.6%
	Multisector	406	387	0.95	0.15	11.9%
	Solution Total	**3,558**	**3,492**	**0.98**	**0.11**	**4.8%**
Total Program	**All**	**66,669**	**75,329**	**1.13**	**0.45**	**9.0% [90% CI]**

Source: Guidehouse analysis

Table 3-25 summarizes the reported and verified demand savings results, along with the CV and relative precision for each stratum sampled for the Small C&I EE Program in PY11.

Table 3-25. Small C&I EE Program Gross Results for Demand

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems	Large	1.58	1.71	1.08	0.47	32.7%
	Medium	1.98	2.24	1.13	0.26	18.1%
	Small	2.20	3.37	1.53	0.66	46.0%
	Extra Small	0.14	0.22	1.53	0.00	100.0%
	Midstream Large	0.60	0.94	1.56	0.22	15.6%
	Midstream Small	0.88	1.70	1.94	0.28	19.1%
	Midstream Very Small	0.03	0.07	1.94	0.00	100.0%
	Solution Total	**7.42**	**10.25**	**1.38**	**0.55**	**14.9%**
New Construction	Very Large	0.23	0.22	0.94	0.00	0.0%
	Large	0.34	0.32	0.92	0.19	14.8%
	Small	0.29	0.29	1.00	0.00	0.0%
	Very Small	0.03	0.03	1.00	0.00	100.0%
	Solution Total	**0.89**	**0.85**	**0.95**	**0.14**	**6.0%**
Whole Building	Medium	0.92	0.90	0.98	0.05	3.8%
	Small	0.98	1.03	1.05	0.09	4.8%
	Very Small	0.04	0.05	1.05	0.00	100.0%
	Solution Total	**1.95**	**1.98**	**1.02**	**0.09**	**3.7%**
Multifamily Targeted	Small	0.33	0.32	0.99	0.08	4.8%
	Multisector	0.06	0.06	1.12	0.16	13.1%
	Solution Total	**0.38**	**0.39**	**1.01**	**0.10**	**4.3%**
Total Program	**All**	**10.65**	**13.46**	**1.26**	**0.64**	**12.8% [90% CI]**

Source: Guidehouse analysis

3.3.3 Net Impact Evaluation

As described in the Phase III Evaluation Plan,[48] Guidehouse applied the PY10 NTG values to the Multifamily Targeted Market Segment and conducted NTG activity in PY11 for the Equipment and Systems, New Construction, and Whole Building Solutions.

The Small and Large C&I EE Programs net impact evaluation used several methods to estimate free ridership, spillover, and NTG ratios for each solution. Guidehouse relied on consistent, crosscutting approaches as well as activities tailored to certain solutions' characteristics. The primary objective of the net savings analysis was to determine the program's net effect on customer electricity usage. The evaluation team derived net program impacts by estimating an

[48] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

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

Free ridership is defined as those participants who would have implemented a measure or purchased equipment anyway, without program support or a rebate. The questions determining free ridership focus on the influence of key program interventions and customer perception of what they would most likely have done in the absence of the program. Interventions vary by solution but can include discounted prices, program information regarding efficient products, and placement of program-discounted products in stores.

Spillover is defined as those participants who were influenced by the program to purchase and install additional energy efficient equipment that saves electricity without a rebate or other program support. Guidehouse analyzed participant responses to a battery of spillover questions. The intent of these questions was to identify what types and amounts of equipment customers purchased and installed on their own to inform a quantitative estimate of program spillover within the overall NTG calculation.

As described in the Phase III Evaluation Plan,[49] the evaluation team applied the PY10 NTG values to the Multifamily Targeted Market Segment. In PY11, Guidehouse surveyed PECO participants in the Equipment and Systems, New Construction, and Whole Building Solutions through online and telephone surveys to gather information about free ridership and spillover. The team developed survey instruments consistent with the Phase III Evaluation Framework's guidance on net impact evaluation techniques[50] and guidance from the Uniform Methods Project on estimating net savings.[51] Survey instruments also captured feedback about customer experiences from participants to inform the process evaluation.

Table 3-26 provides the sampling frame for the net impact evaluation of the Small C&I EE Programs in PY11.

[49] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

[50] PA PUC. "Section 3.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[51] The Uniform Methods Project. *Estimating Net Savings: Common Practices.* National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy14osti/62678.pdf

Table 3-26. Small C&I EE Programs Net Impact Sample Design for PY11

Solution	Stratum Name	Population Size[1]	Adjusted Population Size[2]	Targeted Sample Size	Achieved Sample Size	Response Rate	Verification Method
Equipment and Systems	High Impact	63	30	5	4	13%	Online and phone survey
	Medium Impact	149	68	10	11	16%	
	Low and Very Low Impact	608	231	15	19	8%	
	Solution Total	**820**	**329**	**30**	**34**	**10%**	
New Construction	All Projects	64	40	9	10	25%	Phone survey
	Solution Total	**64**	**40**	**9**	**10**	**25%**	
Whole Building	Medium Impact	33	27	8	7	26%	Online survey
	Low Impact	160	106	20	26	25%	Online survey
	Very Low Impact	35	27	5	6	22%	Online survey
	Solution Total	**228**	**160**	**33**	**39**	**23%**	
Total Program	**All**	**1,112**	**529**	**72**	**83**	**16%**	

[1] Population size represents unique decision makers.
[2] This count excludes customer IDs with duplicate, missing, or invalid customer phone numbers or emails. For emails or phone numbers associated with multiple customer IDs, the highest savings customer ID was selected.

Source: Guidehouse analysis

Table 3-27 summarizes the reported and verified energy savings results, the calculated NTG results, and the CV and relative precision for each stratum sampled for the Small C&I EE Program in PY11.

Table 3-27. Small C&I EE Programs Net Energy Savings Impact Evaluation Results for PY11

Solution Name	Stratum Name	Verified Gross Energy Savings (MWh/yr)	Verified Net Energy Savings (MWh/yr)	Free Ridership Rate	Spillover Rate	NTG Ratio[1]	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems[2]	Large	13,920	11,878	0.62	0.47	0.85	0.72	69.0%
	Medium	14,020	9,544	0.32	0.00	0.68	0.52	24.6%
	Small	12,163	9,381	0.26	0.03	0.77	0.39	13.5%
	Extra Small	787	607	0.26	0.03	0.77	0.39	13.5%
	Midstream Large	4,974	4,178	0.16	0.00	0.84	N/A	N/A
	Midstream Small	12,229	9,416	0.23	0.00	0.77	N/A	N/A
	Midstream Very Small	379	292	0.23	0.00	0.77	N/A	N/A
	Solution Total	**58,472**	**45,297**	**0.34**	**0.12**	**0.77**	**0.68**	**17.3%**
New Construction	Very Large	959	320	0.67	0.00	0.33	0.66	32.7%
	Large	2,001	668	0.67	0.00	0.33		
	Small	1,634	546	0.67	0.00	0.33		
	Very Small	143	48	0.67	0.00	0.33		
	Solution Total	**4,737**	**1,581**	**0.67**	**0.00**	**0.33**	**0.66**	**32.7%**
Whole Building	Medium	4,070	3,469	0.20	0.05	0.85	0.17	10.5%
	Small	4,396	4,068	0.08	0.00	0.93	0.15	4.4%
	Very Small	162	201	0.04	0.28	1.24	0.38	26.2%
	Solution Total	**8,628**	**7,739**	**0.13**	**0.03**	**0.90**	**0.21**	**4.9%**
Multifamily Targeted	Small	3,105	2,510	0.19	0.00	0.81	0.30	17.2%
	Multisector	387	313	0.19	0.00	0.81		
	Solution Total	**3,492**	**2,822**	**0.19**	**0.00**	**0.81**	**0.30**	**17.2%**
Total Program	**All**	**75,329**	**57,439**	**0.33**	**0.10**	**0.76**	**0.85**	**14.7% [90% CI]**

[1] Guidehouse conducted NTG research in PY11 for the Small C&I Equipment and Systems, New Construction, and Whole Building Solutions. For the Small C&I Multifamily Targeted Market Segment, Guidehouse applied stratum-level NTG results from PY10.

[2] For the Midstream Large, Small, and Very Small strata of the Equipment and Systems Solution, Guidehouse applied the NTG values listed in the PY10 Annual Report.

Source: Guidehouse analysis

3.3.3.1 High Impact Measure Research

HIMs represent measure categories or technologies of high importance in the PECO portfolio. In Phase III, the SWE suggested EDCs oversample HIMs to help program planners make decisions concerning those measures for downstream programs only.[52] EDCs were to identify three to five measures for study within each program year based on energy impact, level of uncertainty, prospective value, funding, or other parameters.

Guidehouse reviewed program- and solution-level savings, energy impact, and overall value to PECO to identify the HIMs for the C&I solutions for PY11. The results indicated that LED lighting upgrades, lighting power density projects, and the removal of unnecessary fixtures (delamping) held the highest impact for the Small C&I EE Program. Table 3-28 shows the results of the HIM NTG analysis in PY11.

Table 3-28. Small C&I EE Program HIM NTG Summary

HIM	Solution	Free Ridership Rate	Spillover Rate	NTG Ratio
Small C&I LED lighting	Small C&I Equipment and Systems	0.40	0.32	0.92
Lighting power density	Small C&I New Construction	0.63	0.00	0.37
Delamping	Small C&I Equipment and Systems	0.47	0.00	0.53

Source: Guidehouse analysis

LED lighting free ridership aligns with the results from PY9; however, the reported spillover is up significantly from the prior NTG activities as more customers reported the C&I solutions influenced them to install additional EE measures without an incentive. One site reported installing an additional 1,000 LED exterior area streetlights at one of its other facilities without applying for an incentive because of the savings seen at its current facility.

3.3.4 Process Evaluation

Guidehouse conducted a detailed review of program materials including program databases, tracking systems, and other documents across all Small C&I EE Solutions. PECO and CSP staff also provided essential information about the program design and how the program experience on the ground in PY11 compares with the EE&C Plan.[53] The evaluation team conducted in-depth interviews with PECO and CSP staff at the beginning of the PY11 evaluation and communicated with staff on an ongoing basis. The team developed interview instruments to include questions of interest to the evaluation and to allow for free-flowing conversations to obtain candid feedback from the interviewees.

In addition to conducting interviews with PECO and CSP staff, Guidehouse deployed customer experience surveys to Small and Large C&I EE Program participants. Participants in all solutions—except the Data Centers and Multifamily Targeted Market Segments—received online or telephone surveys to collect their feedback on a series of questions designed to gauge

[52] PA PUC. "Section 3.4.1.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[53] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

customer satisfaction, sources of awareness, firmographic details, and to inform the NTG analysis. Guidehouse developed all online survey instruments according to SWE requirements, and the SWE reviewed and approved each survey instrument in advance of fielding. The evaluation team defined the survey population for each solution's participants based on the program tracking databases provided by PECO. Guidehouse developed a sample sufficient to provide 85/15 confidence/precision for the survey results.

Table 3-29 summarizes the process evaluation activities conducted for each Small C&I EE Program solution.

Table 3-29. Small C&I EE Process Evaluation Activities

Solution	PECO and CSP Staff Interviews	Program Tracking Data Review	Participant Survey
Equipment and Systems	√	√	Online or telephone survey: Guidehouse used surveys to assess customer awareness of the incentive offerings, their satisfaction with the application, the level of effort required to receive their incentive, communication with PECO staff, and the program overall.
New Construction	√	√	Telephone survey: Guidehouse used surveys to assess customer awareness of the incentive offerings, their satisfaction with the application, the level of effort required to receive their incentive, communication with PECO staff, and the program overall.
Data Centers Targeted	√	√	
Whole Building	√	√	Online survey: Guidehouse used surveys to assess customer awareness of the incentive offerings, their satisfaction with the application, the level of effort required to receive their incentive, communication with PECO staff, and the program overall.
Multifamily Targeted	√	√	

Source: Guidehouse analysis

Table 3-30 provides the customer experience survey sample details for each Small C&I EE Solution.

Table 3-30. Small C&I EE Program Customer Experience Survey Sample Design for PY11

Solution	Stratum	Population Size[1]	Adjusted Population Size[2]	Target Sample Size	Achieved Sample Size
Equipment and Systems	High Impact	63	30	5	4
	Medium Impact	149	68	10	11
	Low Impact and Very Low Impact	608	231	15	19
	Solution Total	**820**	**329**	**30**	**34**
New Construction	All Projects	64	40	9	10
	Solution Total	**64**	**40**	**9**	**10**

Solution	Stratum	Population Size[1]	Adjusted Population Size[2]	Target Sample Size	Achieved Sample Size
Whole Building	Medium Impact	33	27	5	6
	Low Impact	160	106	20	26
	Very Low Impact	35	27	8	7
	Solution Total	**228**	**160**	**33**	**39**
Total Program	**All**	**1,112**	**529**	**72**	**83**

[1] Population size represents unique decision makers.

[2] This count excludes customer IDs with duplicate, missing, or invalid customer phone numbers or emails. For emails or phone numbers associated with multiple customer IDs, the highest savings customer ID was selected.

Source: Guidehouse analysis

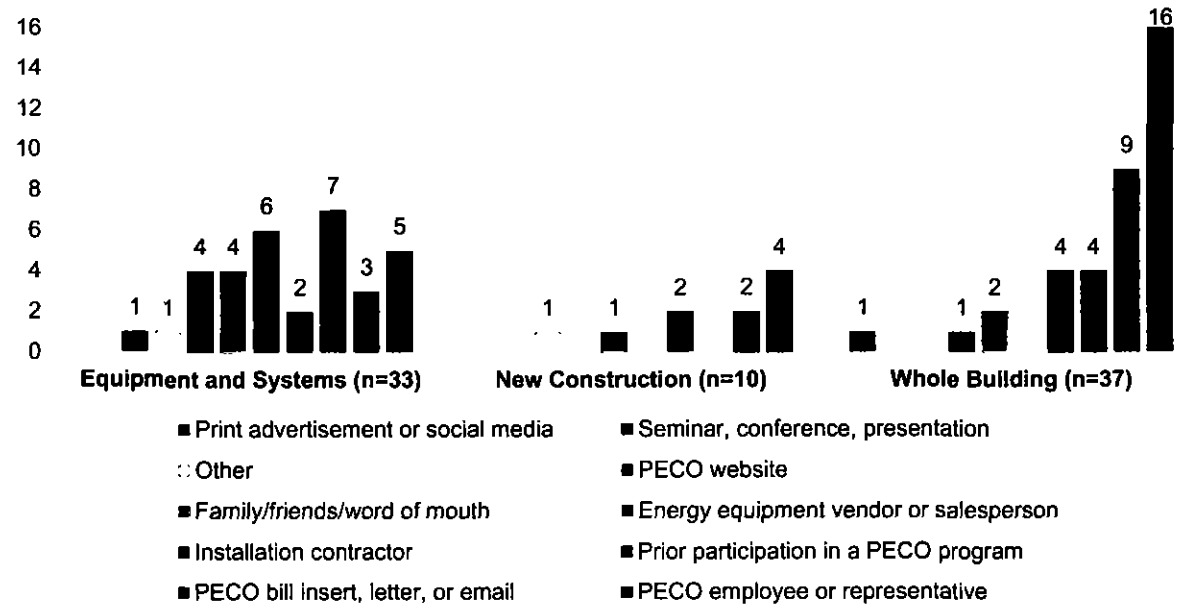
3.3.4.1 Key Findings from Process Evaluation

Findings for the Small C&I EE Program are detailed here. Separate Large C&I EE Program insights are provided in Section 3.4.4, as applicable. For all solutions, the evaluation team interviewed the PECO program manager and CSP staff to identify significant implementation changes to inform the evaluation activities. Based on these interviews, the evaluation team did not document any significant changes to the Small C&I EE Program overall in PY11.

Additionally, Guidehouse surveyed Equipment and Systems, New Construction, and Whole Building participants to measure satisfaction and assess the PECO Small C&I EE Program's effectiveness at encouraging the participation needed to achieve energy savings and participation goals. This section includes results from cross-solution metrics including program awareness and satisfaction. Details on changes to specific solutions are detailed in Appendix H.

The evaluation team examined sources of awareness across all solutions in the Small C&I EE Program to understand effective channels for reaching this sector. PECO employees or representatives drove awareness for New Construction (40%) and Whole Building (32%) and contributed to awareness for Equipment and Systems (15%). Other leading sources of awareness across all solutions included PECO bill inserts, letters, or email, prior participation in a PECO program, installation contractors, EE vendors or salespersons, and word of mouth. Person-to-person outreach appears to be driving participation across the Small C&I EE Program.

Figure 3-5. Sources of Small C&I Awareness



Question: "How did you learn about the [Solution] program?"
The other category response for Equipment and Systems awareness included the Pennsylvania Act 129 outreach program and a third party for New Construction.

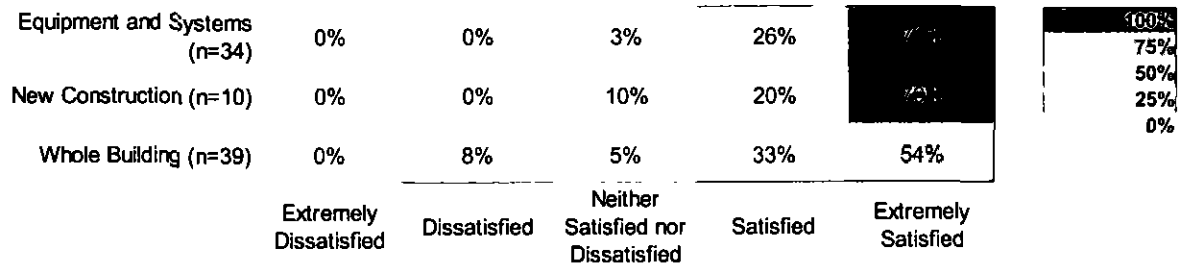
Responses displayed as frequencies instead of percentages due to the small number of respondents.

Source: Guidehouse analysis

For the Small C&I EE Program, satisfaction among program participants across solutions was high, with the majority of participants reporting they are either extremely satisfied or satisfied with the program overall, as Figure 3-6 shows. Equipment and Systems respondents reported the highest satisfaction, with 97% of respondents indicating they were satisfied or extremely satisfied, followed by New Construction (90%), and Whole Building (87%).

Average satisfaction across the three surveyed Small C&I Solutions was 4.5 on a 5-point scale, with 1 representing extremely dissatisfied and 5 representing extremely satisfied. Respondents reported high average satisfaction scores for each solution, with scores of 4.7 for Equipment and Systems, 4.6 for New Construction, and 4.3 for Whole Building.

Figure 3-6. Overall Satisfaction by Small C&I EE Solution



Question: "Using a scale of 1 to 5, with 1 meaning Extremely Dissatisfied and 5 meaning Extremely Satisfied, how would you rate your overall satisfaction with [Solution]?"

Source: Guidehouse analysis

Further details on these questions and customer responses asked in the survey can be found in Appendix H.

3.3.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-31. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-31. Summary of Small C&I EE Program Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$5,719	$12,916
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$20,883	$45,303
	Cost Subtotal	**$26,601**	**$58,220**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$196	$709
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$2,169	$6,079
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$3,201	$9,394
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$5,567**	**$16,181**
	Increased Fossil Fuel Consumption	$0	$0

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	**Cost Subtotal**	**$0**	**$0**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$32,168**	**$74,401**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$23,080	$51,627
	Lifetime Electric Capacity Benefits	$10,046	$20,318
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	-$963	-$153
	Benefits Total	**$32,164**	**$71,792**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**1.00**	**0.96**

[1] Includes direct install equipment costs.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

Table 3-32 presents program financials and cost-effectiveness on a net savings basis.

Table 3-32. Summary of Small C&I EE Program Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$5,719	$12,916
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$13,899	$29,736
	Cost Subtotal	**$19,618**	**$42,653**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$196	$709
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$2,169	$6,079
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Program Delivery (CSP Costs) [5]	$3,201	$9,394
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$5,567**	**$16,181**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0.
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$25,185**	**$58,834**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$17,441	$39,043
	Lifetime Electric Capacity Benefits	$7,651	$15,333
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	-$779	-$267
	Benefits Total	**$24,313**	**$54,109**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**0.97**	**0.92**

[1] Includes direct install equipment costs.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

3.3.6 Status of Recommendations

The impact and process evaluation activities in PY11 led to several findings and recommendations from Guidehouse to PECO. Table 3-33 presents those solution-level findings and recommendations along with a summary of how PECO plans to address the recommendations in program delivery. Additional details on the solution-level analysis activities that led to these findings and recommendations can be found in Appendix H.

Table 3-33. Summary of Findings and Recommendations for the Small C&I EE Program

Solution	Finding	Recommendation	EDC Status
Equipment and Systems, New Construction	Participants rated their satisfaction with the application process lower than other aspects of the program. PECO staff noted that the application process has been a barrier to participation for customers during Phase III due to the required amount of documentation. Customers noted they would like more information on the application requirements prior to starting the application process.	Direct customers to the online resources available to help them complete the application by highlighting these resources on the webpage and marketing materials.	Implemented. PECO has taken several steps to reduce the application burden for customers, including the addition of step-by-step instructions on submitting applications through the online portal. These instructions may help customers better understand what information they will need to gather before they get into more specific detail about the application requirements. PECO also offered bonus incentives to trade allies that completed applications on behalf of customers.
Equipment and Systems, New Construction	Guidehouse identified three projects where the implementer applied full motor savings for two or three separate motors operating as primary and backup (e.g., the motors were found to cycle on and off to share hours between them but never operated simultaneously).	For applications where multiple motors are operated in tandem or cycling on and off to share load, divide the TRM deemed HOU assumption used in the impact calculation by the number of motors that share the load of a single motor.	In Process. PECO implementation team has modified its process to more accurately represent the actual cycling/redundancy schemes for systems with multiple motors.
Equipment and Systems	Guidehouse found that approximately half of all projects categorized as kitchen exhaust fan VFDs were miscategorized by the CSP. Applications categorized as kitchen exhaust fans included sewage pumps, boiler supply fans, and dryer motors. The CSP used the kitchen exhaust fan application as a catchall bucket for measure applications not explicitly deemed in the TRM.	Use a custom calculation approach to determine parameters such as HOU, energy savings factors, and demand savings factors for VFD applications not deemed in the TRM.	In Process. PECO implementation team has modified its process to more accurately categorize VFD applications and will use a custom approach to determine the appropriate calculation parameters.

Source: Guidehouse analysis

3.4 Large C&I EE Program

The Large C&I EE Program offers a crosscutting array of opportunities to assist large C&I customers in reducing their energy consumption and costs. The program encompasses a variety of energy solutions and measures to achieve this goal. The Large C&I EE Program is made up of two solutions and two targeted market segments, listed with the implementers below:

- Equipment and Systems Solution – ICF
- New Construction Solution – ICF
- Data Centers Targeted Market Segment – ICF
- Multifamily Targeted Market Segment – Franklin

Common measures within the Large C&I EE Program include efficient lighting equipment, lighting controls, HVAC equipment, VFDs, refrigeration, and building automation systems, among others. These solutions cut across multiple programs (i.e., Small C&I EE and Large C&I EE), and participation rules vary according to program rules.

Guidehouse did not conduct any evaluation activities for the Data Centers Targeted Market Segment in PY11 because there was no participation. The pandemic affected the gross impact evaluation activities for the two remaining solutions and the Multifamily Targeted Market Segment. Pandemic-related adjustments to evaluation activities are described in Section 3.4.2.

3.4.1 Participation and Reported Savings by Customer Segment

This section provides the Large C&I EE Program results for PY11, including participation, energy and demand savings, and incentive costs. Table 3-34 presents the participation counts and incentive payments for the Large C&I EE Program in PY11 by customer segment.

Table 3-34. Large C&I EE Program Summary by Customer Segment

Parameter	Residential	Small C&I	Large C&I
PYTD No. of Participants	0	0	2,205
PYRTD MWh/yr	0	0	113,652
PYRTD MW	0.00	0.00	16.55
PY11 Incentives ($1,000)	$0	$0	$7,066

Source: Guidehouse analysis

3.4.2 Gross Impact Evaluation

Guidehouse conducted the gross impact evaluation for the Large C&I EE Program following the general approach outlined in its Evaluation Plan for PY11.[54] In cases where the pandemic prevented the planned evaluation activities (in particular, onsite visits and metering), the evaluation team followed the guidance and recommendations provided by the SWE in its June 3, 2020 memo[55] to the EDCs and their evaluation contractors. The team further consulted with

[54] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[55] SWE. *PY11 EM&V and the Coronavirus Outbreak.* Dated June 3, 2020. Dated June 3, 2020.

the SWE on a case-by-case basis for large or complex projects for which the uniform guidance from the memo did not apply. In all cases, Guidehouse adhered to the SWE's guidance for pandemic-related changes to the evaluation activities.

In PY11, the Large C&I EE Program gross impact evaluation consisted of desk reviews, phone verifications, virtual verifications,[56] onsite verifications, and onsite metering for a sample of projects. Summaries of verification activities for each solution and targeted market segment follow:

- **Equipment and Systems Solution:** The evaluation team conducted ex post verification activities for a sample of 38 projects in the Large C&I Equipment and Systems Solution in PY11, which exceeds the target set in the sample design memo.[57]
- **New Construction Solution:** The team conducted ex post verification activities for a sample of 14 projects in the Large C&I New Construction Solution in PY11, which exceeds the target set in the sample design memo.
- **Data Centers Targeted Market Segment:** There was no participation in the Data Centers Targeted Market Segment in PY11.
- **Multifamily Targeted Market Segment:** The evaluation team conducted engineering file reviews for a sample of 28 projects in the Multifamily Targeted Market Segment as outlined in the revised sample design memo.[58] The pandemic prevented any onsite verification work for this segment, so the team applied PY10 realization rates to the PY11 reported savings, after adjusting for the engineering file review findings.

Table 3-35 provides the sampling frame for the gross impact evaluation of the Large C&I EE Program in PY11.

Table 3-35. Large C&I EE Program Gross Impact Sample Design for PY11

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
Equipment and Systems	Very Large	5	5	5	PY11 engineering file reviews; PY11 onsite verification
	Large	20	6	5	PY11 engineering file reviews; PY11 onsite and phone verification
	Medium	57	6	5	PY11 engineering file reviews; PY11 onsite and phone verification
	Small	225	6	5	PY11 engineering file reviews; PY11 phone verification
	Extra Small	211	0	0	N/A
	Midstream Large	35	6	6	PY11 engineering file reviews; PY11 onsite and phone verification
	Midstream Small	989	6	6	PY11 engineering file reviews; PY11 phone verification

[56] Virtual verification included virtual tours and interviews using videoconferencing software as allowed by the SWE according to its June 3, 2020 memo.

[57] PECO. *PY11 Small and Large C&I EE Impact Sampling Design.* Dated March 23, 2020.

[58] PECO. *PY11 Multifamily Targeted Market Segment Sample Revision.* Dated July 17, 2020.

Solution	Stratum Name	Population Size	Targeted Sample Size	Achieved Sample Size	Verification Method
	Midstream Very Small	562	0	0	N/A
	RCx	18	0	3	PY11 engineering file reviews; PY11 onsite and phone verification
	Non-KFVSD[1]	4	0	3	PY11 engineering file reviews; PY11 phone verification
	Solution Total	**2,126**	**35**	**38**	
New Construction	Large	2	4	2	PY11 engineering file reviews; PY11 onsite and phone verification
	Small	23	4	12	PY11 engineering file reviews; PY11 onsite and phone verification
	Very Small	17	0	0	N/A
	Solution Total	**42**	**8**	**14**	
Multifamily Targeted	Large	30	5	N/A	PY11 engineering file reviews; PY10 onsite verification results
	Solution Total	**30**	**5**	**N/A**	
Total Program	**All**	**2,198**	**48**	**52**	

[1] Kitchen fan variable speed drives (KFVSD)

Source: Guidehouse analysis

Table 3-36 summarizes the reported and verified energy savings results, along with the CV and relative precision for each stratum sampled for the Large C&I EE Program in PY11.

Table 3-36. Large C&I EE Program Gross Results for Energy

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems	Very Large	16,039	14,457	0.90	0.00	0.0%
	Large	18,797	18,351	0.98	0.14	11.3%
	Medium	22,674	20,804	0.92	0.10	7.9%
	Small	22,330	21,895	0.98	0.04	3.3%
	Extra Small	1,896	1,859	0.98	0.00	100.0%
	Midstream Large	3,596	6,926	1.93	0.58	40.1%
	Midstream Small	5,130	9,692	1.89	0.87	60.3%
	Midstream Very Small	231	436	1.89	0.00	100.0%
	RCx	7,582	12,731	1.68	1.04	136.7%
	Non-KFVSD	470	94	0.20	0.34	44.4%
	Solution Total	**98,745**	**107,245**	**1.09**	**0.50**	**12.0%**
New Construction	Large	6,076	5,445	0.90	0.00	0.0%
	Small	4,738	6,459	1.36	0.58	25.8%
	Very Small	391	533	1.36	0.00	100.0%
	Solution Total	**11,206**	**12,437**	**1.11**	**0.34**	**14.0%**
Multifamily Targeted	Large	3,701	3,682	0.99	0.08	5.5%
	Solution Total	**3,701**	**3,682**	**0.99**	**0.08**	**5.5%**
Total Program	**All**	**113,652**	**123,363**	**1.09**	**0.55**	**12.0% [90% CI]**

Source: Guidehouse analysis

Table 3-37 summarizes the reported and verified demand savings results, along with the CV and relative precision for each stratum sampled for the Large C&I EE Program in PY11.

Table 3-37. Large C&I EE Program Gross Results for Demand

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems	Very Large	1.72	2.67	1.55	0.00	0.0%
	Large	2.97	3.05	1.03	0.18	14.1%
	Medium	3.59	3.51	0.98	0.03	2.3%
	Small	3.67	3.64	0.99	0.01	0.9%
	Extra Small	0.33	0.33	0.99	0.00	100.0%
	Midstream Large	0.57	0.96	1.71	0.33	23.2%
	Midstream Small	0.77	1.35	1.75	0.72	50.0%
	Midstream Very Small	0.04	0.07	1.75	0.00	100.0%
	RCx	1.02	2.07	2.03	1.64	216.3%
	Non-KFVSD	0.08	0.02	0.24	0.78	102.7%
	Solution Total	**14.76**	**17.68**	**1.20**	**0.71**	**16.9%**
New Construction	Large	0.69	1.31	1.88	0.00	0.0%
	Small	0.60	0.88	1.45	0.54	24.2%
	Very Small	0.07	0.10	1.45	0.00	100.0%
	Solution Total	**1.37**	**2.29**	**1.67**	**0.25**	**10.3%**
Multifamily Targeted	Large	0.42	0.40	0.95	0.08	5.7%
	Solution Total	**0.42**	**0.40**	**0.95**	**0.08**	**5.7%**
Total Program	**All**	**16.55**	**20.36**	**1.23**	**0.76**	**16.8% [90% CI]**

Source: Guidehouse analysis

3.4.3 Net Impact Evaluation

As described in the Phase III Evaluation Plan,[59] Guidehouse applied the PY10 NTG values to the Multifamily Targeted Market Segment and conducted NTG activity in PY11 for the Equipment and Systems and New Construction Solutions. See Section 3.3.3 for an explanation of the NTG activities for the Small and Large C&I EE Programs in PY11.

Table 3-38 summarizes the reported and verified energy savings results, the calculated NTG results, and the CV and relative precision for each stratum sampled for the Large C&I EE Program in PY11.

[59] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

Table 3-38. Large C&I EE Program Net Energy Savings Impact Evaluation Results for PY11

Solution Name	Stratum Name	Verified Gross Energy Savings (MWh/yr)	Verified Net Energy Savings (MWh/yr)	Free Ridership Rate	Spillover Rate	NTG Ratio[1]	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
Equipment and Systems[2]	Very Large	14,457	6,974	0.52	0.00	0.48	0.14	11.5%
	Large	25,248	12,180	0.52	0.00	0.48		
	Medium	23,854	13,991	0.41	0.00	0.59	0.59	37.0%
	Small	24,773	18,323	0.37	0.11	0.74	0.38	14.8%
	Extra Small	1,859	1,375	0.37	0.11	0.74		
	Midstream Large	6,926	5,195	0.26	0.01	0.75	N/A	N/A
	Midstream Small	9,692	6,494	0.34	0.01	0.67	N/A	N/A
	Midstream Very Small	436	292	0.34	0.01	0.67	N/A	N/A
	RCx [3]	0	0	0.00	0.00	0.00	N/A	N/A
	Non-KFVSD [3]	0	0	0.00	0.00	0.00	N/A	N/A
	Solution Total	**107,245**	**64,824**	**0.43**	**0.03**	**0.60**	**0.33**	**9.4%**
New Construction	Large	5,445	2,614	0.58	0.06	0.48	0.46	24.2%
	Small	6,459	3,100	0.58	0.06	0.48		
	Very Small	533	256	0.58	0.06	0.48		
	Solution Total	**12,437**	**5,970**	**0.58**	**0.06**	**0.48**	**0.46**	**24.2%**
Multifamily Targeted	Large	3,682	2,975	0.19	0.00	0.81	0.30	17.2%
	Solution Total	**3,682**	**2,975**	**0.19**	**0.00**	**0.81**	**0.30**	**17.2%**
Total Program	**All**	**123,363**	**73,769**	**0.43**	**0.03**	**0.60**	**0.38**	**9.6% [90% CI]**

[1] Guidehouse conducted NTG research in PY11 for the Large C&I Equipment and Systems and New Construction Solutions.

[2] For the Midstream Large, Small, and Very Small strata of the Equipment and Systems Solution, Guidehouse applied the NTG values listed in the PY10 Annual Report.

[3] For this net impact evaluation, projects from the RCx and Non-KFVSD strata are captured within the strata shown within this table. For those two strata, Guidehouse did not create stratum-specific NTG ratios.

Source: Guidehouse analysis

3.4.3.1 High Impact Measure Research

HIMs represent measure categories or technologies of high importance in the PECO portfolio. In Phase III, the SWE suggested EDCs oversample HIMs to help program planners make decisions concerning those measures for downstream programs only.[60] EDCs were to identify three to five measures for study within each program year based on energy impact, level of uncertainty, prospective value, funding, or other parameters.

Guidehouse reviewed program- and solution-level savings, energy impact, and overall value to PECO to identify the HIMs for the C&I solutions for PY11. The results indicated that LED lighting upgrades, custom projects, and RCx held the highest impact for the Large C&I EE Program. Table 3-39 shows the results of the HIM NTG analysis in PY11.

Table 3-39. Large C&I EE Program HIM NTG Summary

HIM	Solution	Free Ridership Rate	Spillover Rate	NTG Ratio
Large C&I LED lighting	Equipment and Systems	0.48	0.01	0.53
Custom projects	Equipment and Systems	0.50	0.01	0.51
RCx	Equipment and Systems	0.44	0.00	0.56

Source: Guidehouse analysis

LED lighting free ridership for Large C&I customers is up from PY9 (0.39) as larger facility customers reported already having plans and budget set aside for their lighting projects regardless of the PECO incentive.

3.4.4 Process Evaluation

As in the Small C&I EE Program, Guidehouse conducted a detailed review of program materials including program databases, tracking systems, and other documents across all Large C&I EE Solutions. PECO and CSP staff also provided essential information about the program design and how the program experience on the ground in PY11 compares with the EE&C Plan.[61] The evaluation team conducted in-depth interviews at the beginning of the PY11 evaluation and communicated with staff on an ongoing basis. The team developed interview instruments to include questions of interest to the evaluation and to allow for free-flowing conversations to obtain candid feedback from the interviewees.

In addition to conducting interviews with PECO and CSP staff, Guidehouse deployed customer experience surveys to Small and Large C&I EE Program participants. Participants in all solutions—except the Data Centers and Multifamily Targeted Market Segments—received online or telephone surveys to collect their feedback on a series of questions designed to gauge customer satisfaction, sources of awareness, firmographic details, and to inform the NTG analysis. Guidehouse developed all online survey instruments according to SWE requirements, and the SWE reviewed and approved each survey instrument in advance of fielding. The

[60] PA PUC. "Section 3.4.1.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[61] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

evaluation team defined the survey population for each solution's participants based on the program tracking databases provided by PECO. Guidehouse developed a sample sufficient to provide 85/15 confidence/precision for the survey results.

Table 3-40 summarizes the process evaluation activities conducted for each Large C&I EE Program solution.

Table 3-40. Large C&I EE Process Evaluation Activities

Solution	PECO and CSP Staff Interviews	Program Tracking Data Review	Participant Survey
Equipment and Systems	√	√	Online or telephone survey: Guidehouse used surveys to assess customer awareness of the incentive offerings, their satisfaction with the application, the level of effort required to receive their incentive, communication with PECO staff, and the program overall.
New Construction	√	√	Telephone survey: Guidehouse used surveys to assess customer awareness of the incentive offerings, their satisfaction with the application, the level of effort required to receive their incentive, communication with PECO staff, and the program overall.
Data Centers Targeted	√	√	
Multifamily Targeted (Landlord Focus)	√	√	

Source: Guidehouse analysis

Table 3-41 provides the customer experience survey sample details for each Large C&I EE Solution.

Table 3-41. Large C&I EE Program Customer Experience Survey Sample Design for PY11

Solution	Stratum	Population Size[1]	Population Valid Contacts[2]	Target Sample Size	Achieved Sample Size
Equipment and Systems	Very High and High Impact	27	10	7	4
	Medium Impact	53	26	6	8
	Low Impact and Very Low Impact	252	133	15	15
	Solution Total	**332**	**169**	**28**	**27**
New Construction	**Solution Total**	**32**	**24**	**15**	**9**
Total Program	**All**	**364**	**193**	**43**	**36**

[1] Population size represents unique decision makers.

[2] This count excludes customer IDs with duplicate, missing, or invalid customer phone numbers or emails. For emails or phone numbers associated with multiple customer IDs, the highest savings customer ID was selected.

Source: Guidehouse analysis

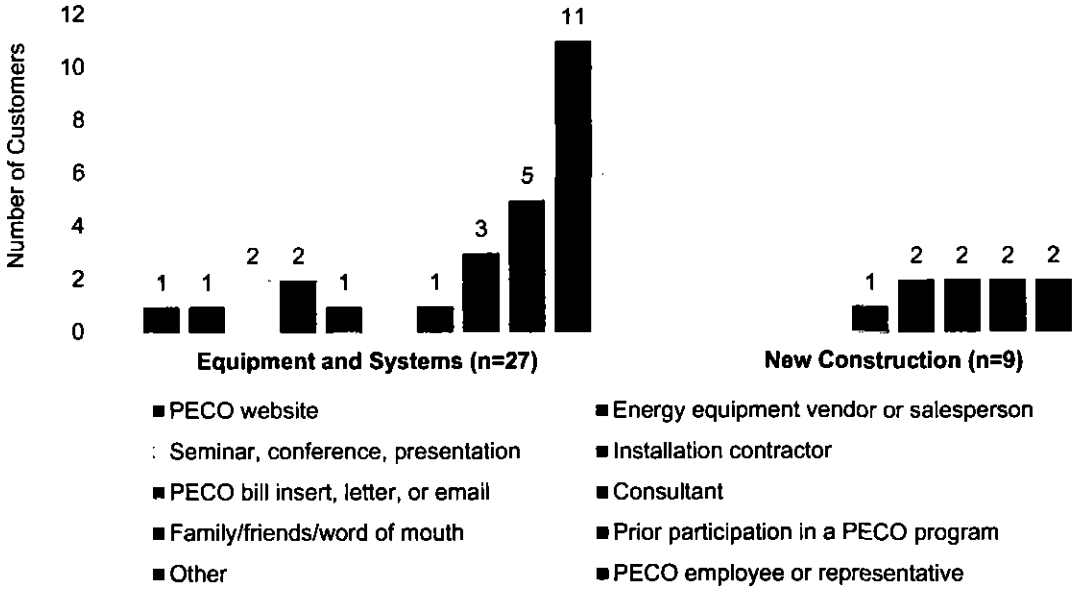
3.4.4.1 Key Findings from Process Evaluation

Findings for the Small C&I EE Programs are detailed in Section 3.3.4. Large C&I EE findings are presented here in this section. For all solutions, the evaluation team interviewed the PECO program manager and CSP staff to identify significant implementation changes to inform evaluation activities. Based on PECO staff and CSP interviews, the team did not document any significant changes to the Large C&I EE Program overall in PY11.

Additionally, Guidehouse surveyed Equipment and Systems and New Construction participants to measure satisfaction and assess the PECO Large C&I EE Program's effectiveness at encouraging the participation needed to achieve energy savings and participation goals. This section includes results from cross-solution metrics including satisfaction and marketing effectiveness. Details on changes to specific solutions are detailed in Appendix H.

As Figure 3-7 shows, PECO employees or representatives drove awareness for Equipment and Systems (n=11). Prior participation in a PECO program, (n=2), word of mouth (n=2), and consultants (n=2) drove awareness for New Construction participants. As with the Small C&I EE Program and consistent with PY9,[62] person-to-person outreach appears to be driving participation across the Large C&I EE Program.

Figure 3-7. Sources of Large C&I EE Program Awareness



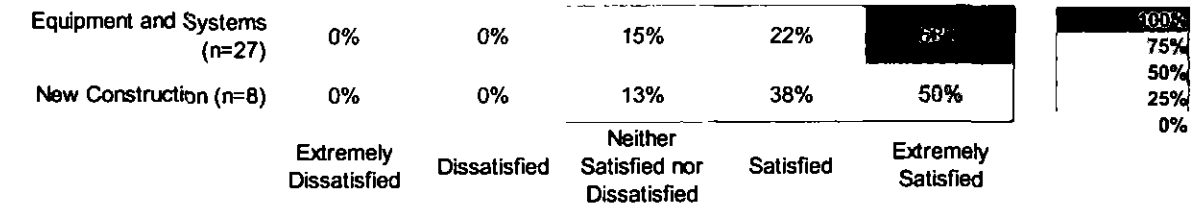
Question: "How did you learn about the [SOLUTION] program?"
The other category responses included in-house knowledge—an engineer.
Responses displayed as frequencies instead of percentages due to the small number of respondents.
Source: Guidehouse analysis

For the Large C&I EE Program, satisfaction among program participants across solutions was high, with a large majority of participants reporting they are either extremely satisfied or satisfied with the program overall, as Figure 3-8 shows. New Construction respondents reported higher

[62] Participants in the Large C&I Equipment and Systems and New Construction Solutions were last surveyed in PY9.

satisfaction, with 88% of respondents indicating they were satisfied or extremely satisfied, followed closely by Equipment and Systems (85%).

Figure 3-8. Overall Satisfaction by Large C&I EE Solution



Question: "Using a scale of 1 to 5, with 1 meaning Extremely Dissatisfied and 5 meaning Extremely Satisfied, how would you rate your overall satisfaction with [Solution]?"

Source: Guidehouse analysis

3.4.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-42. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-42. Summary of Large C&I EE Program Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$7,093	$15,366
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$45,212	$94,801
	Cost Subtotal	**$52,305**	**$110,166**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$222	$452
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$1,251	$3,960
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$5,016	$15,728
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$6,490**	**$20,140**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$58,795**	**$130,306**
Total NPV of Benefits [7] ($1,000)	*Lifetime Electric Energy Benefits*	$40,719	$93,334
	Lifetime Electric Capacity Benefits	$15,247	$33,215
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	-$1,563	-$2,129
	Benefits Total	**$54,403**	**$124,420**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**0.93**	**0.95**

[1] Includes direct install equipment costs.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

Table 3-43 presents program financials and cost-effectiveness on a net savings basis.

Table 3-43. Summary of Large C&I EE Program Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$7,093	$15,366
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$23,607	$58,845
	Cost Subtotal	**$30,700**	**$74,211**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$222	$452
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$1,251	$3,960
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$5,016	$15,728
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Cost Subtotal	**$6,490**	**$20,140**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$37,190**	**$94,351**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$24,181	$63,901
	Lifetime Electric Capacity Benefits	$9,005	$22,499
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	-$942	-$1,537
	Benefits Total	**$32,244**	**$84,863**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**0.87**	**0.90**

[1] Includes direct install equipment costs.

[2] Includes direct costs attributable to plan and advance the programs.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.

[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for direct install programs.

[6] Total TRC Costs includes Total EDC Costs and Participant Costs.

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

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

Source: Guidehouse analysis

3.4.6 Status of Recommendations

The impact and process evaluation activities in PY11 led to several findings and recommendations from Guidehouse to PECO. Table 3-44 presents those solution-level findings and recommendations along with a summary of how PECO plans to address the recommendations in program delivery. Additional details on the solution-level analysis activities that led to these findings and recommendations can be found in Appendix H.

Table 3-44. Summary of Findings and Recommendations for the Large C&I EE Program

Solution	Finding	Recommendation	EDC Status
Equipment and Systems, New Construction	Participants rated their satisfaction with the application process lower than other aspects of the program. PECO staff noted that the application process has been a barrier to participation for customers during Phase III due to the required amount of documentation. Customers noted they would like more information on the application requirements prior to starting the application process.	Direct customers to the online resources available to help them complete the application by highlighting these resources on the webpage and marketing materials.	Implemented. PECO has taken several steps to reduce the application burden for customers, including the addition of step-by-step instructions on submitting applications through the online portal. These instructions may help customers better understand what information they will need to gather before they get into more specific detail about the application requirements. PECO also offered bonus incentives to trade allies that completed applications on behalf of customers.
Equipment and Systems	Guidehouse found that several RCx projects had verified savings and realization rates with large variation from the ex ante estimates. These variations are driven by limited post-retrofit billing or trend data (less than 3 months) and, in one case, not collecting data during the season with the greatest realized savings.	Institute a minimum data collection period for RCx projects (preferably 6-9 months), with data collection during winter, summer, and a shoulder season (spring or fall). Advanced metering infrastructure data should be made available to the CSP, as requested, to enable hourly temperature-binned analysis, which would support a higher rigor impact estimate.	In Process. PECO implementation team will expand the data collection period for retrocommissioning projects to 6-9 months whenever possible. For those instances when the extended data collection of 6-9 months is not possible, the implementation team will endeavor to collect a minimum of 3 months data.
Equipment and Systems, New Construction	Guidehouse identified three projects where the CSP applied full motor savings for two or three separate motors operating as primary and backup (e.g., the motors were found to cycle on and off to share hours between them, but never operated simultaneously).	For applications where multiple motors are operated in tandem or cycling on and off to share load, divide the TRM deemed HOU assumption used in the impact calculation by the number of motors that share the load of a single motor.	In Process. PECO implementation team has modified its process to more accurately represent the actual cycling/redundancy schemes for systems with multiple motors.
Equipment and Systems	Guidehouse found that approximately half of all projects categorized as kitchen exhaust fan VFDs were miscategorized by the CSP. Applications categorized as kitchen exhaust fans included sewage pumps, boiler supply fans, and dryer motors. The CSP used the kitchen exhaust fan application as a catchall bucket for measure applications not explicitly deemed in the TRM.	Use a custom calculation approach to determine parameters such as HOU, energy savings factors, and demand savings factors for VFD applications that are not deemed in the TRM.	In Process. PECO implementation team has modified its process to more accurately categorize VFD applications and will use a custom approach to determine the appropriate calculation parameters.

Source: Guidehouse analysis

3.5 CHP Program

The PECO CHP Program is designed to influence customer behavior and purchasing decisions. CHP technologies generate electric and thermal energy from a single fuel source. Customers with steady baseload electricity usage coupled with steady thermal demand can accomplish significant efficiencies and savings by incorporating CHP (sometimes referred to as cogeneration) in their facilities. The best economics are realized for CHP systems sized to match the minimum electric and thermal loads. PECO designed the CHP Program to confirm participating customers install CHP projects that maximize operational savings and minimize operations and maintenance (O&M) costs.

The CHP Program has three types of incentives distributed at key milestones in the design, construction, and operation phases:

- **Design:** Incentives based on proposed system capacity.
- **Capacity:** Incentives based on a declining tiered incentive rate by installed capacity. Each tier has a fixed incentive per kilowatt paid toward the incremental capacity within each tier.
- **Performance:** Incentives are based on a fixed per kilowatt-hour basis based on actual energy production. The kilowatt-hour production is determined during a monitoring period that begins after the commercial date of operation and is designed to capture the typical system operational performance. Savings for all projects are claimed on implementation and can be adjusted based on the performance monitoring results.

PECO delivers the program directly through a rolling enrollment process. Projects deemed to have a high probability of starting normal operation prior to the close of Phase III are enrolled in the program and are provided a reservation letter for the anticipated incentive amount.

3.5.1 Participation and Reported Savings by Customer Segment

This section provides the total CHP Program results for PY11, including participation, energy and demand savings, and incentive costs. Table 3-45 presents the participation counts and incentive payments for the CHP Program in PY11 by customer segment.

Table 3-45. CHP Program Summary by Customer Segment

Parameter	Residential	Small C&I	Large C&I
PYTD No. of Participants	0	0	1
PYRTD MWh/yr	0	0	747
PYRTD MW	0	0	0.13
PY11 Incentives ($1,000)	$0	$0	$54

Source: Guidehouse analysis

3.5.2 Gross Impact Evaluation

The CHP Program reported one participant in PY11. Participants in the CHP Program are required to log the parameters necessary to calculate electricity generation net of parasitic loads (such as pumps necessary to operate the heat recovery systems) and thermal energy recovery.

The evaluation team relies on this data to estimate the system capacity and annual generation on which PECO bases its capacity and performance incentives.

The gross impact evaluation involved a desktop review of interval data and system as-built project documentation. Guidehouse calculated gross impacts according to the CHP chapter of the Uniform Methods Project.[63] In consultation with the SWE, the evaluation team decided against onsite verification because of the pandemic and the quality of the customer's interval data. Instead, the team conducted telephone interviews with the program participant to verify installation and interviews with the PECO program manager.

Table 3-46 summarizes the reported and verified energy savings results, along with the CV and relative precision for the CHP Program in PY11.

Table 3-46. CHP Program Gross Results for Energy

Solution	Stratum Name	Reported Gross Energy Savings (MWh/yr)	Verified Gross Energy Savings (MWh/yr)	Energy Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
CHP	Census	747	816	1.09	0.00	0.0%
Total Program	**All**	**747**	**816**	**1.09**	**0.00**	**0.0%**

Source: Guidehouse analysis

Table 3-47 summarizes the reported and verified demand savings results, along with the CV and relative precision for the CHP Program in PY11.

Table 3-47. CHP Program Gross Results for Demand

Solution	Stratum Name	Reported Gross Demand Savings (MW)	Verified Gross Demand Savings (MW)	Demand Realization Rate	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
CHP	Census	0.13	0.08	0.65	0.00	0.0%
Total Program	**All**	**0.13**	**0.08**	**0.65**	**0.00**	**0.0%**

Source: Guidehouse analysis

The variations between the reported and verified savings and the observed realization rates for the CHP Program are reasonable given the complexity of these systems and uncertainty in their early operational periods. The difference in verified gross demand savings is attributable to a low capacity factor, with the system output curtailed to 75% of its nameplate rating.

3.5.3 Net Impact Evaluation

Guidehouse used the PY10 results for free ridership and spillover. These values were determined using survey instruments consistent with the Phase III Evaluation Framework's

[63] Simons, G.; Barsun, S. "Chapter 23: Combined Heat and Power Evaluation Protocol," *The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures.* 2017. National Renewable Energy Laboratory. http://www.nrel.gov/docs/fy17osti/68579.pdf

guidance on net impact evaluation techniques[64] and guidance from the Energy Trust of Oregon's NTG methodology.[65]

Table 3-48 summarizes the reported and verified energy savings results, the calculated NTG results, and the CV and relative precision for the CHP Program in PY11.

Table 3-48. CHP Program Net Energy Savings Impact Evaluation Results for PY11

Solution Name	Stratum Name	Verified Gross Energy Savings (MWh/yr)	Verified Net Energy Savings (MWh/yr)	Free Ridership Rate	Spillover Rate	NTG Ratio	Achieved Sample CV or Error Ratio	Relative Precision at 85% Confidence Interval
CHP	Census	816	713	0.13	0.0	0.87	0.00	0.0%
Total Program	**All**	**816**	**713**	**0.13**	**0.0**	**0.87**	**0.00**	**0.0%**

Source: Guidehouse analysis

3.5.3.1 High Impact Measure Research

No HIM measures were included in the CHP Program evaluation.

3.5.4 Process Evaluation

In PY11, per the Phase III Evaluation Plan,[66] Guidehouse's process evaluation consisted of an in-depth interview with the PECO CHP Program manager. The interview gathered information about the participation process and participant attitudes and suggestions for the program going forward. The program manager indicated that the interconnection process continued to be a source of customer dissatisfaction with the program.

3.5.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-49. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-49. Summary of CHP Program Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	EDC Incentives to Participants [1]	$54	$998
	EDC Incentives to Trade Allies	$0	$0

[64] PA PUC. "Section 3.4." *Phase III Evaluation Framework.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[65] Phil Degens and Sarah Castor. *Energy Trust Free Ridership Methodology.* Energy Trust of Oregon. August 7, 2013.

[66] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$64	$8,028
	Cost Subtotal	**$118**	**$9,026**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$0	$0
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$0	$0
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$6	$83
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$6**	**$83**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$547	$7,129
	Cost Subtotal	**$547**	**$7,129**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$670**	**$16,239**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$345	$7,363
	Lifetime Electric Capacity Benefits	$80	$2,006
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$424**	**$9,369**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**0.63**	**0.58**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and advance the programs.
[3] Includes rebate processing, tracking system, general administration, program management, general management, legal, and technical assistance.
[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
Source: Guidehouse analysis

Table 3-50 presents program financials and cost-effectiveness on a net savings basis.

Table 3-50. Summary of CHP Program Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants [1]	$54	$998
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$49	$6,997
	Cost Subtotal	**$103**	**$7,995**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs) [2]	$0	$0
	Design and Development (CSP Costs) [2]	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [3]	$0	$0
	Administration, Management, and Technical Assistance (CSP Costs) [3]	$0	$0
	Marketing (EDC Costs) [4]	$0	$0
	Marketing (CSP Costs) [4]	$0	$0
	Program Delivery (EDC Costs) [5]	$0	$0
	Program Delivery (CSP Costs) [5]	$6	$83
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$6**	**$83**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$477	$6,236
	Cost Subtotal	**$477**	**$6,236**
Total NPV of Costs [6] ($1,000)	**Cost Total**	**$586**	**$14,314**
Total NPV of Benefits [7] ($1,000)	Lifetime Electric Energy Benefits	$301	$6,454
	Lifetime Electric Capacity Benefits	$69	$1,759
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$371**	**$8,212**
TRC Benefit-Cost Ratio [8]	**Benefits Total/Costs Total**	**0.63**	**0.57**

[1] Includes direct install equipment cost.
[2] Includes direct costs attributable to plan and advance the programs.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance.
[4] Includes the marketing CSP and marketing costs by program CSPs. EDC marketing costs broken out as a percentage of sector lifetime savings. This is an adjustment from the Preliminary Annual Report.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
Source: Guidehouse analysis

3.5.6 Status of Recommendations

Table 3-51 presents the findings and recommendations resulting from the PY11 impact and process evaluation along with a summary of how PECO plans to address the recommendations in program delivery.

Table 3-51. Summary of Findings and Recommendations for the CHP Program

Solution	Finding	Recommendation	EDC Status
CHP	Savings calculations for demand are based on nameplate ratings.	Require demand calculations based on actual system performance.	In Process. PECO will work with the implementor to use actual system data to calculate demand savings.
CHP	Calculations made by the technical support contractor are not consistent with the Uniform Methods Project CHP evaluation methodology.	Require the CHP technical support contractor should use methods consistent with the *Uniform Methods Project*.	Implemented. PECO hired a new CHP implementation contractor for PY12 that will use methods consistent with the Uniform Methods Project.

Source: Guidehouse analysis

3.6 DR Programs

PECO's DR Programs include Residential DR, Small C&I DR, and Large C&I DR. These three programs encompass opportunities designed to engage customers across all sectors to reduce demand.

The Residential DR Program's eligible population and target markets are all PECO residential electric customers. The program encompasses three solutions:

- Residential Direct Load Control (DLC)
- Smart Thermostat for DR Savings
- Behavioral DR Savings

Only the Residential DLC Solution is active.

The Residential DLC Solution is implemented by Itron (formerly Comverge). It was designed to shift participant loads from peak to off-peak hours by cycling their central AC during DR events by 50%. The PY11 summer DR events had over 53,000 residential participants. In PY11 and for the remainder of Phase III, participants receive an incentive of $40 per DLC unit per year.

PECO designed its Small C&I DR Program to engage customers to reduce demand through DLC of major electrical end-use equipment during designated peak load hours. The eligible population and target markets for the Small C&I DR Program are all PECO Small C&I customers; this includes customers in the G/E/NP segment.

The Small C&I DLC Solution is implemented by Itron (formerly Comverge). The program shifts load to off-peak hours by cycling participant AC units by 50% during DR event days. The PY11 summer DR events had over 1,300 Small C&I participants. In PY11 and for the remainder of Phase III, participants receive an incentive of $40 per DLC unit per year.

PECO designed the Large C&I DR Program to engage customers in demand reduction through DR aggregation across multiple customers. The eligible population and target markets for the PECO Large C&I DR Program are all PECO large C&I electric customers, including those in the G/E/NP sector. The program encompasses a single solution, the Demand Response Aggregator (DRA) Solution, and is implemented by two CSPs: Enel X (formerly EnerNOC) and CPower.

For Phase III, event days for all programs are called when the PJM day-ahead peak load forecast reaches 96%. Based on the day-ahead forecasts, PECO called four events during the summer of 2019: July 17, July 18, July 19, and August 19.

Compliance targets for DR programs were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect T&D losses. The peak demand impacts presented in this section have been adjusted for line losses.

In PY11, there were no changes to planned evaluation activities due to the pandemic.

3.6.1 Participation and Reported Savings by Customer Segment

Table 3-52 presents the participation counts, reported peak demand savings, and EDC expenditures for the three DR program in PY11 by customer segment.

Table 3-52. PY11 DR Program Summary by Customer Segment

Parameter	Residential (Residential DR Program)	Small C&I (Small C&I DR Program)	Large C&I (Large C&I DR Program)
PYTD No. of Participants	53,924	1,312	340
PYRTD MWh/yr	0	0	0
PYRTD MW	0.00	0.00	0.00
PY11 Incentives ($1,000)	$2,507	$99	$-

Source: Guidehouse analysis

3.6.2 Gross Impact Evaluation

The standalone DR report,[67] submitted to the PA PUC on January 15, 2020, details the impact evaluation methodology and results. Table 3-53 lists the days that DR events were called along with the verified gross demand reductions achieved by each event.[68] It also lists the average DR performance for PY11 and for P3TD. PECO's average DR performance to date is 167.13 MW, which exceeds the Phase III compliance reduction target of 161 MW by 3.8% (103.8% of target achieved to date).

[67] PECO. *Annual Report to the Pennsylvania Public Utility Commission Demand Response Performance Report Only*. January 15, 2020. https://www.peco.com/SiteCollectionDocuments/PhaseIIIEECPsemiannualreportDRs.pdf

[68] Verified impacts for the Large C&I DR program for PY9, PY10, and PY11 have been revised based on corrected interval data provided by PECO. In January 2020, PECO notified Guidehouse of potential issues with the interval data provided for the PY9 through PY11 evaluations, where certain data may not represent actual consumption because of unique meter configurations at different participant sites. After a comprehensive review of all sites and activities to date, the team found that 16, 25, and 6 sites were affected in PY9, PY10, and PY11, respectively. At the request of PECO and in consultation with the SWE, Guidehouse applied evaluation methods prescribed for PY11 to revise the verified impacts for affected sites; impacts for unaffected sites remain unchanged. These revisions increased PVTD by 1.1 MW (0.7%) and P3TD by 1.6 MW (1.0%). Table 2-1 shows a revised summary of the DR performance to date

Table 3-53. PY11 DR PYVTD Performance by Event

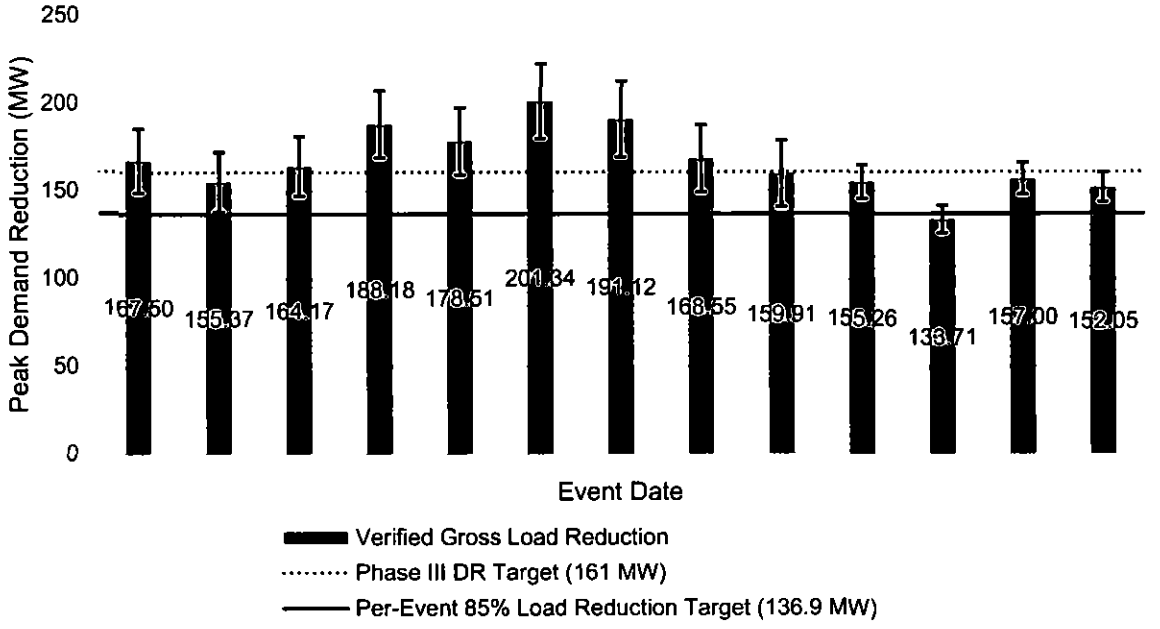
PY	Event Date	Residential DR (MW)	Small C&I DR (MW)	Large C&I DR (MW)	Portfolio (MW)	Relative Precision at 90% Confidence
PY9	June 13, 2017	39.53	0.00	127.97	167.50	10.9%
PY9	July 20, 2017	33.48	0.00	121.89	155.37	11.0%
PY9	July 21, 2017	23.34	0.00	140.83	164.17	10.3%
PY10	July 2, 2018	38.93	0.00	149.25	188.18	10.2%
PY10	July 3, 2018	33.84	0.00	144.67	178.51	10.7%
PY10	August 6, 2018	25.07	1.15	175.12	201.34	10.6%
PY10	August 28, 2018	30.69	0.92	159.52	191.12	11.3%
PY10	September 4, 2018	29.99	0.77	137.79	168.55	11.4%
PY10	September 5, 2018	29.52	0.84	129.54	159.91	11.9%
PY11	July 17, 2019	34.36	0.86	120.04	155.26	6.1%
PY11	July 18, 2019	11.06	1.02	121.63	133.71	5.9%
PY11	July 19, 2019	34.93	1.18	120.89	157.00	5.8%
PY11	August 19, 2019	24.90	0.98	126.17	152.05	5.6%
PYVTD – Average PY11 DR Event Performance		**26.31**	**1.01**	**122.18**	**149.50**	**5.9%**
Phase TD – Average Phase III DR Event Performance		**29.97**	**0.59**	**136.56**	**167.13**	**10.0%**

Source: Guidehouse analysis

The PA PUC's Phase III Implementation Order[69] also established a requirement that EDCs achieve at least 85% of the Phase III compliance reduction target in each DR event. For PECO, this translates to a 137 MW minimum for each DR event. Figure 3-9 shows PY11 event performance relative to the compliance target.

[69] PA PUC. *Energy Efficiency and Conservation Program Implementation Order* at Docket No. M-2014-2424864 (*Phase III Implementation Order*). Entered June 11, 2015.

Figure 3-9. Event Performance Compared to 85% Per-Event Target



Source: Guidehouse analysis

3.6.3 Process Evaluation

Guidehouse conducted a full process evaluation in PY9. No process evaluation activities were conducted in PY11.

3.6.4 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-54 for Residential DR. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-54. Summary of Residential DR Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$2,507	$9,961
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$627	-$2,490
	Cost Subtotal	**$1,880**	**$7,471**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs)[1]	$1	$33

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$1,308	$4,127
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$1,308**	**$4,160**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$3,188**	**$11,631**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$2,435	$7,235
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$2,435**	**$7,235**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**0.76**	**0.62**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

Table 3-55 presents program financials and cost-effectiveness on a net savings basis for Residential DR.

Table 3-55. Summary of Residential DR Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$2,507	$9,961
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$627	-$2,490
	Cost Subtotal	**$1,880**	**$7,471**
	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Program Overhead Costs ($1,000)	Administration, Management, and Technical Assistance (EDC Costs) [1]	$1	$33
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$1,308	$4,127
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$1,308**	**$4,160**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$3,188**	**$11,631**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$2,435	$7,235
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$2,435**	**$7,235**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**0.76**	**0.62**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-56 for Small C&I DR. Guidehouse calculated TRC benefits using gross verified impacts. Costs and benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-56. Summary of Small C&I DR Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$99	$400
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$25	-$100
	Cost Subtotal	**$74**	**$300**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [1]	$0	$2
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$41	$114
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$41**	**$116**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$115**	**$416**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$93	$124
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$93**	**$124**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**0.82**	**0.30**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

Table 3-57 presents program financials and cost-effectiveness on a net savings basis for Small C&I DR.

Table 3-57. Summary of Small C&I DR Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$99	$400
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	-$25	-$100
	Cost Subtotal	**$74**	**$300**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [1]	$0	$2
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$41	$114
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$41**	**$116**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$115**	**$416**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$93	$124
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$193**	**$124**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**0.82**	**0.30**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

A detailed breakdown of program finances and cost-effectiveness is presented in Table 3-58 for Large C&I DR. Guidehouse calculated TRC benefits using gross verified impacts. Costs and

benefits for PYTD results are expressed in 2019 dollars, while P3TD values are expressed as an NPV in 2016 dollars using a discount rate of 7.6%.

Table 3-58. Summary of Large C&I DR Finances – Gross Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$0	$1,707
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$0	-$427
	Cost Subtotal	**$0**	**$1,280**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [1]	$1	$65
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$4,556	$9,806
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$4,557**	**$9,871**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$4,557**	**$11,152**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$5,771	$21,003
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$5,771**	**$21,003**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**1.27**	**1.88**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

Table 3-59 presents program financials and cost-effectiveness on a net savings basis for Large C&I DR.

Table 3-59. Summary of Large C&I DR Finances – Net Verified

Category	Parameter	PYTD ($1,000)	P3TD ($1,000)
NPV of Incremental Measure Costs ($1,000)	EDC Incentives to Participants	$0	$1,707
	EDC Incentives to Trade Allies	$0	$0
	Participant Costs (Net of Incentives/Rebates Paid by Utilities)	$0	-$427
	Cost Subtotal	**$0**	**$1,280**
NPV of Program Overhead Costs ($1,000)	Design and Development (EDC Costs)	$0	$0
	Design and Development (CSP Costs)	$0	$0
	Administration, Management, and Technical Assistance (EDC Costs) [1]	$1	$65
	Administration, Management, and Technical Assistance (CSP Costs) [1]	$0	$0
	Marketing (EDC Costs) [2]	$0	$0
	Marketing (CSP Costs) [2]	$0	$0
	Program Delivery (EDC Costs)	$0	$0
	Program Delivery (CSP Costs)	$4,556	$9,806
	EDC Evaluation Costs	$0	$0
	SWE Audit Costs	$0	$0
	Cost Subtotal	**$4,557**	**$9,871**
NPV of Fossil Fuel Impacts from Fuel Switching ($1,000)	Increased Fossil Fuel Consumption	$0	$0
	Cost Subtotal	**$0**	**$0**
Total NPV of Costs [3] ($1,000)	**Cost Total**	**$4,557**	**$11,152**
Total NPV of Benefits [4] ($1,000)	Lifetime Electric Energy Benefits	$0	$0
	Lifetime Electric Capacity Benefits	$5,771	$21,003
	Lifetime Non-Electric Benefits (Fossil Fuel, Water, O&M)	$0	$0
	Benefits Total	**$5,771**	**$21,003**
TRC Benefit-Cost Ratio [5]	**Benefits Total/Costs Total**	**1.27**	**1.88**

[1] Tracking system, general administration, 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 Electric and Non-Electric Benefits. 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 II are not to be included as a part of Total TRC Benefits for Phase III.

[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Source: Guidehouse analysis

3.6.5 Status of Recommendations

The impact evaluation activities in PY11 led to several findings and recommendations from Guidehouse to PECO.

Table 3-60 presents these findings and recommendations along with a summary of how PECO plans to address the recommendations in program delivery.

Table 3-60. Summary of Findings and Recommendations for the DR Programs

Program	Finding	Recommendation	EDC Status
Large C&I	The participants enrolled for the top five largest curtailments substantially underperformed relative to expectations, including some customers who chose on event days to curtail only a small fraction of their enrolled load. This behavior caused the program to underperform overall.	Explore methods to confirm full participation of largest enrolled loads to mitigate underperformance risk.	Under Consideration. PECO will explore methods of participation to assess level of risk.
Large C&I	Meter data was unavailable for two sites, limiting the ability to evaluate impacts for those sites.	Investigate issues with onsite metering equipment for those sites in advance of the PY12 DR season.	In Process. PECO will work with meter services group to investigate meter equipment issues.
Large C&I	After submitting the DR-only annual report, an issue with the consumption data for several participant sites was uncovered by the CSP and PECO. These sites had electric meters that recorded electricity flowing to the grid but were not marked as such in the data provided for analysis. The issue was isolated to Large C&I DR. Guidehouse reanalyzed all program years, which caused pP3TD results to increase by 1% relative to results reported in the DR Annual Report[70] in January 2020.	Confirm data source has a clear indicator of meter flow direction and provide that data in all data transfers with instructions on how to aggregate data across meters.	Implemented. Addressed and corrected in subsequent reports. The July 15 Preliminary Final Report and this February 15 Annual Report includes the final, SWE-approved P3TD results.

Source: Guidehouse analysis

[70] PECO. *Annual Report to the Pennsylvania Public Utility Commission Demand Response Performance Report Only*. January 15, 2020. https://www.peco.com/SiteCollectionDocuments/PhaseIIIEECPsemiannualreportDRs.pdf

4. Summary of Finances

This section provides an overview of the expenditures associated with PECO's portfolio and the recovery of those costs from ratepayers.

4.1 Program Financials

Program-specific and portfolio total finances for PY11 are shown in Table 4-1. The columns in Table 4-1 and Table 4-2 are adapted from the Direct Program Cost categories in the PA PUC's EE&C Plan template[71] for Phase III. EDC Materials, Labor, and Administration includes costs associated with an EDC's own employees. Implementation Conservation Service Provider (ICSP) Materials, Labor, and Administration includes the program implementation contractor and the costs of any other outside vendors EDCs employ to support program delivery.

Table 4-1. PYTD Financials

Program	Incentives to Participants and Trade Allies ($1,000)	EDC Materials, Labor, and Administration ($1,000)	ICSP Materials, Labor, and Administration ($1,000)	Total Cost ($1,000)
Residential EE	$8,795	$6,808	$11,431	$27,035
Low-Income EE	$170	$-123	$8,516	$8,563
Small C&I EE	$4,077	$2,366	$4,843	$11,286
Large C&I EE	$7,066	$1,474	$5,044	$13,583
CHP	$54	$0	$6	$60
Residential DR	$2,507	$1	$1,308	$3,815
Small C&I DR	$99	$0	$41	$139
Large C&I DR	$0	$1	$4,556	$4,557
Common Portfolio Costs[1]				$9,545
Portfolio Total	**$22,767**	**$10,526**	**$35,744**	**$78,583**
SWE Costs[2]	**N/A**	**N/A**	**N/A**	**$0**
Total	**$22,767**	**$10,526**	**$35,744**	**$78,583**

[1] Includes the administrative CSP, tracking system, general administration, and clerical costs; EDC program management; CSP program management; general management; oversight of major accounts; and technical assistance.

[2] SWE costs are outside of the 2% spending cap.

Sources: PECO's eTrack database, CSP tracking data

[71] PA PUC. "Section 10." EE&C Plan Template. July 21, 2015. http://www.puc.pa.gov/pcdocs/1372426.doc

Table 4-2 shows program-specific and portfolio total finances since the inception of Phase III.

Table 4-2. P3TD Financials

Program	Incentives to Participants and Trade Allies ($1,000)	EDC Materials, Labor, and Administration ($1,000)	ICSP Materials, Labor, and Administration ($1,000)	Total Cost ($1,000)
Residential EE	$30,094	$23,871	$44,832	$98,797
Low-Income EE	$1,204	$1,087	$30,403	$32,694
Small C&I EE	$9,970	$8,935	$15,517	$34,421
Large C&I EE	$16,978	$3,683	$18,461	$39,122
CHP	$1,143	$0	$93	$1,236
Residential DR	$11,020	$33	$4,646	$15,699
Small C&I DR	$442	$2	$132	$577
Large C&I DR	$0	$66	$13,231	$13,297
Common Portfolio Costs[1]				$38,353
Portfolio Total	**$70,852**	**$37,677**	**$127,314**	**$274,196**
SWE Costs[2]	**N/A**	**N/A**	**N/A**	**$700**
Total	$70,852	$37,677	$127,314	$274,896

[1] Includes the administrative CSP, tracking system, general administration, and clerical costs; EDC program management; CSP program management; general management; oversight of major accounts; and technical assistance.

[2] SWE costs are outside of the 2% spending cap.

Sources: PECO's eTrack database, CSP tracking data

4.2 Cost Recovery

Act 129 allows Pennsylvania EDCs to recover EE&C Plan[72] costs through a cost recovery mechanism. PECO's cost recovery charges are organized separately by four customer sectors to confirm the electric rate classes that finance the programs are the rate classes that receive the direct energy and conservation benefits. Cost recovery is governed by a tariffed rate class, so it is necessarily tied to the way customers are metered and charged for electric service. Readers should be mindful of the differences between Table 4-3 and Section 2.4. For example, the low-income customer segment is a subset of PECO's residential tariff(s) and, therefore, is not listed in Table 4-3.

[72] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* Revised March 31, 2016. https://www.puc.pa.gov/pcdocs/1444592.pdf.

Table 4-3. EE&C Plan Expenditures by Cost Recovery Category

Parameter	Cost Recovery Sector	Rate Classes Included	Program Year					
			PY8	PY9	PY10	PY11	PY12	P3TD[1]
EE&C Plan Expenditures ($1,000 Nominal)	Residential	R, RH, and CAP	$35,450	$43,217	$41,675	$40,865	-	$161,207
	Small C&I	GS	$7,035[2]	$11,105	$12,024	$14,209	-	$44,373
	Large C&I	PD, HT, and EP	$9,713	$15,250	$20,056	$23,481	-	$68,500
	Municipal	SLE, AL, and TLCL	$28	$31	$30	$28	-	$117
Portfolio Total		**All**	**$52,225**	**$69,602**	**$73,785**	**$78,583**	**-**	**$274,195**

Note: SWE costs not included.

[1] P3TD values expressed as the sum of nominal dollars.

[2] As noted in the PY9 Preliminary Annual Report, Guidehouse determined that the rounded financial expenditure for the Small C&I EE Program was $882 above actual expenditures. The correction of this value, reflected here, results in a decrease in reported PY8 portfolio expenditures from $52,226 to $52,225 (in $1,000 units).

Source: PECO

Appendix A. Upstream Lighting Cross-Sector Sales

Guidehouse completed its analysis of the upstream lighting cross-sector sales estimation as part of the PY8 evaluation for the LAH Solution. Guidehouse applied the PY8 cross-sector sales values to PY11. Details about the evaluation, including the cross-sector sales assumptions for the solution, can be found in Appendix F.1.

Appendix B. Site Inspection Summary

Table B-1 summarizes the site inspections and common discrepancies found during the evaluation.

Table B-1. PY11 Site Inspection Summary

Program/Solution	Inspection Firm	Number of Inspections Conducted	Number of Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
Small C&I, Equipment and Systems[1]	Guidehouse/INCA	1	1	Ex ante baseline data collection errors
Small C&I, New Construction[1]	Guidehouse/INCA	1	0	N/A
Small C&I, Whole Building	Guidehouse/INCA	4	2	HOU
Large C&I, Equipment and Systems[1]	Guidehouse/INCA	4	2	Incorrect measure assignment or load factor for exhaust fan projects.
Large C&I, New Construction[1]	Guidehouse/INCA	4	1	Ex ante peak demand savings calculated as kWh/8,760
Total		**14**	**6**	

[1] Many C&I projects had small discrepancies from the reported values, with few projects showing 1.00 realization rates for both energy and demand savings. The numbers listed in this table include projects with energy or demand savings that were more than 20% different from the ex ante results.

Source: Guidehouse analysis

Appendix C. HER Impact Evaluation Detail

Guidehouse analyzed the Behavioral Solution (i.e., the HER impact evaluation) as part of its overall solution-level evaluation. Details about the evaluation, including the regression analysis results, can be found in Appendix F.5.

Appendix D. PY11 and P3TD Summary by Customer Segment and Carveout

Table D-1. PY11 Reported Energy Savings by Customer Segment and Carveout

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
LAH	147,509	35	2	0	0
Appliance Recycling	16,991	620	34	0	0
Whole Home	6,206	3	0	0	0
New Construction	2,093	0	0	0	0
Behavioral	71,728	0	0	0	0
Multifamily Targeted	2,894	0	0	0	0
Residential EE Program	**247,421**	**658**	**36**	**0**	**0**
Whole Home	30,474	3,084	3,706	37,265	0
Lighting	0	0	0	0	0
Low-Income EE Program	**30,474**	**3,084**	**3,706**	**37,265**	**0**
Equipment and Systems	0	49,349	0	0	17,639
New Construction	0	4,514	0	0	444
Whole Building	0	9,249	0	0	1,251
Data Centers Targeted	0	0	0	0	0
Multifamily Targeted	0	3,558	0	0	0
Small C&I EE Program	**0**	**66,669**	**0**	**0**	**19,334**
Equipment and Systems	0	0	98,745	0	24,249
New Construction	0	0	11,206	0	3,006
Data Centers Targeted	0	0	0	0	0
Multifamily Targeted	0	0	3,701	0	0
Large C&I EE Program	**0**	**0**	**113,652**	**0**	**27,255**
CHP Program	**0**	**0**	**747**	**0**	**0**
Portfolio Total	**277,895**	**70,411**	**118,141**	**37,265**	**46,588**

Source: Guidehouse analysis

Table D-2. PY11 Reported Demand Savings by Customer Segment and Carveout

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
LAH	18.73	0.01	0.00	0.00	0.00
Appliance Recycling	*2.37*	*0.08*	*0.00*	*0.00*	*0.00*
Whole Home	0.85	0.00	0.00	0.00	0.00
New Construction	0.80	0.00	0.00	0.00	0.00
Behavioral	0.00	0.00	0.00	0.00	0.00

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
Multifamily Targeted	0.37	0.00	0.00	0.00	0.00
Residential EE Program	**23.11**	**0.09**	**0.01**	**0.00**	**0.00**
Whole Home	3.26	0.52	0.56	4.35	0.00
Lighting	0.00	0.00	0.00	0.00	0.00
Low-Income EE Program	**3.26**	**0.52**	**0.56**	**4.35**	**0.00**
Equipment and Systems	0.00	7.42	0.00	0.00	2.70
New Construction	0.00	0.89	0.00	0.00	0.06
Whole Building	0.00	1.95	0.00	0.00	0.29
Data Centers Targeted	0.00	0.00	0.00	0.00	0.00
Multifamily Targeted	0.00	0.38	0.00	0.00	0.00
Small C&I EE Program	**0.00**	**10.65**	**0.00**	**0.00**	**3.05**
Equipment and Systems	0.00	0.00	14.76	0.00	3.73
New Construction	0.00	0.00	1.37	0.00	0.35
Data Centers Targeted	0.00	0.00	0.00	0.00	0.00
Multifamily Targeted	0.00	0.00	0.42	0.00	0.00
Large C&I EE Program	**0.00**	**0.00**	**16.55**	**0.00**	**4.08**
CHP Program	**0.00**	**0.00**	**0.13**	**0.00**	**0.00**
Portfolio Total	**26.38**	**11.25**	**17.25**	**4.35**	**7.13**

Source: Guidehouse analysis

Table D-3. P3TD Reported Energy Savings by Customer Segment and Carveout

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
LAH	482,561	86	5	0	1
Appliance Recycling	57,566	1,137	358	0	0
Whole Home	23,559	3	0	0	0
New Construction	6,155	0	0	0	0
Behavioral	294,115	0	0	0	0
Multifamily Targeted	12,755	0	0	0	0
Residential EE Program	**876,711**	**1,226**	**363**	**0**	**1**
Whole Home	92,299	5,474	3,713	101,486	0
Lighting	9,086	0	0	9,086	0
Low-Income EE Program	**101,385**	**5,474**	**3,713**	**110,572**	**0**
Equipment and Systems	0	139,129	0	0	45,205
New Construction	0	12,330	0	0	1,626
Whole Building	0	26,594	0	0	2,381
Data Centers Targeted	0	119	0	0	0
Multifamily Targeted	0	11,590	0	0	0
Small C&I EE Program	**0**	**189,762**	**0**	**0**	**49,212**
Equipment and Systems	0	0	275,670	0	86,868

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
New Construction	0	0	26,940	0	8,154
Data Centers Targeted	0	0	546	0	36
Multifamily Targeted	0	0	12,208	0	0
Large C&I EE Program	**0**	**0**	**315,365**	**0**	**95,058**
CHP Program	**0**	**0**	**26,450**	**0**	**0**
Portfolio Total	**978,096**	**196,462**	**345,890**	**110,572**	**144,271**

Source: Guidehouse analysis

Table D-4. P3TD Reported Demand Savings by Customer Segment and Carveout

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
LAH	62.65	0.03	0.00	0.00	0.00
Appliance Recycling	8.37	0.16	0.04	0.00	0.00
Whole Home	2.85	0.00	0.00	0.00	0.00
New Construction	2.02	0.00	0.00	0.00	0.00
Behavioral	0.00	0.00	0.00	0.00	0.00
Multifamily Targeted	1.63	0.00	0.00	0.00	0.00
Residential EE Program	**77.53**	**0.19**	**0.05**	**0.00**	**0.00**
Whole Home	10.44	0.92	0.57	11.93	0.00
Lighting	1.07	0.00	0.00	1.07	0.00
Low-Income EE Program	**11.51**	**0.92**	**0.57**	**13.00**	**0.00**
Equipment and Systems	0.00	19.68	0.00	0.00	5.03
New Construction	0.00	2.24	0.00	0.00	0.19
Whole Building	0.00	5.47	0.00	0.00	0.56
Data Centers Targeted	0.00	0.02	0.00	0.00	0.00
Multifamily Targeted	0.00	1.18	0.00	0.00	0.00
Small C&I EE Program	**0.00**	**28.59**	**0.00**	**0.00**	**5.78**
Equipment and Systems	0.00	0.00	39.60	0.00	12.61
New Construction	0.00	0.00	3.34	0.00	0.93
Data Centers Targeted	0.00	0.00	0.04	0.00	0.00
Multifamily Targeted	0.00	0.00	1.52	0.00	0.00
Large C&I EE Program	**0.00**	**0.00**	**44.50**	**0.00**	**13.55**
CHP Program	**0.00**	**0.00**	**2.80**	**0.00**	**0.00**
Portfolio Total	**89.04**	**29.70**	**47.91**	**13.00**	**19.33**

Source: Guidehouse analysis

Table D-5. PY11 Verified Energy Savings by Customer Segment and Carveout

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
LAH	147,719	34	2	0	0
Appliance Recycling	*18,204*	*682*	*38*	*0*	*0*
Whole Home	5,873	3	0	0	0
New Construction	1,851	0	0	0	0
Behavioral	67,056	0	0	0	0
Multifamily Targeted	2,846	0	0	0	0
Residential EE Program	**243,549**	**718**	**40**	**0**	**0**
Whole Home	29,530	2,888	3,471	35,888	0
Lighting	0	0	0	0	0
Low-Income EE Program	**29,530**	**2,888**	**3,471**	**35,888**	**0**
Equipment and Systems	0	58,472	0	0	25,477
New Construction	0	4,737	0	0	471
Whole Building	0	8,628	0	0	1,157
Data Centers Targeted	0	0	0	0	0
Multifamily Targeted	0	3,492	0	0	0
Small C&I EE Program	**0**	**75,329**	**0**	**0**	**27,105**
Equipment and Systems	0	0	107,245	0	32,504
New Construction	0	0	12,437	0	3,359
Data Centers Targeted	0	0	0	0	0
Multifamily Targeted	0	0	3,682	0	0
Large C&I EE Program	**0**	**0**	**123,363**	**0**	**35,864**
CHP Program	**0**	**0**	**816**	**0**	**0**
Portfolio Total	**273,078**	**78,935**	**127,689**	**35,888**	**62,969**

Source: Guidehouse analysis

Table D-6. PY11 Verified Demand Savings by Customer Segment and Carveout

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
LAH	18.95	0.01	0.00	0.00	0.00
Appliance Recycling	2.45	0.08	0.00	0.00	0.00
Whole Home	0.80	0.00	0.00	0.00	0.00
New Construction	0.77	0.00	0.00	0.00	0.00
Behavioral	7.65	0.00	0.00	0.00	0.00
Multifamily Targeted	0.36	0.00	0.00	0.00	0.00
Residential EE Program	***30.97***	***0.09***	***0.01***	***0.00***	***0.00***
Whole Home	3.15	0.49	0.54	4.18	0.00
Lighting	0.00	0.00	0.00	0.00	0.00
Low-Income EE Program	**3.15**	**0.49**	**0.54**	**4.18**	**0.00**

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
Equipment and Systems	0.00	10.25	0.00	0.00	4.19
New Construction	0.00	0.85	0.00	0.00	0.06
Whole Building	0.00	1.98	0.00	0.00	0.29
Data Centers Targeted	0.00	0.00	0.00	0.00	0.00
Multifamily Targeted	0.00	0.39	0.00	0.00	0.00
Small C&I EE Program	**0.00**	**13.46**	**0.00**	**0.00**	**4.54**
Equipment and Systems	0.00	0.00	17.68	0.00	5.30
New Construction	0.00	0.00	2.29	0.00	0.58
Data Centers Targeted	0.00	0.00	0.00	0.00	0.00
Multifamily Targeted	0.00	0.00	0.40	0.00	0.00
Large C&I EE Program	**0.00**	**0.00**	**20.36**	**0.00**	**5.88**
CHP Program	**0.00**	**0.00**	**0.08**	**0.00**	**0.00**
Portfolio Total	**34.13**	**14.05**	**20.99**	**4.18**	**10.42**

Source: Guidehouse analysis

Table D-7. P3TD Verified Energy Savings by Customer Segment and Carveout

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
LAH	482,483	7,330	4	0	1
Appliance Recycling	58,019	1,192	364	0	0
Whole Home	22,205	3	0	0	0
New Construction	5,921	0	0	0	0
Behavioral	277,963	0	0	0	0
Multifamily Targeted	12,495	0	0	0	0
Residential EE Program	**859,086**	**8,525**	**369**	**0**	**1**
Whole Home	86,488	3,903	3,477	93,869	0
Lighting	9,081	0	0	2,689	0
Low-Income EE Program	**95,569**	**3,903**	**3,477**	**96,558**	**0**
Equipment and Systems	0	147,318	0	0	52,386
New Construction	0	12,907	0	0	1,704
Whole Building	0	25,895	0	0	2,279
Data Centers Targeted	0	50	0	0	0
Multifamily Targeted	0	10,373	0	0	0
Small C&I EE Program	**0**	**196,543**	**0**	**0**	**56,369**
Equipment and Systems	0	0	281,058	0	92,599
New Construction	0	0	27,382	0	8,239

Program and Solution	Residential (MWh)	Small C&I (MWh)	Large C&I (MWh)	Low-Income Carveout (MWh)	G/E/NP Carveout (MWh)
Data Centers Targeted	0	0	529	0	22
Multifamily Targeted	0	0	12,056	0	0
Large C&I EE Program	**0**	**0**	**321,025**	**0**	**100,860**
CHP Program	**0**	**0**	**20,440**	**0**	**0**
Portfolio Total	**954,655**	**208,971**	**345,311**	**96,558**	**157,229**

Source: Guidehouse analysis

Table D-8. P3TD Verified Demand Savings by Customer Segment and Carveout

Program and Solution	Residential (MW)	Small C&I (MW)	Large C&I (MW)	Low-Income Carveout (MW)	G/E/NP Carveout (MW)
LAH	63.69	1.54	0.00	0.00	0.00
Appliance Recycling	8.23	0.16	0.04	0.00	0.00
Whole Home	2.68	0.00	0.00	0.00	0.00
New Construction	1.93	0.00	0.00	0.00	0.00
Behavioral	31.73	0.00	0.00	0.00	0.00
Multifamily Targeted	1.54	0.00	0.00	0.00	0.00
Residential EE Program	**109.80**	**1.70**	**0.04**	**0.00**	**0.00**
Whole Home	9.77	0.68	0.54	10.99	0.00
Lighting	1.07	0.00	0.00	0.32	0.00
Low-Income EE Program	**10.85**	**0.68**	**0.54**	**11.31**	**0.00**
Equipment and Systems	0.00	22.90	0.00	0.00	6.83
New Construction	0.00	2.23	0.00	0.00	0.19
Whole Building	0.00	4.46	0.00	0.00	0.49
Data Centers Targeted	0.00	0.01	0.00	0.00	0.00
Multifamily Targeted	0.00	1.06	0.00	0.00	0.00
Small C&I EE Program	**0.00**	**30.66**	**0.00**	**0.00**	**7.50**
Equipment and Systems	0.00	0.00	42.72	0.00	13.91
New Construction	0.00	0.00	4.82	0.00	1.64
Data Centers Targeted	0.00	0.00	0.04	0.00	0.00
Multifamily Targeted	0.00	0.00	1.47	0.00	0.00
Large C&I EE Program	**0.00**	**0.00**	**49.04**	**0.00**	**15.55**
CHP Program	**0.00**	**0.00**	**2.45**	**0.00**	**0.00**
Portfolio Total	**120.65**	**33.03**	**52.07**	**11.31**	**23.05**

Source: Guidehouse analysis

Appendix E. Participation Counts

Across PECO's portfolio, participation is calculated in significantly different ways across solutions and CSPs. Table E-1 provides an overview of the different participation definitions by program and solution.

Table E-1. Overview of Participation Definitions

Program	Solution	*Conservation* Service Provider	Participation Definition
Residential	LAH (Lighting)	CLEAResult	Sum number of total lamp packs sold
	LAH (Appliances and HVAC)	CLEAResult	Count of rebates issued
	Whole Home	CLEAResult	Count of unique premise ID
	Appliance Recycling	ARCA Recycling	Count of all orders on distinct days
	New Construction	PSD	Sum No. of participants
	Behavioral	Oracle	Sum No. of participants
	Multifamily Targeted	Franklin	Distinct count of utility account ID by program, solution, and invoice number
Low-Income	Whole Home	CMC	Count of unique premise numbers for component 1 and 2
	Whole Home	ARCA Recycling	Count of all orders on distinct days
Small C&I	Equipment and Systems	ICF	Count of unique project number
	New Construction	ICF	Count of unique project number
	Whole Building	SmartWatt	Count of unadjusted projects
	Data Centers Targeted	ICF	Count of unique project number
	Multifamily Targeted	Franklin	Distinct count of utility account ID by program, solution, and invoice number
Large C&I	Equipment and Systems	ICF	Count of unique project number
	New Construction	ICF	Count of unique project number
	Data Centers Targeted	ICF	Count of unique project number
	Multifamily	Franklin	Distinct count of utility account ID by program, solution, sector, and invoice number
CHP		Varies by participant	Count of unique project numbers
Residential DR		Itron	Count of unique account number with device status as installed or swapped and the measure code is CACS (central air conditioner switch)
Small C&I DR		Itron	Count of unique account number with device status as installed or swapped and the measure code is CACS
Large C&I DR		CPower and EnelX	Large C&I customer (defined by account number) enrolled for at least 1 hour of at least one event

Source: Guidehouse analysis

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Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129

Appendix F: Residential Energy Efficiency Program
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Program Year 11
(June 1, 2019 – May 31, 2020)

For Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

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PECO
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Appendix F. Residential Energy Efficiency Program Detail

This appendix details the evaluation methods and activities Guidehouse Inc. (Guidehouse or the evaluation team)[1] deployed in program year 11 (PY11) for select Residential Energy Efficiency (EE) Program solutions (listed below). Refer to Section 3.1 in the main body report for key evaluation findings, results, and conclusions for these solutions.

- Lighting, Appliances & HVAC (LAH)
- Appliance Recycling
- Whole Home
- New Construction
- Behavioral

The Multifamily Targeted Market Segment also contributes to the Residential EE Program; however, given its cross-program nature, evaluation details for that market segment are presented independently in Appendix I.

F.1 Lighting, Appliances & HVAC Solution

The LAH Solution offers customers energy savings opportunities by assisting them in purchasing the most efficient technology when shopping for new products. The solution provides both upstream and downstream incentives:

- **Upstream:** Point of purchase discounts to increase the market share of ENERGY STAR®-qualified light-emitting diode (LED) bulbs
- **Downstream:** Rebates for equipment sold through retail and heating, ventilation, and air conditioning (HVAC) installer sales channels (known to customers as the Home Rebates Program), and instant rebates for equipment sold through the PECO Marketplace.

Appliances and HVAC equipment rebated by the program include central air conditioners (ACs), central heat pumps, ENERGY STAR refrigerators, and high efficiency furnace fans. The solution also distributes educational materials that increase customer awareness and acceptance.

In PY9, PECO launched the PECO Marketplace as a way for customers to shop for energy efficient technologies online. The conservation service provider (CSP) Uplight (changed from Simple Energy in PY11) operates the PECO Marketplace and offers instant discounts on ENERGY STAR-qualified LED bulbs, advanced power strips, and smart/learning thermostats.

For this evaluation, participation in the upstream Lighting channel of LAH is defined as the sum of stock keeping unit (SKU) sales. A SKU describes a sold lighting product, which can be a single bulb or a multipack of bulbs.[2] For Appliances and HVAC participants, participation is defined as the total number of non-adjusted records in PECO's tracking data (participation includes power strips and thermostats sold through the PECO Marketplace). A record may

[1] On October 11, 2019, Guidehouse LLP completed its acquisition of Navigant Consulting, Inc. and its operating subsidiaries. For more information, see: https://guidehouse.com/news/corporate-news/2019/guidehouse-completes-acquisition-of-navigant.

[2] This definition is consistent with LED bulbs sold through the PECO Marketplace.

represent one or more rebated items (e.g., a single participant purchasing multiple thermostats during the same purchase event).

The COVID-19 pandemic reduced LAH Solution savings during March and April 2020, although the solution continued to offer customers ways to save energy during this period. Participation increased steadily after April as customers resumed upgrading their HVAC system and purchasing efficient appliances and LED bulbs. By the end of PY11, participation and savings generated by the solution were similar to PY10.

F.1.1 Lighting

The following subsections present the evaluation details and findings for the Lighting channel of the LAH Solution. Guidehouse conducted the following activities to verify the gross impacts and confirm CSP reporting accuracy.

- Record-level Technical Reference Manual (TRM) review
- ENERGY STAR certification verification
- Invoice review
- Incentive analysis

These analysis activities verified the solution's reported savings through a bulb-level, bottom-up recalculation of energy and demand impacts for all program bulbs incented by PECO during PY11.

F.1.1.1 Record-Level TRM Review

Guidehouse applied energy and demand savings algorithms to verified input parameters as outlined in the Pennsylvania TRM[3] to calculate impacts. The evaluation team used commercial and industrial (C&I) facility lighting usage assumptions described in the TRM to calculate savings for the portion of bulbs purchased by nonresidential customers as estimated by PY8 in-store intercept efforts. The team adjusted baseline wattages for some bulbs based on bulb characteristics and the TRM methodology for assigning baseline watts. The team applied all other TRM parameters consistent with the methodology outlined in the TRM. Guidehouse used the following methodology to verify and update baseline wattages:

1. **Generated a list of unique bulb model/description/lumens/watts/type** from the tracking data, resulting in 2,185 unique models.
2. **Applied baseline wattages** using the bulb type and lumens based on the TRM assumptions.
3. **Reviewed the bulb classification and reclassified products as necessary** to determine an appropriate baseline wattage. When the lumen values fell out of the ranges specified in the TRM, the evaluation team applied a baseline wattage equal to the advertised replacement wattage on the product. Adjustments were made for the following products:

[3] PA PUC. *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards*. Dated June 2016, errata update February 2017.

a. Candelabra base (5 models): Guidehouse found specialty decorative products with candelabra bases that should be classified as exempt products.

b. Globe (4 models): Guidehouse found four globe products less than 750 lumens that should be classified as exempt. These models were originally classified as nonexempt.

c. High lumens (11 models): Guidehouse found products with a lumen output higher than the upper bounds in the TRM tables and applied replacement wattages.

d. Reflectors (5 models): Guidehouse found several reflector bulbs classified as specialty (2) and general service (3); the team reclassified these as reflectors and applied TRM baseline wattages.

e. Downlight retrofit kits (109 models): Guidehouse classified downlight retrofits kits categorized as fixtures as BR30-equivalent based on common replacements in the market.

f. Fixtures (81 models): Guidehouse updated baseline wattage to reflect suitable general service lamp replacements rather than using the advertised replacement wattage.

g. Fixtures (5 models): Guidehouse found five fixtures classified as reflector retrofit kits that should be T8 replacements.

h. Small reflectors (26 models): For reflectors smaller than 2.5 inches, Guidehouse applied replacement wattages.

In addition to verifying baseline wattages, Guidehouse also reviewed efficient wattages against the product details in the database to confirm consistency and accuracy. Guidehouse found several records with inconsistencies:

- Fixtures (25 models): Guidehouse found 25 records for integrated fixtures where the efficient wattage did not match the product details.
- Specialty (2 models): Guidehouse found two records for specialty products with wattages listed as 9.5 W but with an actual wattage of 4 W.

These adjustments had a minor (<1%) effect on the Lighting verified program savings.

Finally, Guidehouse incorporated cross-sector sales. Per the Phase III Evaluation Plan,[4] the evaluation team applied values from the PY8 evaluation (primary research was not conducted for these values in PY9, PY10, or PY11). The evaluation team applied the cross-sector sales values on a per-retailer and per-bulb type basis, as detailed in Table F-1. For lighting sales through the PECO Marketplace, Guidehouse assumed zero cross-sector sales.

Table F-1. Cross-Sector Sales of Standard and Specialty LEDs

Stratum	Retailers	Cross-Sector Sales Ratio – Standard LED	Cross-Sector Sales Ratio – Specialty LED
Ba	Ace Hardware, BJ's Wholesale Club, Costco Wholesale, The Home Depot, Lowe's Home Improvement, Sam's Club, True Value Hardware	0.007	0.02

[4] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

Stratum	Retailers	Cross-Sector Sales Ratio – Standard LED	Cross-Sector Sales Ratio – Specialty LED
Bb	Batteries Plus Bulbs, Dollar General, Dollar Tree, Ollie's Bargain Outlet, One Dollar Zone, Target, Walgreens, Walmart	0.002	0.011
Bc	Goodwill, The Salvation Army, Simple Energy (PECO Marketplace), Uplight (PECO Marketplace), hard-to-reach retailers, and independent hardware	0	0

Source: Guidehouse analysis

For the C&I savings contributions, Guidehouse applied the same hours of use (HOU) and coincidence factor (CF) values used in PY10: 2,607 for HOU and 0.45 for CF.

F.1.1.2 ENERGY STAR® Certification Verification

The Phase III TRM stipulates that only ENERGY STAR-certified products be incented through the Lighting Solution; therefore, Guidehouse independently reviewed the unique SKUs for all PY11 program bulbs to confirm they met this requirement. The evaluation team performed several automated and manual checks to verify ENERGY STAR certification:

1. Generated a list of unique SKUs and compared it against the current (as of September 2020) ENERGY STAR bulb and fixture lists for direct matches based on model number.
2. Compared the list against archived (December 2017-December 2019) ENERGY STAR bulb and fixture lists for additional direct matches based on model number.
3. Performed a fuzzy match algorithm to find instances where a model number is present in one of the ENERGY STAR database fields representing additional model information.
4. Reached out to program and CSP staff at PECO to confirm the ENERGY STAR identification number for remaining SKUs that did not match (186 out of 2,185).

Guidehouse confirmed that all PY11 program bulbs are ENERGY STAR-certified models. The majority (1,999 out of 2,185 unique SKUs) mapped directly or indirectly based on model number to the ENERGY STAR bulb and fixture lists, with manual searches confirming the remainder.

F.1.1.3 Invoice Review

Guidehouse verified program database-reported incentive spend against PECO-provided retailer invoices. The evaluation team did not find any discrepancies based on incentives paid. Because only incentives were provided in the invoice documentation, the team could not directly verify quantities; thus, incentives are deemed as an appropriate surrogate for quantity.

F.1.1.4 Incentive Analysis

Guidehouse analyzed the minimum, maximum, and average incentive for each retailer and bulb type combination to confirm that incentives align with PECO's Phase III Energy Efficiency and

Conservation (EE&C) Plan.[5] The evaluation team found no cases where the incentives fell outside of the plan's guidelines.

The team also conducted a pricing and incentive review to compare the per-bulb incentives with the manufacturer suggested retail price (MSRP) and the expected retail price.[6] Guidehouse generally expects that the MSRP less the per-package incentive would equal the expected retail price. However, this equation does not hold true for 15,782 (8.2% of total) records. Furthermore, 1,012 cases had a higher expected retail price than the MSRP (0.5% of records). The evaluation team found similar issues from PY8 through PY10 and learned there could be a manufacturer rebate to bring down the expected retail price more than the PECO incentive. Through discussions with the PECO program manager, the team identified opportunities for PECO to continue working with the CSP and manufacturers to encourage maintenance of accurate inputs, communication of other manufacturer rebates, and updates to prices as often as possible to confirm these differences are not erroneous. Guidehouse also discussed with PECO opportunities for the CSP to institute a quality control (QC) check during data processing that would indicate an error when the MSRP is lower than the expected retail price. This finding does not materially impact the verified savings.

F.1.1.5 Results Summary

Table F-2 summarizes the results of these activities.

Table F-2. Summary of Activities and Findings for Residential Lighting

Activity	Finding	Description
Record-Level TRM Review	Guidehouse adjusted baseline wattages for several LED products (246 out of 2,185).	Guidehouse adjusted baseline wattages for a variety of lamp types. The effects of this adjustment were minor (<1%) and demonstrate that the program is accurately characterizing impacts.
	Guidehouse adjusted efficient wattage for several led products (27 out of 2,185).	Several fixture products were listed with incorrect efficient wattage values. For all models affected, the database reported both incorrect and correct efficient wattages for the model numbers, indicating inconsistent treatment of the same LED product.
	Two records (two SKUs) were reported with different savings values than expected based on the tracking database inputs.	Guidehouse found negative reported savings despite positive sales values in one case; in another case, the LED wattage value was blank.
ENERGY STAR Certification Verification	No issues, but difficulty identifying some products based on model number.	Guidehouse confirmed all program bulbs in PY11 were ENERGY STAR-certified models. The majority (1,999 out of 2,185 unique SKUs) mapped directly or indirectly based on model number to ENERGY STAR bulb and fixture lists, with manual searches confirming the remainder.

[5] PECO. *PECO Program Years 2016-2020 Act 129 – Phase III Energy Efficiency and Conservation Plan.* November 30, 2015. https://www.puc.pa.gov/pcdocs/1398320.pdf

[6] The expected retail price is the actual price a customer pays after incentives (including the PECO incentive and any other incentive, such as a manufacturer rebate).

Activity	Finding	Description
Invoice Review	No issues—all invoices match tracking database values.	Guidehouse reviewed the incentives to confirm the invoiced amount from manufacturers equals the invoiced amount in the CSP data. The evaluation team found no discrepancies.
Incentive Analysis	No issues—all incentives consistent with plan guidelines.	Guidehouse compiled the minimum, maximum, and average incentive for each retailer/bulb category/bulb type combination to confirm the incentives align with PECO's Phase III EE&C Plan. The team found no cases where the incentives fell outside the plan's guidelines.

Source: Guidehouse analysis

F.1.2 Appliances and HVAC

The following subsections present the evaluation details and findings for the non-Lighting, downstream rebate channel of the LAH Solution (i.e., the Appliances and HVAC channel).[7]

F.1.2.1 Gross Impact Evaluation

Guidehouse conducted the following activities to verify the gross impacts and to review the CSP database for accuracy in the reporting process:

- Engineering desk reviews for all measures
  - Record-level savings review: Review of energy savings calculations and assumptions per the TRM and Statewide Evaluator (SWE)-approved interim measure protocols (IMPs), using CSP-collected project data where appropriate
  - Invoice review
- Engineering file reviews and online survey verification for HVAC projects
  - HVAC participant project file review
  - HVAC participant online verification
- Online survey verification for Appliances projects

The Phase III Evaluation Plan[8] specified phone verifications for HVAC and Appliance projects, requiring the evaluation team to cold call customers to discuss their participation in the Home Rebates Program. Guidehouse piloted online verification surveys in PY11, in place of the cold calling task, to reduce the burden on customers during the pandemic. The SWE approved the online verification survey methodology in April 2020 through a memo detailing updates to the Evaluation Plan.

F.1.2.1.1 Engineering Desk Reviews

Guidehouse verified program-reported savings for all projects reported in the program tracking database, eTrack, quarterly. The evaluation team used the measure-specific variables provided in the eTrack database to populate the energy and demand savings algorithms as detailed in

[7] Known to customers as the Home Rebates Program.

[8] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

the TRM and SWE-approved IMPs to verify the reported energy and demand savings estimates. The team completed engineering desk reviews for a census of Appliances and HVAC projects reported in PY11.

Table F-3 summarizes the results of the desk review activities that had the biggest impact on the realization rate of energy savings.

Table F-3. Summary of Desk Review Activities for Residential Non-Lighting

Impact Activity	Finding	Description
Record-Level Savings Review	Air source heat pumps (ASHPs): Ex ante savings used the baseline seasonal energy efficiency ratio (SEER) value (SEERb) of 13.	The 2016 TRM defines the SEERb for ASHPs as 14. Guidehouse used the SEERb of 14 for the ex post calculations, resulting in an ASHP realization rate of 0.87 for energy savings and 0.54 for demand savings.
	ENERGY STAR air purifiers: Ex ante savings used default savings values defined in PECO's EE&C Plan instead of the savings algorithms defined in the SWE-approved IMP documentation.	Guidehouse calculated ex post savings for ENERGY STAR air purifiers using the SWE-approved IMP, resulting in a realization rate of 3.21 for energy savings and 3.22 for demand savings.
	ENERGY STAR residential clothes washers: ex ante savings used deemed integrated modified energy factor (IMEF) values defined in the TRM for PY8 and PY9.	The TRM shifted deemed minimum IMEF values for PY10 and beyond for federal standards for top- and front-loading washers (TRM, Table 2-81) and for ENERGY STAR residential clothes washers (TRM, Table 2-81, updated by ENERGY STAR Program Requirements Product Specification for Clothes Washers, version 8, effective February 5, 2018). Guidehouse used the new minimum IMEF values in the ex post calculations, resulting in a realization rate of 0.75 for both energy savings and demand savings.
	ENERGY STAR dehumidifiers: Guidehouse identified discrepancies with the ex ante liters of water per kWh consumed (L per kWh) and capacity values in eTrack.	Ex ante savings were based on a default L per kWh value instead of the values detailed in the TRM on Table 2-92. Guidehouse also found project rows with no capacity values, causing the ex post savings estimates to zero out. These factors resulted in a realization rate of 0.62 for both energy savings and demand savings.
	ENERGY STAR most efficient refrigerators: A portion of ex ante savings incorrectly used equations for ENERGY STAR refrigerators rather than the TRM table for most efficient refrigerators.	For ENERGY STAR most efficient refrigerators, equations for ENERGY STAR refrigerators were used instead of equations from TRM Table 2-73, resulting in a realization rate of 1.27 for both energy savings and demand savings.
Invoice Review	No issues.	Guidehouse reviewed the incentives to confirm that the invoice amounts in the PECO tracking database matched those from the CSP data. The team found no discrepancies.

Source: Guidehouse analysis

F.1.2.1.2 Engineering File Reviews and Online Survey Verification

This activity included a detailed engineering review of project files for HVAC participants and an online survey of participants who installed HVAC and appliances to verify equipment installation. Guidehouse received 81 completed HVAC verification surveys and requested a sample of 70 project files from the CSP to review to achieve at least 15% relative precision at the 85% confidence level for the HVAC measures, which is well above the minimum sample quotas detailed in the PY11 sample design memo.[9] The evaluation team used the project files to verify the measure-specific variables listed in the eTrack database, such as capacity (tons), SEER, and heating seasonal performance factor (HSPF). The team applied the verified variables to the TRM and IMP algorithms to calculate verified energy and demand savings for the sample.

Guidehouse received 137 completed verification surveys for Appliance projects, above the targeted 75 completes required to achieve at least 15% relative precision at the 85% confidence level in the results. The evaluation team compared the project files to the results of the online verification survey for HVAC and Appliance projects. Table F-4 summarizes the results of these project file reviews and the online survey verification.

Table F-4. Summary of Engineering File Reviews and Survey Verification for Residential Non-Lighting

Impact Activity	Finding	Description
Engineering File Reviews	High efficiency furnace fans: Guidehouse found discrepancies between the project files and verification survey for systems with heating and cooling vs. heating-only furnace fan usage.	Guidehouse found three high efficiency furnace fan projects out of 16 marked as "Heating Use Only" in the eTrack database, but all customers reported having central cooling. Energy savings are lower for furnace fans that are used for heating only than those used for heating and cooling. The evaluation team was only able to verify one of these systems using the project files and adjusted energy savings accordingly. The team did not adjust energy savings for the other two systems.
	ENERGY STAR refrigerators: Guidehouse identified discrepancies regarding the ice-through-the-door feature.	Two customers reported not having the ice-through-the-door feature on their refrigerator, but the tracking database showed savings with the ice-through-the-door feature. An additional customer reported having the ice-through-the-door feature, but the tracking database showed savings without such a feature. Guidehouse used the conservative estimate of savings for all three customers.
	Ductless mini-split heat pumps: customers reported different counts of indoor units than documented in the project files.	The number of ductless mini-split room units did not match for two of the 10 projects reviewed: • The first project showed one room unit in the project file documentation, but the customer reported having four room units. • The second project showed one room unit in the project file documentation, but the customer reported having five room units. Guidehouse did not adjust gross savings to include additional room units due to the lack of information on HOU and other criteria.

Source: Guidehouse analysis

[9] Guidehouse. *PECO PY11 Lighting, Appliances, and HVAC Impact and Process Sample Design.* Revised March 4, 2020.

F.1.2.2 Net Impact Evaluation

Guidehouse conducted net-to-gross (NTG) analysis for the Appliances and HVAC channel of the LAH Solution in PY11. This section details the methods and results of the NTG analysis.

F.1.2.2.1 NTG Methodology

Guidehouse surveyed a sample of participants to gather information on free ridership and spillover and to estimate NTG ratios by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[10]

Using the Phase III Evaluation Framework[11] methodology, Guidehouse asked program participants identified as decision makers if they would have purchased all, some, or none of the same program measures in the absence of the Home Rebates Program. The evaluation team also asked participants to rate the influence of several key program elements in their decision to participate, including the program's educational materials and marketing, the rebate offered through the program, utility and program staff, and where applicable, the contractor who installed the new equipment.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE upgrades influenced by the Home Rebates Program but completed without receiving a rebate. Guidehouse prompted customers with examples of technologies available for upgrades and applied deemed savings values to quantify the responses.

F.1.2.2.2 NTG Sampling

Guidehouse stratified the population of Appliances and HVAC channel participants by project type. Using the four highest energy-saving project types for each channel (Appliances and HVAC) and a fifth other category, Guidehouse created 10 strata as defined in Table 3-7 and summarized by delivery mechanism in Table F-5.

F.1.2.2.3 NTG Results

Guidehouse calculated NTG results by strata as Table F-5 shows.

Table F-5. Appliances and HVAC NTG Results

Stratum	Free Ridership Result	Estimated Participant Spillover	NTG Ratio
Total Appliances	0.49	1.07	1.58
Total HVAC	0.45	0.33	0.88
Appliances and HVAC Channel Total	**0.46**	**0.48**	**1.02**

Source: Guidehouse analysis

[10] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

[11] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

Free ridership for the LAH Appliances and HVAC channel is high at 0.46% overall. Customers are becoming increasingly aware of EE products and nearly half of the participants in PY11 reported they would have purchased the efficient equipment regardless of the PECO incentive.

Customers purchasing efficient appliances through the program also had a high spillover rate—participants were influenced to purchase additional EE products without applying for the incentive. These customers purchased their qualifying appliances at retail outlets advertising PECO's program and reported taking additional actions to reduce energy use because of the program marketing. Customers upgrading their HVAC systems worked primarily with HVAC contractors and reported lower spillover rates. The PECO marketing material in retail stores is operating as intended by influencing customers to consider additional ways to save energy, where the marketing material left behind by contractors is having less of an impact on customer decision-making.

F.1.2.3 Process Evaluation

Guidehouse performed a process evaluation for the Residential EE Program and its solutions during PY11.[12] For the Appliances and HVAC channel, the process evaluation activities included the following:

- PECO and CSP staff interviews
- Program materials review
- Online participant surveys to assess how customers heard about the Appliances and HVAC channel, sources customers use to find information on saving energy, customer satisfaction with the program, and the likelihood to recommend the program to others. Guidehouse segmented the survey sample according to participation type.

PECO and the CSP, CLEAResult, worked through participation issues at the onset of the pandemic. Overall, the program had relatively steady participation throughout the year, as customers continued to purchase appliances for their home and apply for program incentives. HVAC installations increased once contractors were allowed to visit homes and upgrade HVAC systems. Non-Lighting participation decreased by approximately 1,000 participants between PY10 and PY11,[13] but savings were similar between the two program years as more customers installed efficient HVAC systems in PY11, generating greater overall energy savings.

F.1.2.3.1 Methodology

The evaluation team used in-depth interviews with PECO and CSP staff and reviewed program materials to document program approaches and gain insight into ways the market reacted to the Appliances, HVAC, and PECO Marketplace channels of the LAH Solution in PY11.

The team also conducted online surveys with participating customers to understand perceptions of the program, gather feedback on possible program improvements, and measure free ridership and spillover. Guidehouse sampled participants from each program channel, HVAC

[12] Guidehouse last surveyed LAH Solution participants in the PY8 evaluation year. Guidehouse did not survey participants in the Lighting channel of LAH in PY11.

[13] PY10 participation was approximately 33,700 non-Lighting channel participants, while PY11 was approximately 32,800 participants.

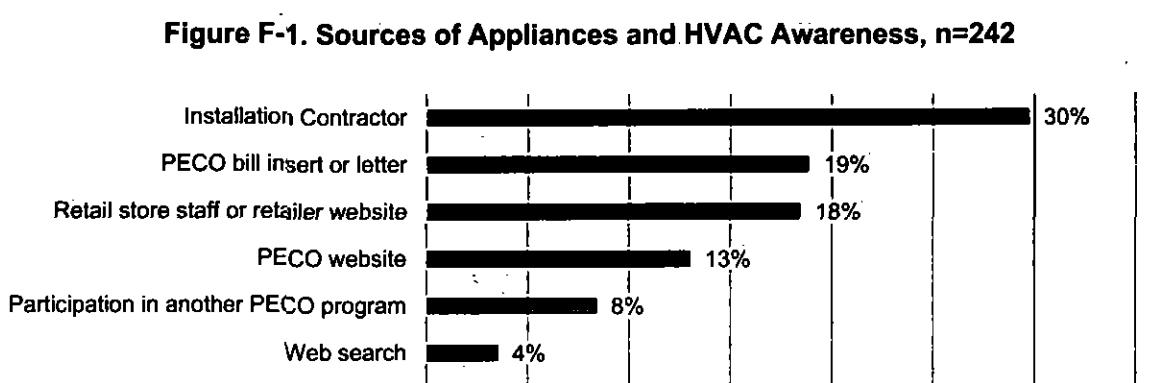
and Appliances, and by project type to create 10 strata. The sampling methodology is discussed in Section 3.1.4 in the main body report.

F.1.2.3.2 Findings

Interviews with PECO and CSP staff found the Appliances and HVAC channel is operating as intended for PY11. The solution's marketing and online presence makes participation easy and clear. Guidehouse tested customer service inquiries, both through email and online chat, and found near-real-time responses from utility and CSP staff.

Guidehouse focused on sources of awareness, ways customers learn about saving energy, and overall program satisfaction in the results from the customer experience surveys conducted in PY11. As Figure F-1 shows, 30% of customers surveyed learned about the solution from an installation contractor, 19% from a PECO bill insert, and another 18% from retail store staff or retailer website. Participation in another PECO program (8%) emerged as a new source of customer awareness as compared to the results from the prior customer survey conducted in PY8.

Figure F-1. Sources of Appliances and HVAC Awareness, n=242

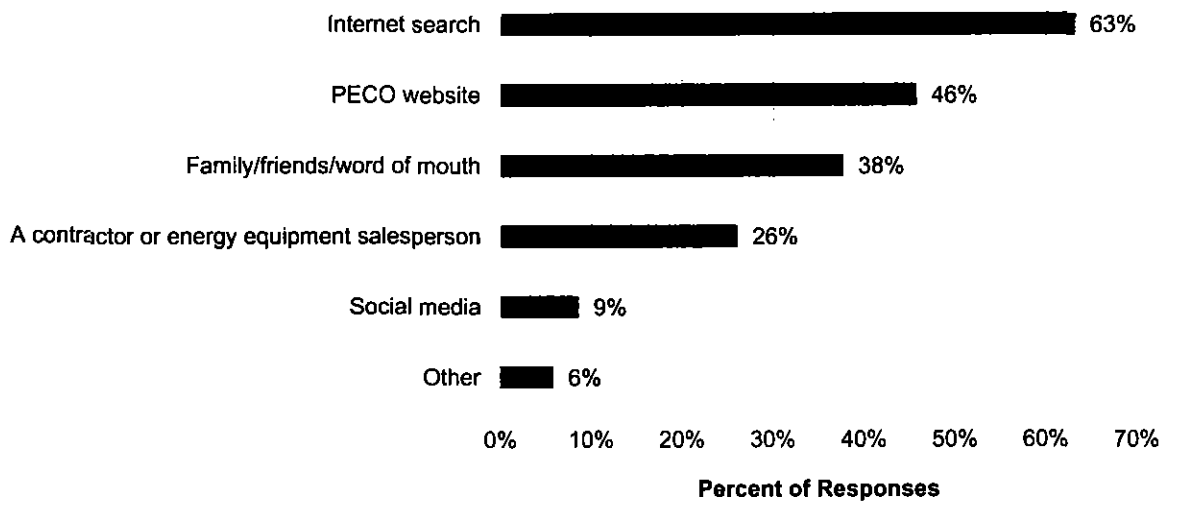


Question: "How did you learn about the [Solution] program?"
Other responses include information on product packaging, TV advertisement, and known industry knowledge.
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Appliances and HVAC customers cited internet searches (63%) and the PECO website (46%) as the two most common ways they find information on ways to save energy[14] (Figure F-2).

[14] This question allowed for multiple responses.

Figure F-2. Sources of Information on Ways to Save Energy, n=242

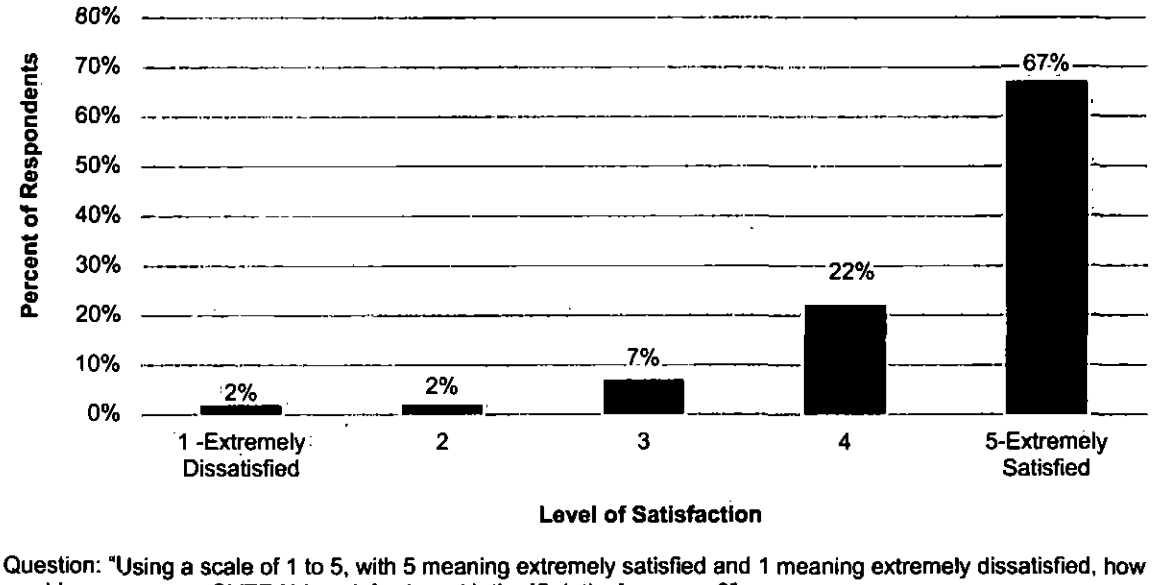


Question: "Where do you typically look for information on ways to save energy?" Multiple responses allowed, so percentages do not add up to 100%.
Other responses include appliance stores, retail websites, consumer reports, magazines and newspapers, and PECO bill inserts.
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Using a scale from 1 to 5, with 1 meaning extremely dissatisfied and 5 meaning extremely satisfied, the Appliances and HVAC channel received an average customer satisfaction rating of 4.5. Of participants, 89% reported being satisfied with the program, citing the types of equipment eligible for a rebate through the program and the contractor installing their HVAC system as drivers of satisfaction. Drivers for dissatisfaction included complaints with the complexity and difficulty of the rebate process, and confusion with the specific types of equipment qualifying for the incentive. PECO and CLEAResult improved the incentive application in PY10 and PY11 to streamline the process and reduce confusion for potential participants.

Figure F-3 summarizes the satisfaction ratings provided by Appliances and HVAC participants.

Figure F-3. Overall Satisfaction with Appliances and HVAC, n=242



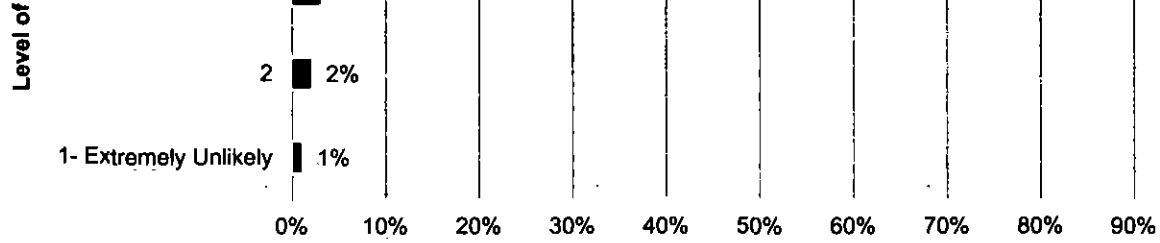
Question: "Using a scale of 1 to 5, with 5 meaning extremely satisfied and 1 meaning extremely dissatisfied, how would you rate your OVERALL satisfaction with the [Solution] program?"

Note: Do Not Know responses have been excluded.

Source: Guidehouse analysis

The majority (95%) of respondents stated that they were likely or extremely likely to recommend the Appliances and HVAC channel to others, as Figure F-4 shows.

Figure F-4. Likelihood of Recommending Appliances and HVAC to Others, n=242



Question: "On a scale of 1-5, with 5 meaning extremely likely and 1 meaning extremely unlikely, overall, how likely are you to recommend PECO's [Solution] to others?"

Note: Do Not Know responses have been excluded.

Source: Guidehouse analysis

F.1.3 PECO Marketplace

The following subsections present the evaluation details and findings for the PECO Marketplace channel of the LAH Solution.

F.1.3.1 Gross Impact Evaluation

Guidehouse conducted engineering desk reviews and a record-level TRM review for all strata in the PECO Marketplace to verify the gross impacts and to check the CSP database for reporting accuracy.

F.1.3.1.1 Engineering Desk Reviews

Guidehouse applied the same desk review process for the PECO Marketplace channel as the downstream Appliances and HVAC channel, including quarterly verification of program-reported savings in the program tracking database, eTrack. The evaluation team used the measure-specific variables listed in the eTrack database to populate the energy and demand savings algorithms as detailed in the TRM and SWE-approved IMPs to verify the reported savings estimates. The team completed desk reviews for a census of PECO Marketplace non-Lighting measures.

Table F-6 summarizes the results of these desk review activities.

Table F-6. Summary of Desk Review Activities for PECO Marketplace

Impact Activity	Finding	Description
Record-Level Savings Review	Smart/learning thermostats: Guidehouse could not source the heating energy savings factor in the ex ante calculations.	Guidehouse reviewed all applicable data sources for the heating energy savings factor values used in the ex ante calculations but were unable to replicate the savings estimates. The team used the SWE-approved IMP in the ex post calculations, resulting in a realization rate of 1.05 for energy savings.

Source: Guidehouse analysis

F.1.3.2 Net Impact Evaluation

Guidehouse conducted NTG analysis for the PECO Marketplace in PY11. This section details the methods and results of the NTG analysis.

F.1.3.2.1 NTG Methodology

Guidehouse surveyed a census of PECO Marketplace participants to gather information on free ridership and spillover and estimate NTG ratios. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[15]

Guidehouse asked program participants identified as decision makers if they had planned to purchase energy efficient equipment while online that day, and if they would have purchased all, some, or none of the same technologies if the PECO Marketplace did not exist. The evaluation

[15] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

team also asked participants to rate the influence of other key program elements in their decision to purchase products on the PECO Marketplace, including the instant rebate offered through the PECO Marketplace, the importance of energy savings and environmental considerations, PECO marketing, and recommendations from friends, family, or associates.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE activities influenced by the PECO Marketplace but completed without receiving a rebate. Guidehouse engineered approximate savings estimates for the reported energy-saving activities to quantify attributable spillover savings.

Estimating the NTG ratio for LED bulbs through the PECO Marketplace required assumptions for gross savings estimates by bulb type. Typically, Guidehouse uses gross energy savings by sample point to estimate the NTG ratio, but the CSP treats PECO Marketplace bulb sales the same as upstream lighting sales and does not capture customer data (e.g., names, emails, or phone numbers). The evaluation team was able to obtain customer contact data from the PECO Marketplace implementer (Uplight) but could not map it back to the reported savings. The team estimated an average bulb savings by type and was able to map that bulb type to the customer data. Guidehouse applied the survey participant free ridership result to the average bulb savings estimate to calculate the NTG ratio.

F.1.3.2.2 NTG Sampling

Guidehouse surveyed a census of all PECO Marketplace participants rather than pulling a stratified sample.

F.1.3.2.3 NTG Results

Guidehouse calculated NTG results by technology as detailed in Table 3-8. The PECO Marketplace total is shown in Table F-7.

Table F-7. PECO Marketplace NTG Results

Stratum	Free Ridership Result	Estimated Participant Spillover	NTG Ratio
Marketplace Total	**0.32**	**0.03**	**0.71**

Source: Guidehouse analysis

PECO Marketplace participants reported high free ridership for smart/learning thermostats. This group intended to purchase a smart thermostat and visited the PECO Marketplace to find one. LED bulbs had a lower free ridership, meaning customers were influenced by the instant rebate offered by the PECO Marketplace in their decision to purchase the bulbs.

PECO Marketplace participants reported minimal spillover, identifying few energy efficient activities attributable to their PECO Marketplace experience.

F.1.3.3 Process Evaluation

Guidehouse performed the following process evaluation activities in PY11 for the PECO Marketplace:

- PECO and CSP staff interviews
- Program materials review
- Online participant surveys to assess how customers heard about the PECO Marketplace, sources customers use to find information on saving energy, customer satisfaction with the PECO Marketplace, and the likelihood to recommend the PECO Marketplace to others. Guidehouse segmented the survey sample according to participation type, as outlined in Section F.1.3.3.1.

F.1.3.3.1 Methodology

The evaluation team used in-depth interviews with PECO and CSP staff and reviewed program materials to document program approaches and gain insight into ways the market reacted to the PECO Marketplace in PY11.

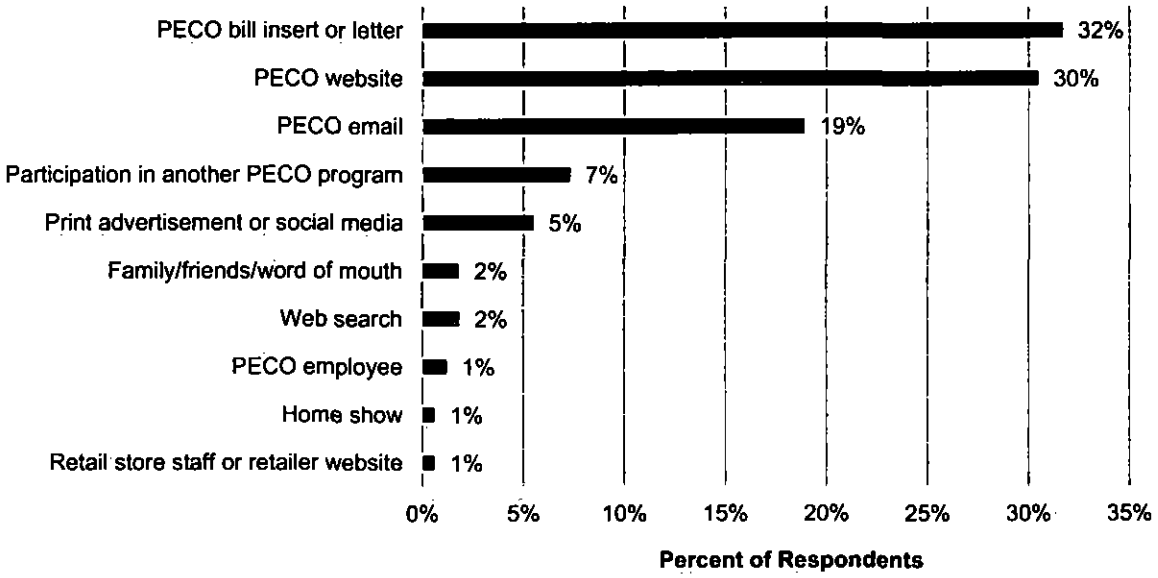
The team also conducted online surveys with participating customers to understand perceptions of the program, gather feedback on possible program improvements, and to measure free ridership and spillover. The sampling methodology is discussed in Section 3.1.4 in the main body report.

F.1.3.3.2 Findings

Interviews with PECO and CSP staff and the review marketing materials found the PECO Marketplace is operating as intended for PY11. The PECO Marketplace provides clear instructions and installation videos for smart thermostats, meeting the TRM requirement for estimating savings, and does not include A-19 bulbs phased out as a part of the Energy Independence and Security Act of 2007 (EISA).

Guidehouse analyzed the results of the PY11 customer experience surveys to find sources of awareness of the PECO Marketplace, ways customers learn about saving energy, overall satisfaction with the PECO Marketplace, and likelihood to recommend the PECO Marketplace to others. As Figure F-5 shows, respondents most frequently learned about the PECO Marketplace through a PECO bill insert or letter (32%), the PECO website (30%), or a PECO email (19%), indicating that current PECO-branded outreach methods are effective.

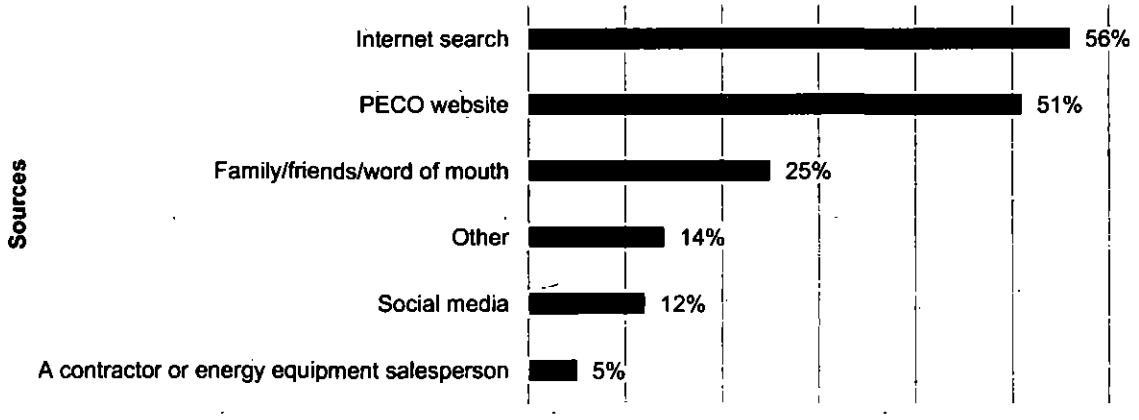
Figure F-5. Sources of PECO Marketplace Awareness, n=164



Question: "How did you learn about the Marketplace?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Customers reported internet searches (56%) and the PECO website (51%) as their top sources of information on ways to save energy, as Figure F-6 shows.

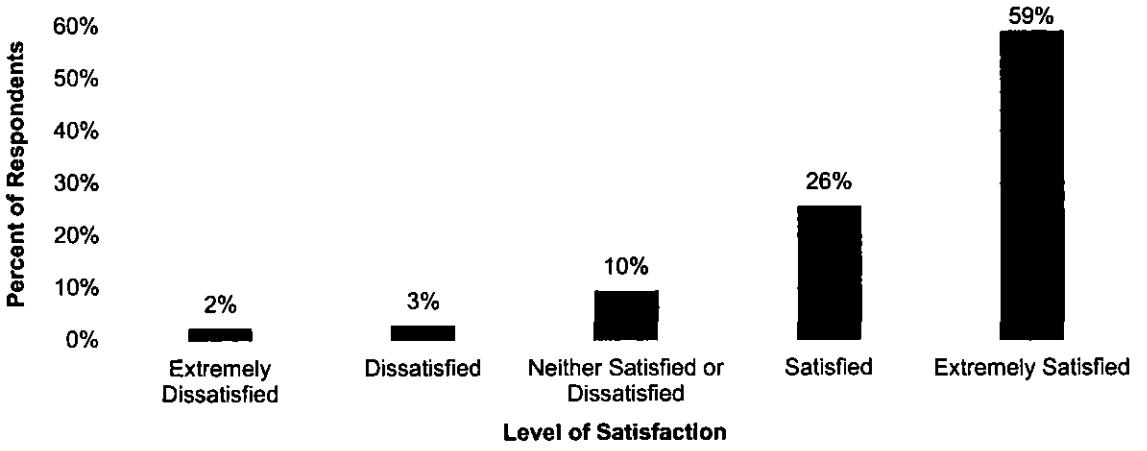
Figure F-6. Sources of Information on Ways to Save Energy, n=156



Question: "Where do you typically look for information on ways to save energy? Select all that apply."
Note: Multiple responses allowed, so percentages do not add up to 100%; Do Not Know responses have been excluded.
Source: Guidehouse analysis

Using a scale from 1 to 5, with 1 meaning extremely dissatisfied and 5 meaning extremely satisfied, the PECO Marketplace received an average customer rating of 4.4, with 59% of respondents rating the PECO Marketplace a 5 and 26% rating it a 4 (Figure F-7). Drivers of dissatisfaction included issues with customer service, product shipment speed, and limited selection of products offered on the PECO Marketplace.

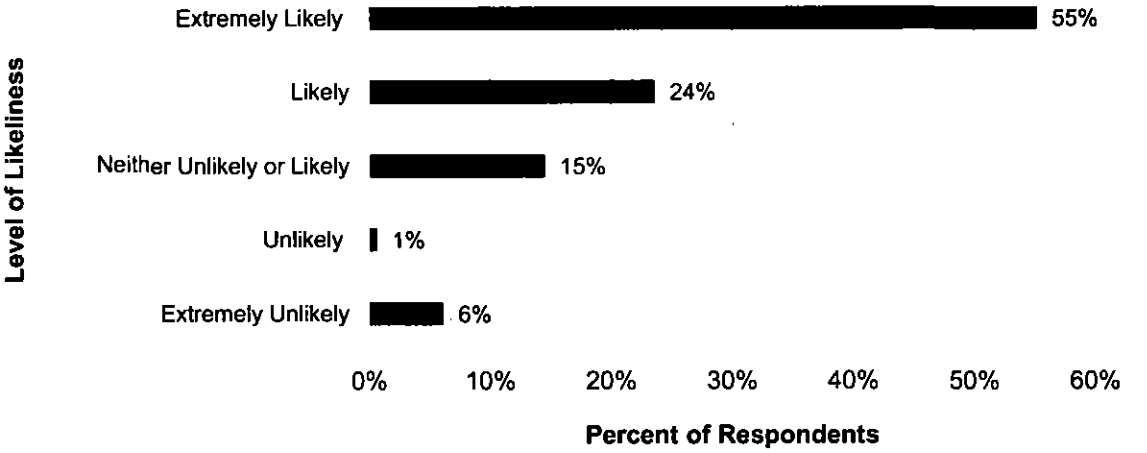
Figure F-7. Overall Satisfaction with PECO Marketplace, n=167



Question: "Using a scale of 1 to 5, with 1 meaning "Extremely Dissatisfied" and 5 meaning "Extremely Satisfied," how would you rate your OVERALL satisfaction with the Marketplace?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Of respondents, 79% reported they were likely to recommend the PECO Marketplace to others, as Figure F-8 shows.

Figure F-8. Likelihood of Recommending PECO Marketplace to Others, n=165



Question: "On a scale of 1-5, with 1 meaning "Extremely Unlikely" and 5 meaning "Extremely Likely," overall, how likely are you to recommend PECO's Marketplace to others?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

F.2 Appliance Recycling Solution

The Appliance Recycling Solution helps customers recycle energy-wasting appliances by removing and recycling operating, inefficient refrigerators, freezers, and room ACs from residential customer sites at no cost to participants. ARCA is the CSP for this solution.

A participant is a customer who schedules a pickup for one or more units. If the same customer initiates multiple pickup orders during the year, each order is counted as an individual participant. However, if a customer initiates more than one order on the same day, those orders count as a single participant. In PY11, the CSP shifted to a contactless pickup method due to the pandemic. This change is viewed as temporary to practice social distancing health and safety recommendations.

Customers may be referred to the Appliance Recycling Solution through other solution activities. For example, Low-Income EE Program Whole Home Solution auditors may identify a qualifying appliance and recommend the Appliance Recycling Solution to the customer. A customer who implements Whole Home measures and recycles an appliance would be considered a participant in both solutions. Findings in this section can be attributed to both the Residential and Low-Income Programs. Savings attributable to income-eligible customers are reported through the Low-Income EE Program Whole Home Solution.

F.2.1 Gross Impact Evaluation

Guidehouse verified participation counts and conducted three primary evaluation tasks to verify gross impacts for the Appliance Recycling Solution in PY11.

- Conducted an algorithm review using the default coefficients and independent variable values specified in Table 2-78 of the TRM.
- Used a regression analysis to refine the deemed gross verified savings to account for the program's specific appliance stock characteristics—average age, size (cubic feet), and configuration, among others.
- Conducted an online survey to verify the appliance characteristics recorded in the tracking data and to gather additional data as inputs to the part-use factor (PUF) of the TRM's algorithm.

The analysis outputs, coupled with the PUF, formed the basis for the gross verified savings related to compliance. This calculation yields a gross savings per unit that, when summed, yields the solution's verified savings. This section summarizes the findings of these activities.

F.2.1.1 Participant Counts

Guidehouse analyzed participation counts as part of the evaluation and did not find any difference from reported participation counts.

F.2.1.2 Gross Verification Findings

Guidehouse conducted an algorithm review using the default coefficients and independent variable values specified in Table 2-78 of the TRM. The evaluation team performed this review on a census of recycled units in the program tracking data to determine whether the deemed

values were properly applied when calculating program savings. The team calculated a lower annual unit energy consumption (UEC) value for freezers and a higher UEC for refrigerators (Table F-8) than reported in the tracking data. This discrepancy is the result of incorrect inputs for the pre-1990 independent variable, which the TRM specifies should be calculated using electric distribution company (EDC)-gathered data and not a prescribed deemed value.

During the algorithm review, the evaluation team discovered a number of appliance ages to be outside a normal range. Many of these appliances had ages greater than 60 years up to 99 years of age. In order to alleviate the chance of over or under estimating energy savings, the implementor should use the appliances actual year of manufacture.

The room AC annual UEC, 159 kWh/yr, is specified in the TRM and was correctly applied in the tracking data. However, the three deemed UEC values are only a check and do not factor into the final verified savings.

The evaluation team refined the gross verified savings to account for the program's specific appliance stock characteristics—average age, size (cubic feet), and configuration, among others—as recorded in the program tracking data. In this case, the regression analysis used the coefficients detailed in the TRM and the measure stock characteristics for the algorithm's independent variables. The team conducted this analysis on a census of recycled units. The regression analysis of the recycled stock calculated a higher UEC for refrigerators than the deemed values and a lower UEC for freezers (Table F-8). As specified by the TRM, Guidehouse used the deemed room AC UEC value.

The evaluation team also conducted an online survey to verify the appliance characteristics recorded in the tracking data and to gather additional data as input to the PUF. Survey respondents reported a lower PUF than the default values for Residential EE measures and a higher PUF for Low-Income measures (Table F-8). The PUF for refrigerators and freezers is the primary driving factor for the solution's realization rate differing from 1.00. There is no room AC PUF.

Table F-8. Appliance Recycling Impact Evaluations Values

Sector	Measure	Reported UEC (kWh/yr)	TRM UEC (kWh/yr)	PUF
Residential	Refrigerators	945	1,114	95.2%
Residential	Freezers	844	798	79.3%
Low-Income	Refrigerators	945	1,087	97.6%
Low-Income	Freezers	844	736	100%
Residential/Low-Income	Room AC	159	159	-

Source: Guidehouse analysis

Refer to Table 3-5 and Table 3-6 in the main body report for all energy, demand, and realization rate values. This includes refrigerator, freezer, and room AC verified savings values.

F.2.2 Net Impact Evaluation

Guidehouse conducted NTG analysis for the Appliance Recycling Solution in PY11. This section details the methods and results of the NTG analysis.

F.2.2.1 NTG Methodology

Guidehouse surveyed a sample of participants to gather information on free ridership and estimate NTG by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[16]

Using the Evaluation Framework[17] methodology, Guidehouse asked program participants identified as decision makers if they would have kept or discarded their equipment in the absence of the Appliance Recycling Solution.[18] The team probed participants further about their plans to use the equipment had they not recycled it through the solution, as well as how they may have chosen to discard the equipment in absence of the solution. Responses helped Guidehouse quantify the energy savings attributable to each participant and calculate a weighted average NTG ratio for the solution.

F.2.2.2 NTG Sampling

Guidehouse stratified the population of Appliance Recycling participants by the type of equipment recycled through the program, refrigerators, freestanding freezers, and room ACs.

F.2.2.3 NTG Results

Guidehouse calculated NTG results by strata as shown in Table 3-8 in the main body report. Participants reported high free ridership, intending to get rid of their appliance without the help of the Appliance Recycling Solution. Guidehouse probed this group to identify exactly how they planned to get rid of their appliances and verified these units would have been completely removed from service.

F.2.3 Process Evaluation

Guidehouse performed targeted process evaluation for the Residential EE Program and its solutions during PY11. For the Appliance Recycling Solution, this included PECO and CSP staff interviews.

F.2.3.1 Methodology

The evaluation team used in-depth interviews with PECO and CSP staff to collect data regarding program implementation in PY11. The interviews focused on implementation strategies, data tracking, program management, and areas for program improvement. The team also conducted online surveys with participating customers in conjunction with impact evaluation verification to better understand customer perceptions of the program and to measure free ridership and spillover. Guidehouse sampled participants based on three participation types: Refrigerator(s), Freezer(s), and AC(s). The sampling methodology is discussed in Section 3.1.4 in the main body report.

[16] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

[17] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

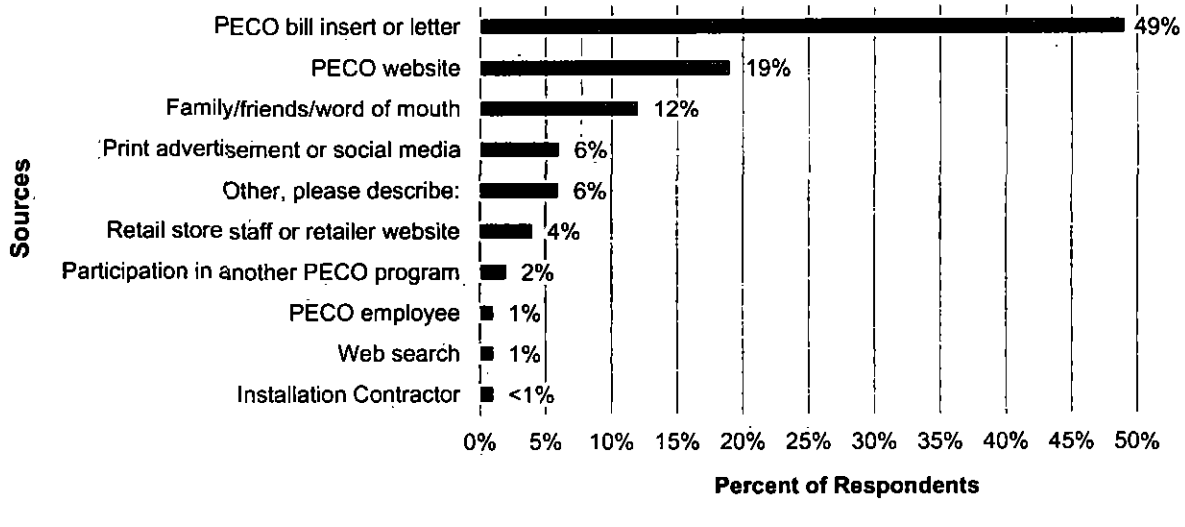
[18] Guidehouse did not survey low-income participants for NTG results.

F.2.3.2 Findings

As Figure F-9 shows, nearly half of respondents (49%) learned about the solution through a PECO bill insert or letter. Other common sources of awareness included information on the PECO website (19%) and friends and family (12%). These responses are similar to PY8 in which respondents most frequently reported learning about the program through a PECO bill insert (57%), family or friends (word of mouth) (13%), and the PECO website (9%). These sources continue to drive program awareness and remain valuable marketing channels.

Few participants learned about the program from an installation contractor (<1%) or retail staff or retailer website (4%). Print advertisements or social media (6%) are also low sources of customer awareness. Other responses included advertisements on television, radio or local news channels, and PECO emails.

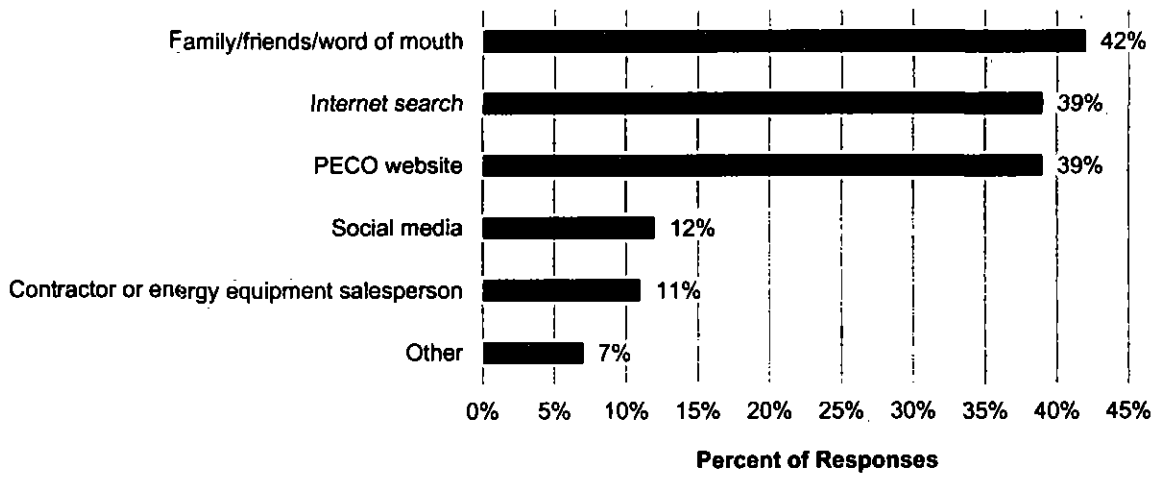
Figure F-9. Sources of Appliance Recycling Solution Awareness, n=269



Question: "How did you learn about the [Solution] program?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Respondents most frequently indicated family, friends, or word of mouth (42%), the PECO website (39%), and internet searches (39%) as places they typically look for information on ways to save energy, as Figure F-10 shows.

Figure F-10. Sources of Information on Ways to Save Energy, n=260

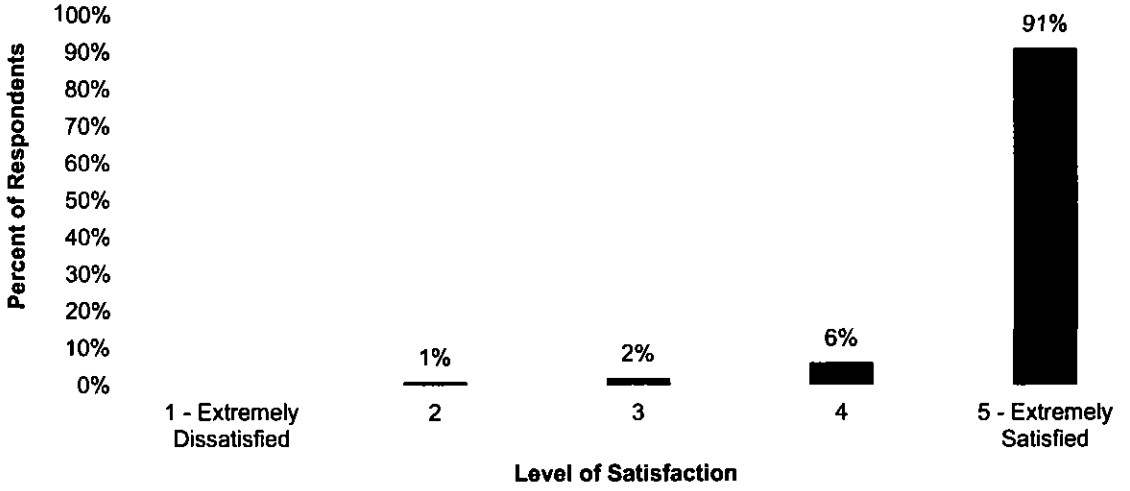


Question: "Where do you typically look for information on ways to save energy? Select all that apply."
Note: Multiple responses allowed, so percentages will not add up to 100%; Do Not Know responses have been excluded.
The other response category includes PECO mail inserts or emails, news sources, and Pennsylvania utility websites.
Source: Guidehouse analysis

Using a scale from 1 to 5, with 1 meaning extremely dissatisfied and 5 meaning extremely satisfied, the Appliance Recycling Solution received an average customer rating of 4.9, with 97% of respondents noting satisfaction or extreme satisfaction, an increase of 4 percentage points since PY8. Very few (1%) respondents reported being dissatisfied with the solution. No respondents indicated they were extremely dissatisfied with the program.

On average, respondents reported the highest satisfaction with communication by PECO, effort to schedule an appointment, and service of the pickup crew. Figure F-11 summarizes the satisfaction ratings provided by survey respondents when asked about the Appliance Recycling Solution specifically.

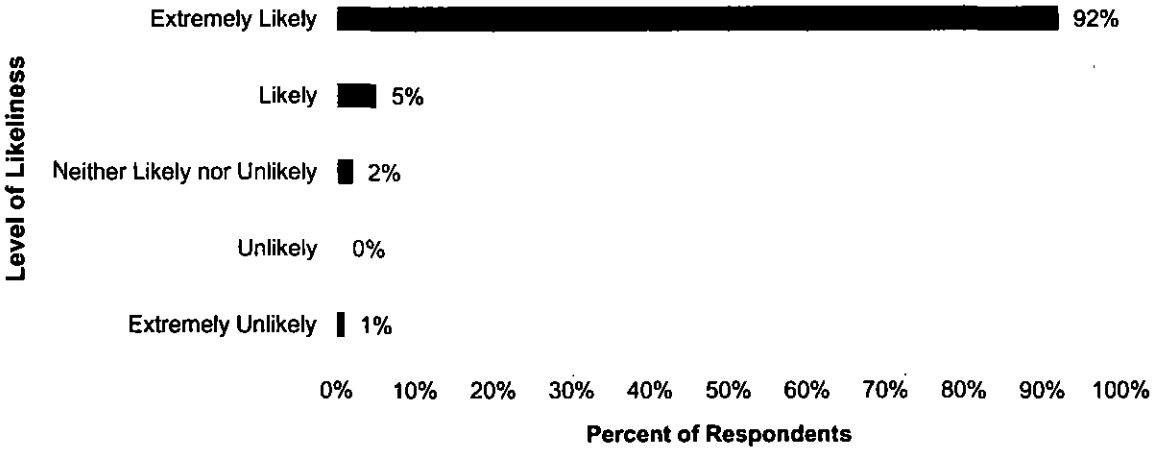
Figure F-11. Overall Satisfaction with Appliance Recycling Solution, n=270



Question: "Using a scale of 1 to 5, with 1 meaning "Extremely Dissatisfied" and 5 meaning "Extremely Satisfied," how would you rate your OVERALL satisfaction with the [Solution] program?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Most respondents (92%) said they were extremely likely to recommend the Appliance Recycling Solution to another person, an increase of 4 percentage points from the last customer survey conducted in PY8. Very few (1%) respondents said they were extremely unlikely to recommend the solution. Figure F-12 summarizes respondents' likelihood to recommend the program to others.

Figure F-12. Likelihood of Recommending Appliance Recycling Solution to Others, n=270



Question: "On a scale of 1-5, with 1 meaning "Extremely Unlikely" and 5 meaning "Extremely Likely," overall, how likely are you to recommend PECO's [Solution] program to others?"
Source: Guidehouse analysis

F.3 Whole Home Solution

PECO's Whole Home Solution is for customers who want to understand how to improve the energy performance of their entire home. This solution offers a general walkthrough assessment available to all PECO residential customers and a more comprehensive audit, including blower door and combustion safety tests, to PECO residential electric heat customers or customers with central AC. Participating customers are sorted into one of these two categories based on the outcome of an initial screening call with CSP staff. During the assessment or audit site visits, customers receive direct installation of efficient products (such as lighting, power strips, and pipe insulation for electric domestic hot water tanks). Customers with electric heat may be eligible for additional thermal envelope improvements (insulation and air sealing).

Customers may also participate through a retail pathway available for larger HVAC measures:

- Fuel switching – gas, propane, or oil heat to electric heat
- Fuel switching – fossil fuel water heater to electric hot water heater
- Heat pump water heater
- Variable speed pool pump

Customers may be directed to the retail pathway through the walkthrough assessment, audit, or direct referral from customer service or a contractor. Customers may participate in one or the other, or both pathways.

The Residential Whole Home Solution stopped in-home assessments and measure installations in March 2020 due to the impacts of the pandemic. Major measure rebates continued to be offered during this time, although participation decreased compared to PY10. During the stoppage, program staff have been developing and piloting a virtual in-home assessment option; virtual assessments were not conducted in PY11.

F.3.1 Gross Impact Evaluation

The impact evaluation focused on verifying reported savings and determining the degree to which reported and verified savings were consistent with planned savings. PY11 impact evaluation activities included a tracking database analysis, phone verifications, and desk reviews of a sample of projects.

F.3.1.1 Tracking Database Review

Guidehouse evaluated reported savings through a preliminary database review, comparing reported savings with TRM assumptions and algorithms. The team conducted this analysis on a census of reported measures, resulting in an adjustment to reported savings. The database review identified six discrepancies between reported savings and verified savings, as Table F-9 shows.

Table F-9. Residential EE Program Whole Home Solution Tracking Database Review

Measure	Discrepancy	Observations	Measure kWh Realization Rate	Measure kW Realization Rate
Residential Air Sealing	All single-family (SF) attached homes are using a default savings value.	The TRM states that savings for this measure are for SF detached homes only. However, the SWE has provided guidance that savings for these attached homes should use the same TRM algorithm as the SF detached home.	1.04	1.33
Crawl Space Insulation	The calculations for projects with ASHPs as the unit type are inconsistent based on tracking data inputs. Guidehouse was able to verify calculated savings for six out of the 12 ASHP projects.	Use the same TRM methodology for all calculated savings or confirm that all variables presented in the tracking data are accurate.	0.92	1.00
Floor Insulation	The database is missing key inputs to complete TRM calculation. The measure was reported as a custom savings measure and applied default values of 0.34 kWh and 0.00008 kW. Savings only account for cooling activities. ASHP heating savings were not calculated.	Calculate savings based on the floor insulation IMP. Key inputs such as heating system type, heating system efficiency, cooling system type, cooling system efficiency, roof area, roof baseline, wall area, and wall R-value need to be captured to calculate savings.	3.49	4.40
Knee Wall Insulation	The database is missing key inputs to complete TRM calculation. The measure was reported as a custom savings measure and applied default values of 1.01 kWh and 0.00029 kW.	Calculate savings based on the ceiling/attic and wall insulation measure. Key inputs such as heating system type, heating system efficiency, cooling system type, cooling system efficiency, roof area, roof baseline, wall area, and wall R-value need to be captured to calculate savings.	N/A	N/A
Duct Insulation	The database is missing key inputs to complete the TRM calculations.	Record project city, cooling system capacity, cooling system efficiency, heating system capacity, and heating system efficiency to calculate savings based on duct insultation IMP.	N/A	N/A

Measure	Discrepancy	Observations	Measure kWh Realization Rate	Measure kW Realization Rate
Rim Joist Insulation	One site's savings did not match the reported variables in the tracking data. This site also reports 0 kW savings.	Baseline R-value, installed insulation R-value, length and height of rim joist, cooling and heating degree days, SEER, heating system efficiency, and equivalent full load hours of air conditioning presented in the tracking data should align with reported savings.	0.99	1.00

Source: Guidehouse analysis

Discrepancies between reported savings and verified savings identified in the tracking database review are incorporated in the phone verification savings results detailed in Section F.3.1.2. Although Guidehouse confirmed measure installation, the phone verification realization rates reflect TRM inputs and tracking database review results.

F.3.1.2 Phone Verification and File Review

Guidehouse used phone verification to confirm measure installation. The evaluation team used a random sample of projects from the population of program participants in the PY11 tracking database for its sampling strategy. The team selected sampled projects based on project size to confirm the sample reflected the participant population. Large projects (defined as reported savings >1,874 kWh) and medium projects (defined as reported savings between 1,330 kWh and 1,874 kWh) were sampled for onsite verifications. Small projects (308 kWh-1,329 kWh) were sampled for phone verification. The team did not sample very small projects (<308 kWh); instead, small project strata realization rates were applied to the very small project strata.

The evaluation team used phone verifications to confirm product installation. In cases where a customer could not remember the quantity of products installed, Guidehouse relied on the reported savings values. In cases where a customer provided definitive quantity values, the team used the customer's reported values and adjusted the verified savings accordingly.

Differences between reported and verified savings were because of the following reasons:

Phone verification: Guidehouse verified installations at 17 sites. Of the 17 sites, four were Small Strata, five were Medium Strata, and seven were Large Strata.

- **Lighting:** 16 of the 17 sites received ENERGY STAR LEDs.
  - The measure-level energy realization rate was 0.92.
  - Guidehouse verified 396 out of 426 ENERGY STAR LEDs.
- **Domestic Hot Water:** 1 of the 17 sites received water heater pipe insulation.
  - The measure-level energy realization rate was 0.00.
  - Guidehouse verified 0 feet out of 12 feet of electric water heater pipe insulation.
- **Consumer Electronics:** 10 of the 17 sites received Tier 2 advanced power strips.

- The measure-level energy realization rate was 0.98.
- Guidehouse verified 15 out of 15 smart strip plug outlets.
  - One smart strip was verified installed with items other than the reported entertainment center use, reducing the projected savings.

- **Shell Measures:** 1 of the 17 sites received multiple installation and air sealing measures.
  - The measure-level energy realization rate was 1.51.
  - Guidehouse verified that all shell measures were installed.
    - The savings associated with heating the home were not applied to the floor insulation portion of the reported savings, which is consistent with the tracking database review floor insulation findings.

Guidehouse conducted file reviews for a sample of project files for which the team did phone verification. The evaluation team did not identify any discrepancies between the sampled project files and reported savings.

The team calculated the final program realization rate by applying realization rates determined through phone verification to the adjusted reported savings (reported savings adjusted by the TRM tracking database review).

F.3.2 Net Impact Evaluation

Guidehouse conducted NTG analysis for the Whole Home Solution in PY11. This section details the methods and results of the NTG analysis.

F.3.2.1 NTG Methodology

Guidehouse surveyed a sample of participants to gather information on free ridership and spillover and estimate NTG ratios by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[19]

Using the Evaluation Framework[20] methodology, Guidehouse asked program participants identified as decision makers if they would have installed all, some, or none of the same program measures in the absence of the Whole Home Solution. The team also asked participants to rate the influence of several key program elements in their decision to participate, including the expected energy savings from the solution, information provided by the energy advisor, and the no-cost installation of free efficient equipment.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE upgrades influenced by the Whole Home Solution but completed without receiving a rebate. Guidehouse prompted customers with examples of technologies available for upgrades and applied deemed savings values to quantify the responses.

[19] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio*. Revised March 3, 2020.
[20] Pennsylvania PUC. *Phase III Evaluation Framework*. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

F.3.2.2 NTG Sampling

Guidehouse stratified the population of Whole Home participants by the size of energy savings generated from the installation of energy efficient equipment, including very small (<308 kWh), small (308 kWh-1,329 kWh), medium (1,330 kWh-1,874 kWh), and large (>1,874 kWh).

F.3.2.3 NTG Results

Guidehouse calculated NTG results by strata as shown in Table 3-8 in the main body report. Participants reported similar free ridership across all strata. Spillover results align with the strata sizes where the smaller the strata, the higher the reported spillover. These results are expected, as Guidehouse stratified participants by energy savings, resulting in residents included in the very small strata that had limited installation opportunities through the Whole Home Solution. These customers tend to be savvy energy savers who have already made upgrades to their home that would be covered by the solution.

F.3.3 Process Evaluation

Guidehouse completed a process evaluation for the Whole Home Solution to assess PY11 activities. The evaluation team reviewed program materials, conducted in-depth interviews with PECO and CSP staff, and conducted online surveys with participant customers. Process evaluation of the Whole Home Solution was last conducted in PY9.

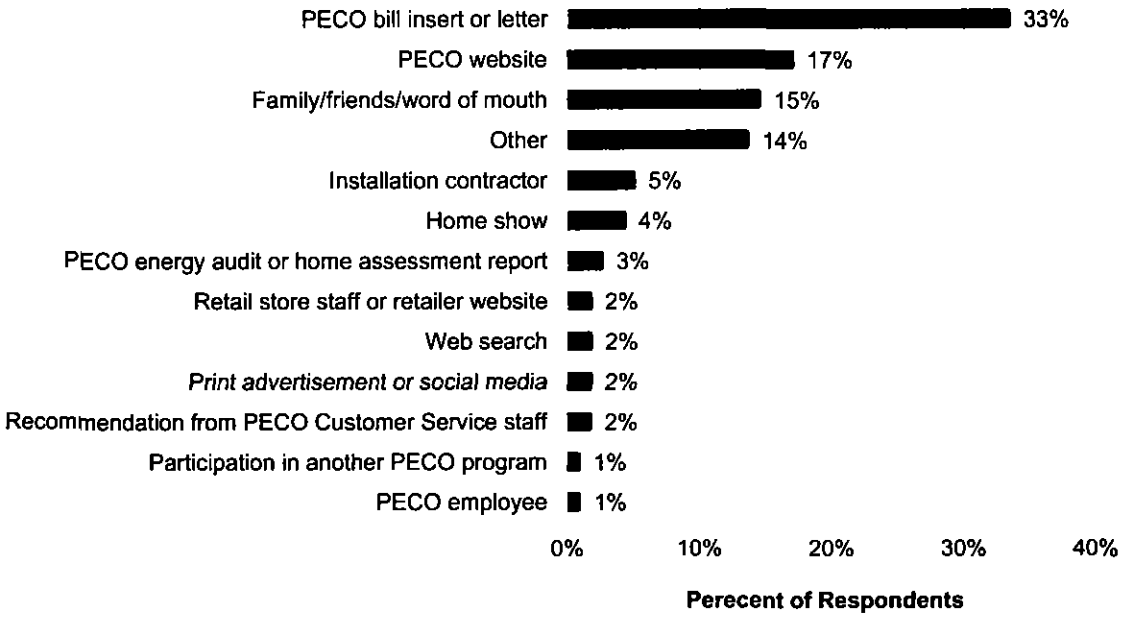
F.3.3.1 Methodology

The evaluation team used in-depth interviews with PECO and CSP staff to collect data regarding PY11 program implementation. The interviews focused on implementation strategies, data tracking, program management, and areas for program improvement. The team also conducted online surveys with participating customers to better understand customer program perceptions and to measure free ridership and spillover. Guidehouse sampled participants based on the four project sizes. This methodology captured customer experiences from each Whole Home project type (i.e., direct installation, direct installation with major thermal shell measures, or a rebated major measure such as heat pump water heater or pool pump). The sampling methodology is discussed in Section 3.1.4 in the main body report.

F.3.3.2 Findings

Survey respondents were asked about the sources from which they learned about the program. Of the respondents surveyed, 33% heard about the solution through PECO bill inserts, while 17% learned about the solution through the PECO website. Of customers, 15% also heard about the Whole Home Solution from family and friends. Only 5% of respondents stated that they learned about the solution through a contractor (Figure F-13).

Figure F-13. Sources of Program Awareness for Whole Home Solution, n=117



Question: "How did you learn about the [Solution] program?"

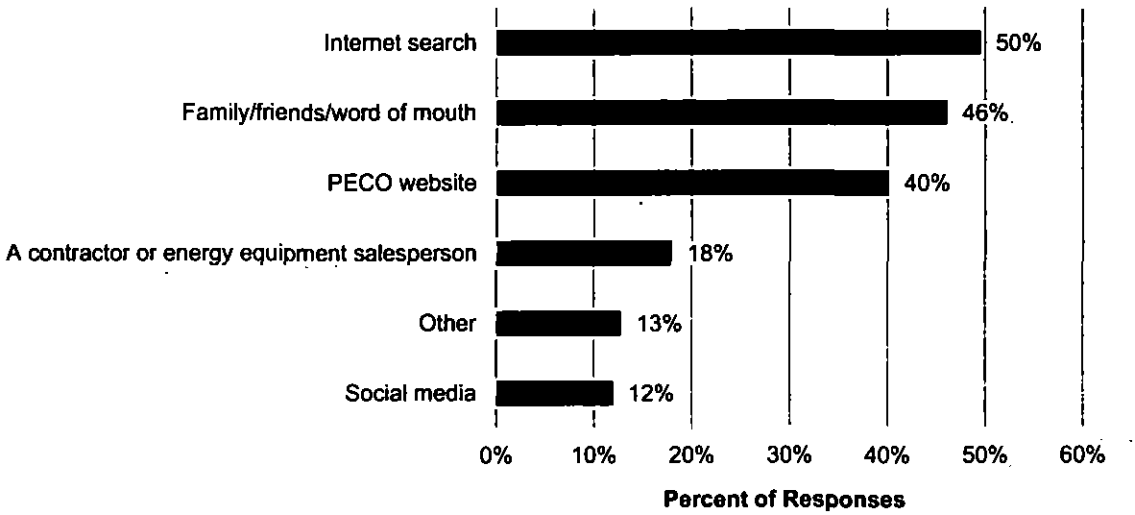
Note: Responses were recoded to other common themes indicated in the verbatim responses. Other responses include PECO email, radio, TV or commercials, past experience, a homeowners association letter, and an appliance rebate. Totals may not add up to 100% due to rounding.

Do Not Know responses have been excluded.

Source: Guidehouse analysis

Whole Home Solution customers were also asked how they looked for ways to save energy. Internet searches (50%) and word of mouth through family and friends (46%) were the two primary sources cited, as Figure F-14 shows. Customers also stated the PECO website (40%) was a source of information, making online research the main way customers seek information on ways to save energy.

Figure F-14. Information on Ways to Save Energy for Whole Home Solution, n=117



Question: "Where do you typically look for information on ways to save energy?"

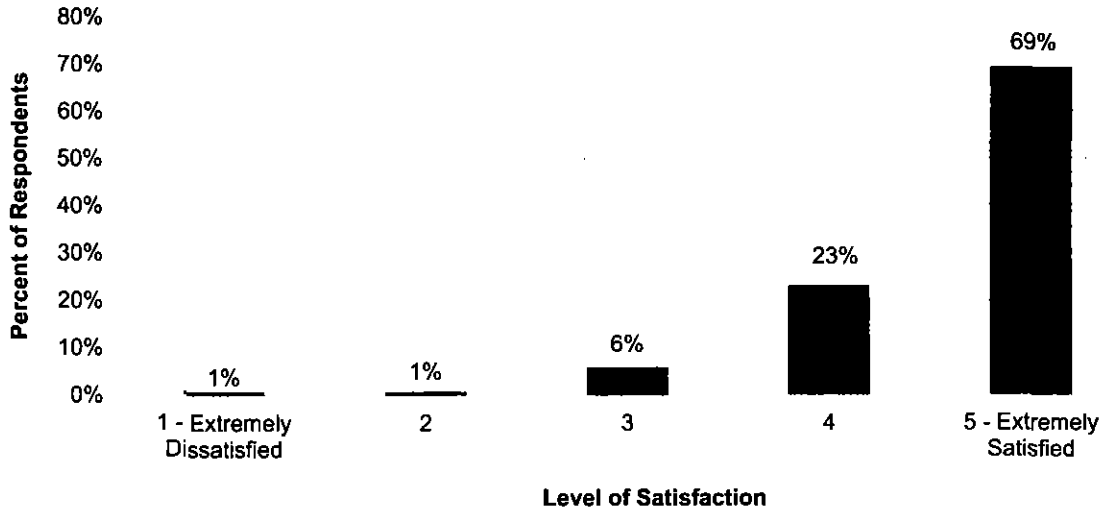
Note: Totals may not add up to 100% as customers could select multiple responses. Other responses include consumer reports, home improvement stores, magazines and newspapers, and PECO bill inserts.

Do Not Know responses have been excluded.

Source: Guidehouse analysis

Participants were asked their overall satisfaction with their participation in the Whole Home Solution. The average participant satisfaction was 4.6 on a 5-point scale, with 1 representing extremely dissatisfied and 5 representing extremely satisfied. Overall, the solution received high satisfaction ratings, with 92% of customers reporting they were either satisfied or extremely satisfied with the program, an increase of 7 percentage points from PY9. Customers expressed high satisfaction with the energy savings from products installed and the installation contractor. Several customers also said they referred the program to others. Only 2% of respondents indicated dissatisfaction (Figure F-15), an improvement of 3 percentage points from PY9.

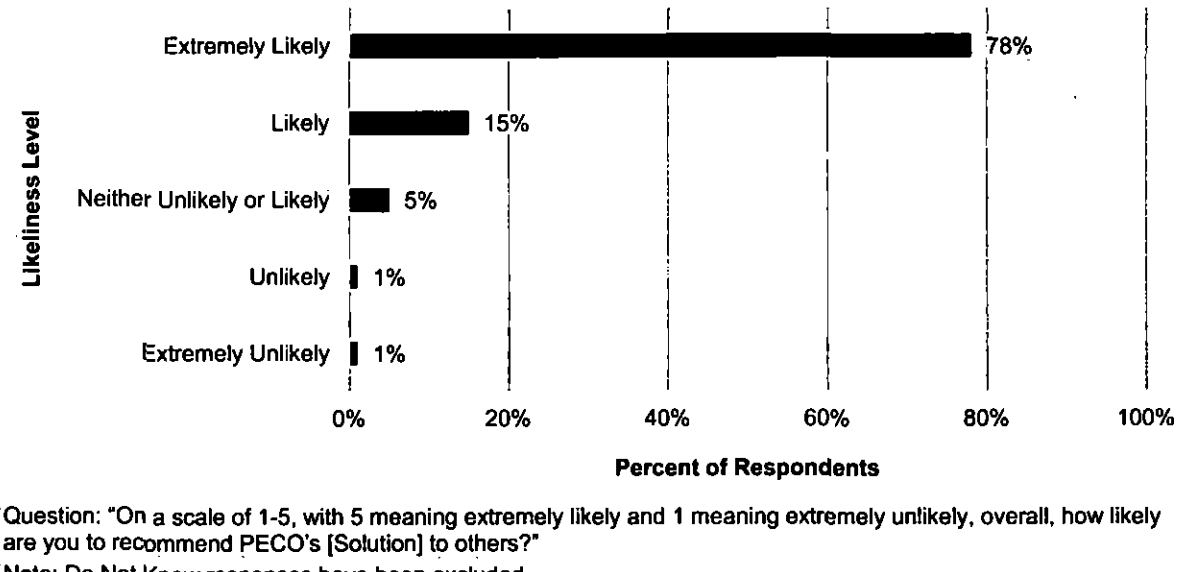
Figure F-15. Overall Satisfaction by Whole Home Participants, n=117



Question: "Using a scale of 1 to 5, with 5 meaning extremely satisfied and 1 meaning extremely dissatisfied, how would you rate your OVERALL satisfaction with the [Solution] program?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

A majority (93%) of respondents said they were either likely or extremely likely to recommend the Whole Home Solution to another person, with less than 2% stating they were unlikely or extremely unlikely to recommend the solution (Figure F-16). With word of mouth as one of the main sources of saving energy information and customers' high level of likeliness to recommend the Whole Home Solution, an opportunity exists to leverage the willingness of customers to tell others about their positive program experience.

Figure F-16. Likelihood of Recommending Whole Home Solution to Others, n=117



Question: "On a scale of 1-5, with 5 meaning extremely likely and 1 meaning extremely unlikely, overall, how likely are you to recommend PECO's [Solution] to others?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

F.4 New Construction Solution

PECO's Residential New Home Rebates Program intends to accelerate the adoption of EE in the design, construction, and operation of new single-family (SF) and multifamily homes by using the US Environmental Protection Agency's (EPA's) ENERGY STAR Homes certification. Builders building new SF or multifamily homes can take advantage of PECO's New Home Rebates Program to incorporate EE. The program also offers incentives for Code Plus homes. A Code Plus home achieves savings of 30% above a code-level home and provides builders an additional incentive tier below the ENERGY STAR-certified home level.

Performance Systems Development (PSD) is the CSP for this solution. A participant is a new home.

The pandemic had minimal impact on the overall program results; however, it had a variety of impacts on the individual program builders. Participating builder feedback about the pandemic ranged from minimal impact to delayed project schedules due to shutdowns by the City of Philadelphia, social distancing guidelines, and limited ability to access units for Home Energy Rating System (HERS) rating and ENERGY STAR certification.

F.4.1 Gross Impact Evaluation

In the PY11 Residential New Construction Solution impact evaluation for weather-sensitive measures, Guidehouse reviewed project REM/Rate files and conducted building simulation modeling using REM/Rate software. For non-weather-sensitive measures, the evaluation team calculated verified impacts based on TRM algorithms and inputs and data gathered from Residential New Construction files, REM/Rate files, and supplementing information from PECO's LAH Solution.

F.4.1.1 Engineering File Reviews

The evaluation team reviewed an extract of all project REM/Rate models and all prescriptive measure calculations (lighting, appliances, and hot water measures) for compliance with the appropriate TRM sections. The team reviewed project tracking data, ex ante measure savings calculations, and REM/Rate model files submitted by raters for compliance with program requirements.[21]

F.4.1.2 Energy and Demand Savings Calculation – Weather-Sensitive Measures Analysis

For weather-sensitive measure savings (heating and cooling), Guidehouse independently recalculated heating and cooling savings by running the REM/Rate building simulation models. The evaluation team conducted building simulation modeling for a sample of projects completed in PY11. Each REM/Rate file was run using a batch process against the PECO reference home[22] based on TRM specifications. The team calculated the annual heating, cooling, and demand savings of program homes as the difference between the baseline (PECO reference home) and the as-built simulation results.

F.4.1.3 Energy and Demand Savings Calculation – Non-Weather-Sensitive Measures Analysis

For non-weather-sensitive measures (lighting, appliances, and hot water measures), Guidehouse used a combination of data and assumptions from the TRM and PECO's LAH Solution. For ENERGY STAR appliances such as refrigerators, clothes dryers, clothes washers, dishwashers, water heaters, and ceiling fans, the evaluation team used the model number provided in the appliance form to determine consumption and calculated savings using TRM algorithms. For lighting, the team obtained average per-unit savings from the LAH Solution, which is calculated using TRM algorithms.

In its PY9 Annual Report,[23] the SWE recommended Guidehouse remove savings for non-weather-sensitive measures (lighting, appliances, and hot water measures) from the REM/Rate model and calculate them separately using the TRM algorithms. This approach required granular data for non-weather-sensitive measures that is not being collected by the CSP. Therefore, in cases where project-level CSP data was not available, the evaluation team used data and assumptions from PECO's LAH Solution, as approved by the SWE. In general, the team considered the LAH Solution lighting data an appropriate proxy for the Residential New Construction measure data because the configurations and sales were weighted toward customers preferences in the PECO service territory.

Per the Phase III Evaluation Plan,[24] Guidehouse did not conduct onsite or phone verification for this solution because of the solution's overall size contribution to PECO's portfolio.

[21] The Phase III CSP relies on nonproprietary software, REM/Rate, for energy savings estimation.

[22] The CSP shared the specifications for the Pennsylvania 2016 Savings Reference home for use in the REM/Rate models.

[23] *SWE Annual Report Act 129 Program Year 9*. January 15, 2019.

[24] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio*. Revised March 3, 2020.

F.4.1.4 Realization Rate Calculation

The evaluation team obtained the total verified energy and demand savings[25] by summing the savings from non-weather-sensitive measures and weather-sensitive measures. The team then compared the resulting total verified energy and demand savings to the reported savings to determine the realization rates.

F.4.1.5 Sampling

Guidehouse used a simple random sample to select 15 files for review. There is no stratification for this solution.

F.4.1.6 Findings

The solution realization rates can be attributed to the difference in the methodology and assumptions used by the REM/Rate software for non-weather-sensitive measures, which differs from the TRM.

Guidehouse identified the following findings during the impact evaluation:

- The kilowatt-hour realization rate is due to the difference in how lighting savings are calculated. The reported savings, from REM/Rate, are calculated based on the compact fluorescent lamp (CFL) vs. LED percentage, whereas Guidehouse uses per-unit savings for LEDs from the LAH Solution (calculated using TRM algorithms) multiplied by the number of bulbs documented by HERS raters in the lighting forms. Guidehouse's approach assumes a 43 W halogen baseline, which corresponds to the adjusted lighting outputs from REM/Rate. For projects with CFLs installed, the evaluation team multiplied per-unit LED savings obtained from the LAH Solution with a 0.84 factor (because LAH contains no CFLs to reference). Guidehouse calculated this factor based on its review of a sample of LED and CFL bulb savings.
- HERS raters did not consistently use the most updated lighting form.
- Data discrepancies were identified across some lighting forms and REM/Rate models. In two of the sampled sites, the REM/Rate model indicated that LEDs were present, but the lighting forms only specified CFLs.
- Per the TRM, water heater savings are only included for sites with heat pump water heaters. Among the 15 sampled projects, one project included an electric heat pump water heater. REM/Rate calculates ex ante water heating savings regardless of fuel or technology type, resulting in reduced ex post water heating savings for the remaining 14 projects.
- For several projects, the raters only provided model number information for a subset of the appliances installed. Guidehouse used technology specifications based on the model number to calculate TRM savings when available. When model information was not provided, the team used the average savings from appliances where model information was available.

[25] REM/Rate demand savings has a built-in 0.9 coincident demand factor applied, and the PECO TRM prescribed that 0.647 should be used as the coincident demand factor for heating and cooling. These two factors are accounted for in the savings calculation.

F.4.2 Net Impact Evaluation

Guidehouse conducted NTG analysis for the Residential New Construction Solution in PY11. This section details the methods and results of the NTG analysis.

F.4.2.1 NTG Methodology

Guidehouse surveyed a census of contractors participating in the New Construction Solution to gather information on free ridership and spillover and estimate NTG ratios. The evaluation team developed phone survey instruments consistent with the Phase III Evaluation Plan.[26]

Using the Evaluation Framework[27] methodology, Guidehouse asked contractors what their company would have done in absence of the New Construction Solution (e.g., built fewer ENERGY STAR-certified or Code Plus new homes). The evaluation team also asked participants to rate the influence of several key program elements in their decision to participate, including the program incentive, recommendations from program staff, program marketing materials, and recommendations from the HERS rater involved with the new home project.

The NTG evaluation estimates spillover by quantifying energy savings from contractor-reported new home projects that met ENERGY STAR or Code Plus certifications but did not receive a PECO incentive.

F.4.2.2 NTG Sampling

Guidehouse surveyed a census of contractors participating in the Residential New Construction Solution.

F.4.2.3 NTG Results

Guidehouse calculated NTG results by strata as shown in Table 3-8 in the main body report. Builders reported minimal free ridership—the program is working as intended by incentivizing the construction of more efficient, ENERGY STAR-certified and Code Plus homes.

F.4.3 Process Evaluation

Guidehouse completed a process evaluation for the New Construction Solution in PY11. The process evaluation consisted of in-depth interviews with PECO program staff and CSP implementation staff as well as participating builder online surveys.

F.4.3.1 Methodology

Guidehouse interviewed key PECO and CSP staff in PY11. The interviews focused on implementation strategies, data tracking, program management, and areas for program improvement.

[26] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

[27] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

The evaluation team also conducted online surveys with participating builders to better understand their perceptions of the program and to measure free ridership and spillover. The team reached out to a census of the participating population and completed eight builder surveys; this number was just shy of the sample size goal of 10, despite offering a $100 incentive to respondents. The onset of the pandemic had a negative impact on achieving the target sample size. The sampling methodology is discussed in Section 3.1.4 in the main body report.

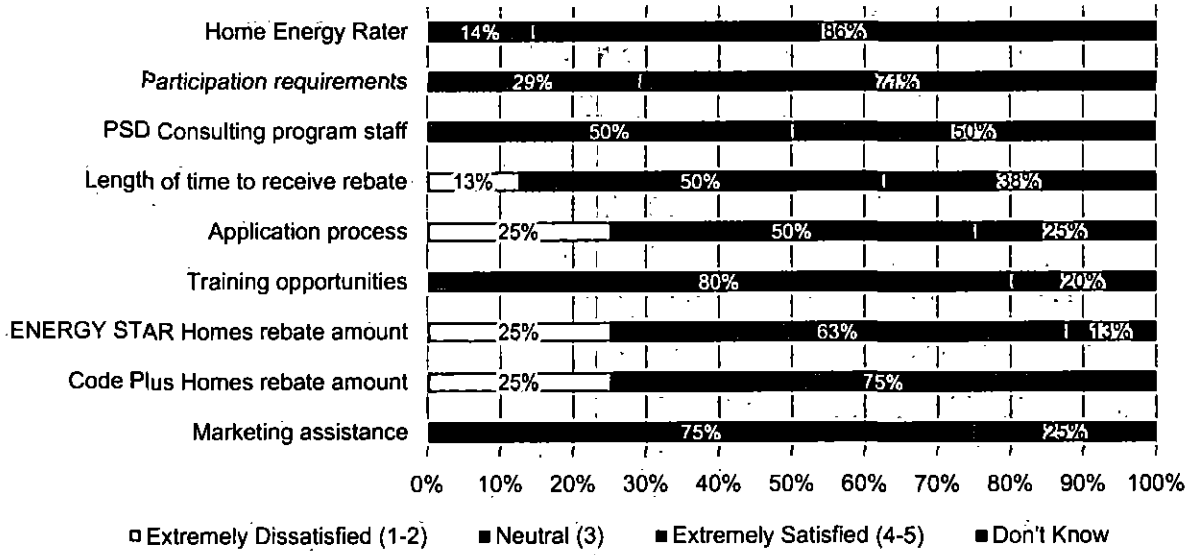
F.4.3.2 Findings

The following summarizes Guidehouse's findings resulting from the PY11 evaluation of the New Construction Solution. The last process evaluation builder survey was conducted in PY9.

Participating builders were generally satisfied with the program overall, with seven out of eight builders rating it a 4 or above on a scale from 1 to 5. When asked about satisfaction with specific aspects of the program, builders reported the highest satisfaction with working with the home energy rater, the requirements for participating in the program, and working with the CSP staff, as Figure F-17 shows. Based on the verbatim responses, builders generally felt that the CSP did a good job requesting feedback on program improvements, providing guidance on program processes, and responding quickly to questions.

Builders reported lower satisfaction with the rebate amounts for Code Plus homes and ENERGY STAR homes, and the rebate application process. When comparing low satisfaction results from PY9 to PY11, the level of satisfaction for the ENERGY STAR Homes rebate decreased from 4.0 to 2.8 on a scale of 1 to 5. Some survey responses indicated the rebate level is not attractive enough for the amount of effort to receive a rebate. Other surveyed responses indicated the application process was cumbersome, and the required documentation was not clear.

Figure F-17. Component Satisfaction Ratings for New Home Rebates Program PY11 (n=8)

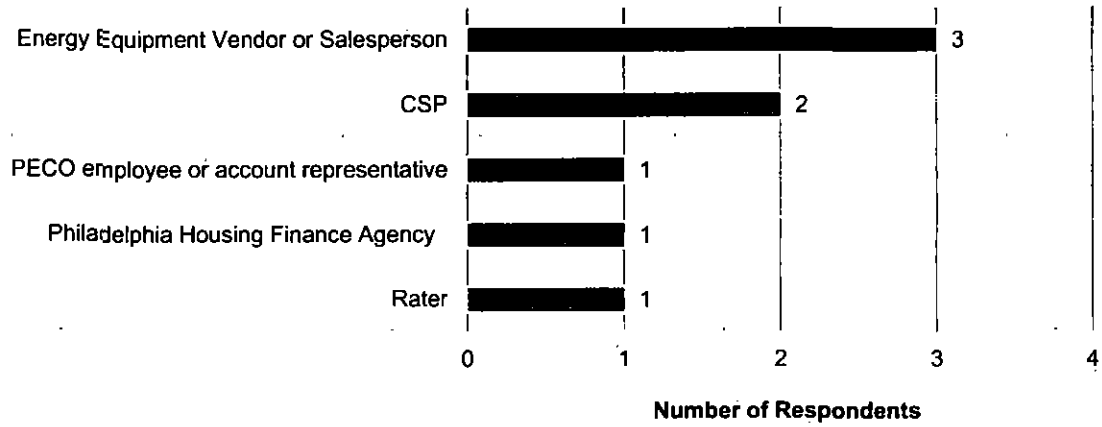


Question: "On a scale of 1 to 5, where 5 is Extremely Satisfied and 1 is Extremely Dissatisfied, how would you rate your satisfaction with the following aspects of the PECO New Home Rebates Program?"

Source: Guidehouse analysis

Surveyed builders were asked to identify how they learned about the New Construction Solution. Three out of eight builders heard about the program from an energy equipment vendor or salesperson, as Figure F-18 shows. Two builders stated they learned about the program from the implementation contractor, one builder mentioned the rater, and another builder mentioned the PECO representative. One builder reported the Pennsylvania Housing Finance Agency was a source of program information.

Figure F-18. Builder Awareness of Program (n=8)

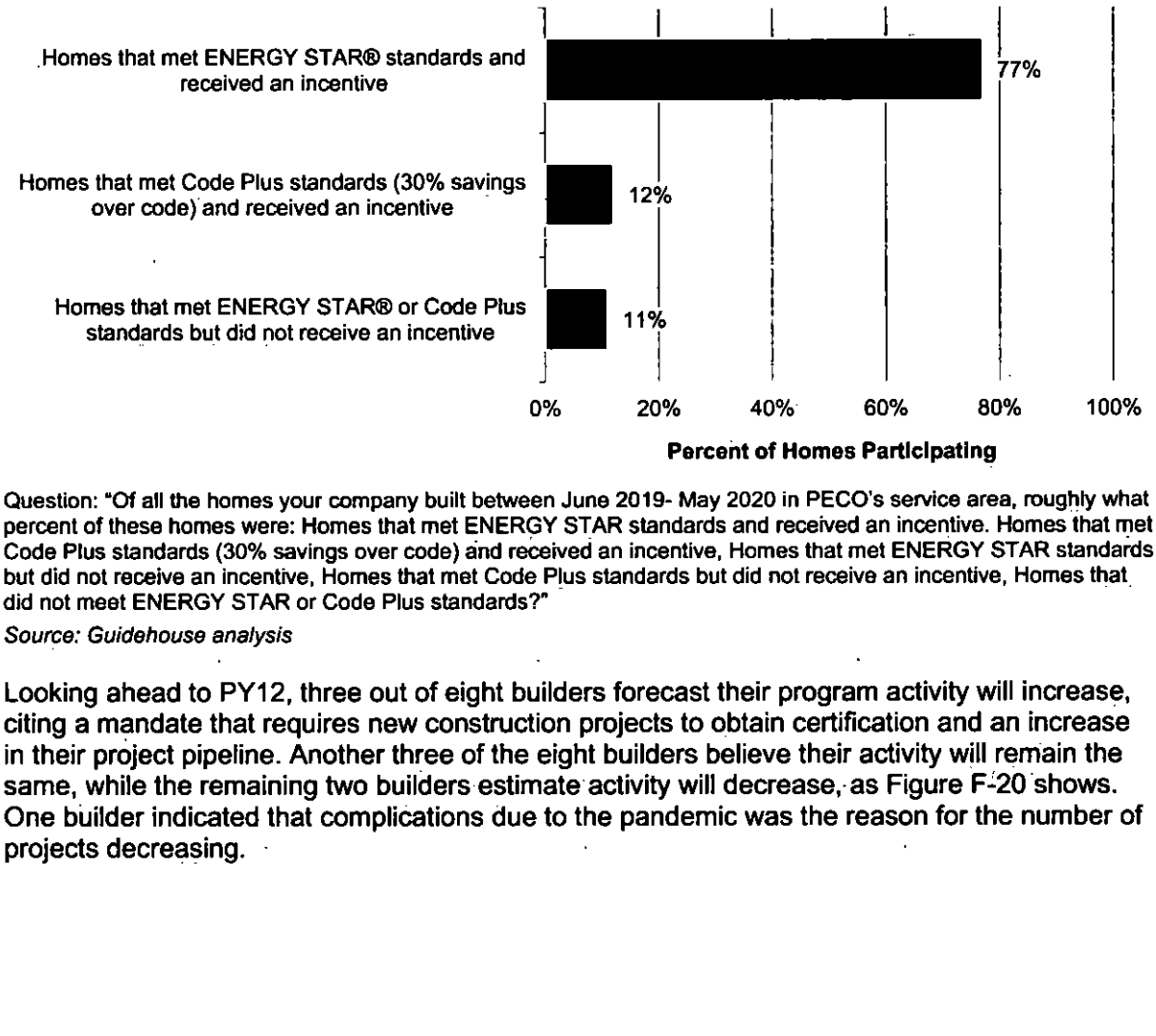


Question: "How did you learn about PECO's New Home Rebates Program?"
Other includes: Pennsylvania Housing Finance Agency
Source: Guidehouse analysis

When asked to identify the greatest challenge to building homes to ENERGY STAR standards, three out of eight builders reported additional costs and paperwork. Similarly, builders who built to Code Plus standards cited additional costs and paperwork and scheduling delays as challenges hindering their ability to construct homes to the higher standards. Similar challenges were also captured by surveyed builders in the PY9 evaluation.

The evaluation team asked builders to report several statistics related to the homes built by their company in PY11. As Figure F-19 shows, 77% of all homes built by respondents met ENERGY STAR standards and received an incentive through the New Construction Solution. In addition, 12% of homes were constructed to Code Plus standards and received an incentive through the program, while 11% of homes met ENERGY STAR or Code Plus standards but did not receive an incentive.

Figure F-19. Portion of Respondents' Homes Participating in PY11 (n=8)

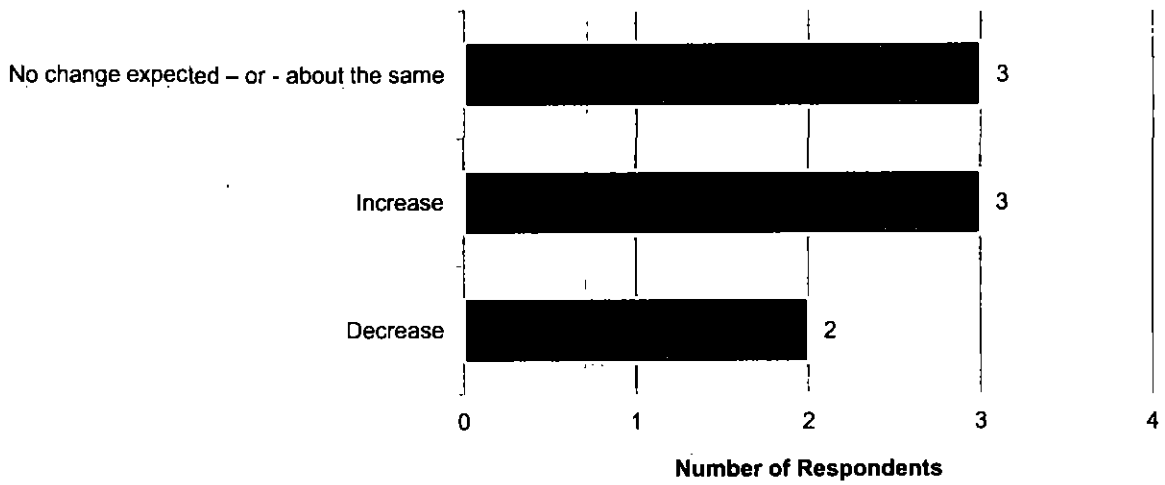


Question: "Of all the homes your company built between June 2019- May 2020 in PECO's service area, roughly what percent of these homes were: Homes that met ENERGY STAR standards and received an incentive. Homes that met Code Plus standards (30% savings over code) and received an incentive, Homes that met ENERGY STAR standards but did not receive an incentive, Homes that met Code Plus standards but did not receive an incentive, Homes that did not meet ENERGY STAR or Code Plus standards?"

Source: Guidehouse analysis

Looking ahead to PY12, three out of eight builders forecast their program activity will increase, citing a mandate that requires new construction projects to obtain certification and an increase in their project pipeline. Another three of the eight builders believe their activity will remain the same, while the remaining two builders estimate activity will decrease, as Figure F-20 shows. One builder indicated that complications due to the pandemic was the reason for the number of projects decreasing.

Figure F-20. Builder Forecast for PY12 Program Activity (n=8)



Question: "In 2021, do you expect the number of homes you enroll in PECO's New Home Rebates Program to increase, decrease, or stay about the same compared to last year?"

Source: Guidehouse analysis

F.5 Behavioral Solution

A major objective of the Residential EE Program is to provide education, awareness, and motivation to customers that want easy entry into the EE market and want to benefit from energy efficient products. To achieve these ends, the Behavioral Solution partners with Oracle (the solution's CSP) to implement a randomized control trial (RCT) that provides a select set of residential customers with home energy reports (HERs). The reports provide participants with helpful information about the ways they use energy. HERs use social norms to compare a customer's energy use to the average energy use of other households like theirs, so customers have a better sense of whether their energy use patterns fall above or below the norm. These reports also provide targeted recommendations or tips to customers, suggesting actions they can take to reduce consumption. The combination of HER content serves to enhance a customer's understanding of their energy use, encourage them to reduce their consumption using targeted tips and social norms, and enhance customer engagement and satisfaction. The reports are sent to a targeted subset of customers on an opt-out basis. As of August 2020, the reports are being provided to roughly 350,000 PECO customers.

In addition to the RCT, the Behavioral Solution provides HERs to households enrolled in PECO's AC Saver Program. The AC Saver Program is a residential demand response (DR) initiative that primarily seeks to reduce the peak demands of participants. The HERs sent to these participants are intended to maintain customer satisfaction while enhancing customer education and awareness related to EE benefits.

One participant is counted as a utility account included in the solution's treatment group, including those accounts associated with the AC Saver Program.

Table F-10 and Table F-11 summarize the participating treatment group homes by cohort and month for those households included within the PY11 scope of evaluation activities.

Table F-10. Behavioral Solution Treatment Group Counts – Waves 1-4

Month	Wave 1	Wave 2	Wave 3	Wave 4
Jun 2019	24,806	31,686	54,502	175,300
Jul 2019	24,601	31,473	54,136	174,058
Aug 2019	24,430	31,287	53,819	172,883
Sep 2019	24,293	31,108	53,540	171,834
Oct 2019	24,163	30,969	53,317	170,882
Nov 2019	24,045	30,842	53,109	170,051
Dec 2019	23,933	30,740	52,946	169,392
Jan 2020	23,828	30,630	52,792	168,655
Feb 2020	23,742	30,541	52,644	168,033
Mar 2020	23,668	30,462	52,523	167,534
Apr 2020	23,552	30,350	52,355	166,861
May 2020	23,466	30,267	52,202	166,264

Source: Guidehouse analysis

Table F-11. Behavioral Solution Treatment Group Counts – Waves 5, 6, AC Saver, and Total

Month	Wave 5 – Electric	Wave 5 – Dual Fuel	Wave 6 – Electric	Wave 6 – Dual Fuel	AC Saver	Total
Jun 2019	24,276	14,945	0	0	34,301	**359,816**
Jul 2019	23,979	14,798	19,294	5,560	34,185	**382,084**
Aug 2019	23,707	14,652	18,828	5,496	33,944	**379,046**
Sep 2019	23,463	14,542	18,460	5,437	33,752	**376,429**
Oct 2019	23,242	14,440	18,182	5,396	33,558	**374,149**
Nov 2019	23,072	14,347	17,925	5,357	33,395	**372,143**
Dec 2019	22,924	14,284	17,710	5,329	33,259	**370,517**
Jan 2020	22,760	14,217	17,519	5,304	33,090	**368,795**
Feb 2020	22,633	14,167	17,341	5,276	32,939	**367,316**
Mar 2020	22,524	14,132	17,197	5,258	32,830	**366,128**
Apr 2020	22,382	14,054	16,994	5,221	32,686	**364,455**
May 2020	22,260	13,984	16,866	5,191	32,558	**363,058**

Note: Wave 6 began HER deployment in July 2019.
Source: Guidehouse analysis

F.5.1 Impact Evaluation Methodology

Guidehouse followed the impact evaluation methodology outlined in Section 6.1.1 of the Phase III Evaluation Framework.[28] The evaluation team estimated savings using a monthly lagged dependent variable (LDV) model. For details on this model, refer to Section 6.1.1.5 of the Phase III Evaluation Framework.

F.5.2 Summary Statistics and Results

Table F-12 through Table F-15 summarize the regression outputs and summary statistics by cohort in both the RCT and AC Saver groups. The tables also include the absolute precision results for each wave. The Phase III Evaluation Framework[29] (at Section 6.1.1.1.1) requires the solution-level verification achieve an absolute precision of ±0.5% at the 95% confidence level (two-tailed); individual waves may have a wider margin of error. Given the Behavioral Solution analysis examines the solution's entire population (a census evaluation), the precisions reported in Table F-12 and Table F-13 reflect the error of the regression analysis estimate rather than a sampling uncertainty. This uncertainty is reflected in the Behavioral Solution analysis only. That is, the regression analysis estimation error is not reflected in the Residential EE Program or the PY11 portfolio total savings uncertainty. Those rolled up uncertainties only reflect sampling uncertainties that may be associated with other solutions.

Notably, Guidehouse did not find any anomalies in monthly savings due to the pandemic. March, April, and May 2020 savings aligned with the previous months of PY11. Per guidance from the SWE, the evaluation team did not attempt to modify or normalize savings. Pandemic effects, if any, on the Behavioral Solution savings are part of the observed conditions.

[28] SWE. *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs.* October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[29] SWE. *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs.*

Table F-12. Behavioral Solution Cohort Regression Details – Waves 1-4

Month	Wave 1		Wave 2		Wave 3		Wave 4	
	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error
Jun 2019	-0.49	0.12	-1.17	0.22	-0.98	0.14	-0.44	0.09
Jul 2019	-0.58	0.14	-1.46	0.25	-1.10	0.16	-0.54	0.12
Aug 2019	-0.47	0.13	-1.37	0.23	-1.05	0.15	-0.53	0.10
Sep 2019	-0.41	0.11	-1.14	0.20	-0.94	0.12	-0.48	0.08
Oct 2019	-0.48	0.11	-0.94	0.16	-0.77	0.10	-0.32	0.07
Nov 2019	-0.77	0.16	-1.00	0.21	-0.84	0.13	-0.30	0.09
Dec 2019	-0.95	0.20	-1.15	0.25	-1.00	0.15	-0.40	0.11
Jan 2020	-1.01	0.20	-1.29	0.26	-1.02	0.15	-0.38	0.11
Feb 2020	-0.88	0.19	-1.23	0.25	-0.96	0.15	-0.33	0.10
Mar 2020	-0.82	0.16	-1.04	0.21	-0.88	0.13	-0.35	0.09
Apr 2020	-0.69	0.14	-1.08	0.19	-0.87	0.12	-0.35	0.08
May 2020	-0.49	0.12	-0.98	0.20	-0.92	0.12	-0.39	0.08

Source: Guidehouse analysis

Table F-13. Behavioral Solution Cohort Regression Details – Waves 5, 6, and AC Saver

Month	Wave 5 – Electric		Wave 5 – Dual Fuel		Wave 6 – Electric		Wave 6 – Dual Fuel		AC Saver	
	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error
Jun 2019	-0.54	0.15	-0.60	0.17	0.00	0.00	0.00	0.00	-0.39	0.08
Jul 2019	-0.58	0.17	-0.75	0.21	-0.19	0.14	0.02	0.28	0.60	0.10
Aug 2019	-0.58	0.16	-0.53	0.19	-0.20	0.13	-0.37	0.26	-0.01	0.09
Sep 2019	-0.56	0.13	-0.43	0.15	-0.28	0.11	-0.62	0.23	-0.70	0.07

Month	Wave 5 – Electric		Wave 5 – Dual Fuel		Wave 6 – Electric		Wave 6 – Dual Fuel		AC Saver	
	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error
Oct 2019	-0.46	0.12	-0.25	0.12	-0.26	0.11	-0.54	0.20	-0.25	0.05
Nov 2019	-0.45	0.17	-0.05	0.14	-0.39	0.17	-0.46	0.23	-0.38	0.07
Dec 2019	-0.65	0.20	-0.07	0.16	-0.66	0.20	-0.48	0.27	-0.34	0.08
Jan 2020	-0.62	0.20	-0.11	0.16	-0.78	0.20	-0.72	0.26	-0.47	0.07
Feb 2020	-0.32	0.19	-0.03	0.15	-0.63	0.19	-0.82	0.25	-0.59	0.07
Mar 2020	-0.24	0.16	-0.19	0.14	-0.62	0.16	-0.51	0.22	-0.51	0.06
Apr 2020	-0.32	0.15	-0.13	0.14	-0.67	0.15	-0.41	0.23	-0.43	0.06
May 2020	-0.43	0.14	-0.26	0.14	-0.57	0.13	-0.69	0.23	-0.68	0.07

Note: Wave 6 began HER deployment in July 2019.
Source: Guidehouse analysis

Table F-14. Behavioral Solution Cohort Percent Savings – Waves 1-4

Month	Wave 1		Wave 2		Wave 3		Wave 4	
	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision
Jun 2019	1.44%	0.70%	1.77%	0.65%	1.95%	0.53%	1.21%	0.51%
Jul 2019	1.40%	0.66%	1.82%	0.60%	1.74%	0.50%	1.15%	0.48%
Aug 2019	1.27%	0.71%	1.89%	0.63%	1.85%	0.51%	1.26%	0.48%
Sep 2019	1.35%	0.73%	1.97%	0.67%	2.13%	0.55%	1.51%	0.52%
Oct 2019	1.53%	0.66%	1.90%	0.65%	2.21%	0.55%	1.32%	0.54%
Nov 2019	1.53%	0.64%	1.55%	0.65%	2.10%	0.63%	1.11%	0.68%
Dec 2019	1.54%	0.63%	1.50%	0.65%	2.21%	0.65%	1.30%	0.70%
Jan 2020	1.62%	0.63%	1.71%	0.67%	2.28%	0.67%	1.27%	0.69%
Feb 2020	1.53%	0.66%	1.77%	0.70%	2.32%	0.70%	1.18%	0.70%

Month	Wave 1		Wave 2		Wave 3		Wave 4	
	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision
Mar 2020	1.77%	0.67%	1.73%	0.68%	2.30%	0.65%	1.33%	0.64%
Apr 2020	1.72%	0.68%	1.92%	0.68%	2.33%	0.65%	1.36%	0.64%
May 2020	1.43%	0.72%	1.76%	0.72%	2.36%	0.62%	1.46%	0.58%

Note: Wave 6 began HER deployment in July 2019.
Source: Guidehouse analysis

Table F-15. Behavioral Solution Cohort Percent Savings – Waves 5, 6, and AC Saver

Month	Wave 5 – Electric		Wave 5 – Dual Fuel		Wave 6 – Electric		Wave 6 – Dual Fuel		AC Saver	
	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision	Percent Savings	Absolute Precision
Jun 2019	1.51%	0.81%	1.63%	0.90%	0.00%	0.00%	0.00%	0.00%	1.37%	0.56%
Jul 2019	1.26%	0.74%	1.54%	0.82%	0.39%	0.54%	-0.03%	0.82%	-1.60%	0.51%
Aug 2019	1.43%	0.76%	1.22%	0.86%	0.44%	0.55%	0.62%	0.86%	0.04%	0.52%
Sep 2019	1.76%	0.82%	1.35%	0.93%	0.76%	0.60%	1.32%	0.98%	2.85%	0.57%
Oct 2019	1.73%	0.86%	1.04%	0.97%	0.76%	0.63%	1.52%	1.08%	1.34%	0.57%
Nov 2019	1.34%	1.01%	0.21%	1.13%	0.79%	0.68%	1.23%	1.20%	1.91%	0.66%
Dec 2019	1.66%	1.00%	0.27%	1.15%	1.13%	0.67%	1.15%	1.24%	1.51%	0.66%
Jan 2020	1.59%	1.01%	0.43%	1.16%	1.32%	0.66%	1.74%	1.24%	2.16%	0.66%
Feb 2020	0.88%	1.05%	0.13%	1.22%	1.15%	0.68%	2.11%	1.25%	2.94%	0.69%
Mar 2020	0.76%	1.01%	0.82%	1.13%	1.33%	0.68%	1.41%	1.18%	2.70%	0.67%
Apr 2020	1.08%	1.00%	0.56%	1.16%	1.62%	0.72%	1.16%	1.24%	2.28%	0.68%
May 2020	1.50%	0.92%	1.00%	1.08%	1.50%	0.69%	1.71%	1.12%	3.39%	0.65%

Note: Wave 6 began HER deployment in July 2019.
Source: Guidehouse analysis

Table F-16 summarizes the monthly gross savings for the Behavioral Solution waves informed by the regression analysis activities. These results reflect the impacts before any consideration of the overlap analysis, which is described in Section F.5.3.

Table F-16. Behavioral Solution Monthly Verified Modeled Savings

Month	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5 – Electric	Wave 5 – Dual Fuel	Wave 6 – Electric	Wave 6 – Dual Fuel	AC Saver	Total
Jun 2019	366	1,112	1,601	2,318	394	271	0	0	397	**6,459**
Jul 2019	439	1,424	1,845	2,935	430	345	116	-3	-632	**6,899**
Aug 2019	355	1,326	1,749	2,839	430	239	119	64	13	**7,133**
Sep 2019	301	1,060	1,505	2,480	396	189	157	101	704	**6,894**
Oct 2019	360	903	1,275	1,721	332	110	146	90	257	**5,196**
Nov 2019	555	921	1,332	1,551	310	22	209	74	383	**5,358**
Dec 2019	708	1,094	1,648	2,112	460	33	362	80	350	**6,847**
Jan 2020	749	1,228	1,662	2,008	435	50	424	118	482	**7,157**
Feb 2020	606	1,094	1,466	1,617	209	13	319	125	568	**6,017**
Mar 2020	600	979	1,433	1,808	168	84	328	83	523	**6,008**
Apr 2020	488	979	1,361	1,735	213	55	341	65	418	**5,655**
May 2020	354	916	1,481	2,019	298	113	296	111	690	**6,278**

Note: Wave 6 began HER deployment in July 2019.

Source: Guidehouse analysis

F.5.3 Dual Participation Analysis

To the extent that the Behavioral Solution increases participation in other solutions, some savings from the regression analysis could be double counted if appropriate adjustments are not made. Double counting can be avoided for solutions that track participation at the customer level by generating estimates of the increase in participation in the solution among Behavioral Solution participants. This is also known as dual participation savings.

To generate estimates of dual participation, Guidehouse followed the Phase III Evaluation Framework[30] guidance on completing dual participation analyses. The Evaluation Framework conveys that exposure to the Behavioral Solution messaging often motivates participants to take advantage of other solution offerings promoted through Behavioral Solution materials. This exposure creates a situation where households in the treatment groups tend to participate in other solutions at a higher rate than households in the control groups.[31] The framework methodology calls for program-specific uplift calculations, and the SWE requests those values be reported. Given PECO's reorganization of Phase I and Phase II programs into solutions for Phase III, Guidehouse estimated aggregate uplift across residential programs.

Guidehouse's dual participation analysis also accounts for upstream EE solutions. The calculation of double counted savings from upstream solutions is complicated by participation not being tracked at the customer level; therefore, the approaches described previously for specific homes are infeasible. Per Section 6.1.1.8.2 of the Evaluation Framework, the evaluation team used an assumed upstream reduction factor subtracted from the estimate of energy savings for each wave of Behavioral Solution participants after downstream double counted savings had been removed. The specific reduction factors used for the waves are shown in Table F-17.

Table F-17. Default Upstream Adjustment Factors

Years Since Cohort Inception	Default Upstream Reduction Factor	Behavior Waves
1	0.75%	Wave 6
2	1.50%	-
3	2.25%	Wave 5
4 and beyond	3.00%	Wave 1, Wave 2, Wave 3, Wave 4, AC Saver

Source: Phase III Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs, Prepared by The Statewide Evaluation Team: NMR Group, Inc., EcoMetric Consulting, LLC, and Demand Side Analytics, LLC. Contracted Under the Pennsylvania Public Utility Commission's RFP 2015-3 for the Statewide Evaluator, October 21, 2016

Table F-18 summarizes the overlap or uplift savings associated with downstream and upstream EE solutions found for each of the Behavioral Solution waves. These savings are subtracted from the total savings shown in Table F-16.

[30] SWE. *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs*. October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[31] Pennsylvania PUC. "Section 6.1.1.8. Dual Participation Analysis." *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs*. October 21, 2016. . http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

Table F-18. Downstream and Upstream Savings Adjustments

Behavior Waves	Downstream Dual Participation Savings (MWh/yr)	Upstream Dual Participation Savings (MWh/yr)	Total Dual Participation (MWh/yr)
Wave 1	673	156	**829**
Wave 2	1,331	351	**1,682**
Wave 3	927	523	**1,450**
Wave 4	1,120	721	**1,841**
Wave 5 – Electric	147	88	**235**
Wave 5 – Dual Fuel	162	31	**193**
Wave 6 – Electric	68	21	**88**
Wave 6 – Dual Fuel	31	7	**37**
AC Saver	2,437	52	**2,489**

Source: Guidehouse analysis

F.5.4 Behavioral Program Impacts

By combining the results of the regression analysis and the overlap analysis, Guidehouse created a final set of PY11 Behavioral Solution impact estimates, detailed in Table F-19. These energy savings reflect the net impacts for each of the six waves of RCT participants and AC Saver. The evaluation team used an NTG ratio of 1.00.

Table F-19. Behavioral Solution Net Impacts

Behavior Waves	Gross Verified Savings (MWh/yr)	Downstream Dual Participation Savings (MWh/yr)	Upstream Dual Participation Savings (MWh/yr)	Net Verified Savings (MWh/yr)	Demand Savings (MW)[32]
Wave 1	5,881	673	156	5,052	0.58
Wave 2	13,036	1,331	351	11,354	1.30
Wave 3	18,359	927	523	16,909	1.93
Wave 4	25,144	1,120	721	23,303	2.66
Wave 5 – Electric	4,075	147	88	3,840	0.44
Wave 5 – Dual Fuel	1,524	162	31	1,332	0.15
Wave 6 – Electric	2,818	68	21	2,730	0.31
Wave 6 – Dual Fuel	908	31	7	871	0.10
AC Saver	4,154	2,437	52	1,666	0.19
Total	**75,901**	**6,896**	**1,949**	**67,056**	**7.65**

Source: Guidehouse analysis

Total verified savings are 67,056MWh/yr. Solution-reported savings by PECO are 71,728 MWh/yr, resulting in an energy realization rate of 0.93.

[32] PECO claims the verified demand savings, but the implementer (Oracle) does not evaluate these savings as part of its standard reporting. Therefore, there is no realization rate for demand savings.

Appendix G. Residential Low-Income EE Program

This appendix details the evaluation sample design, methods, and activities deployed in PY11 for the Residential Low-Income EE Program Whole Home Solution. PECO discontinued the Lighting Solution in PY9. Refer to Section 3.2 in the main body report for evaluation findings, results, and conclusions for this solution.

The Multifamily Targeted Market Segment (described in Appendix I) does not contribute to the Low-Income EE Program. Income-eligible multifamily buildings are served through the Low-Income EE Program's Whole Home Solution.

G.1 Whole Home Solution

PECO's Low-Income Whole Home Solution offers income-eligible customers multiple pathways to engage with PECO to improve the energy performance of their entire home. These pathways include the following:

- Free home energy checkups, providing site visits, education, and direct installation of energy efficient products.
- Collaboration with property owners to deliver services to income-eligible customers living in multifamily buildings, consistent with the home energy checkup. This effort includes large private property owners and the city's public housing authority.
- Collaboration with complementary income-eligible programs (such as the Philadelphia Gas Works and Weatherization Agencies) to identify income-eligible customers and serve them comprehensively with free home energy checkups through a single outreach effort.
- Workshops delivered to income-eligible multifamily buildings providing energy education and energy kits.
- Collaboration with the Low-Income Usage Reduction Program (LIURP), providing complementary efficient products to increase the LIURP service offering's comprehensiveness.
- LED lighting giveaways through food banks and community events in collaboration with community partner organizations.
- Direct customer referrals to the Appliance Recycling Solution.

The Low-Income Whole Home Solution stopped all in-person activities in March 2020 due to the pandemic. During the stoppage, program staff have been developing and piloting an Energy Kit with educational materials and efficient products for direct installation by eligible customers. The solution is also developing a virtual assessment for eligible customers. These supplemental activities were not fielded in PY11.

G.1.1 Gross Impact Evaluation

The PY11 impact evaluation focused on verifying reported savings; activities conducted included tracking database analysis, phone verifications, and desk reviews of a sample of projects. The evaluation team conducted phone verifications on direct installation measures as part of the core home energy checkup pathway.

The Low-Income EE Program Whole Home Solution referred eligible customers to the Residential EE Program Appliance Recycling Solution. Subsequent appliance recycling projects were implemented and evaluated consistent with the Appliance Recycling Solution's procedures. Reported and verified Appliance Recycling Solution savings attributable to income-eligible customers are reported through the Low-Income EE Program Whole Home Solution.

G.1.1.1 Tracking Database Review

Guidehouse evaluated reported savings through a preliminary database review, comparing reported savings with TRM[33] assumptions and algorithms. The evaluation team analyzed a census of reported measures, resulting in an adjustment to reported savings. The database review identified six discrepancies between reported savings and verified savings, as Table G-1 illustrates.

Table G-1. Low-Income EE Program Whole Home Solution Tracking Database Review

Measure	Discrepancy	Observations	kWh Realization Rate	kW Realization Rate
Low Flow Aerators	A mix of TRM deemed and custom temperature values (Tout) are being applied.	Guidehouse recommends calculating savings using TRM algorithms for accuracy and consistency.	0.56	0.56
Low Flow Showerheads	A mix of TRM deemed and custom temperature values (Tout) are being applied.	Guidehouse recommends calculating savings using TRM algorithms for accuracy and consistency.	0.71	0.71
Freezer Replacement	Guidehouse calculated savings of 631 kWh and 0.0707 kW using the IMP average of replacement UEC for all freezer types (247.75) except freezer category 9. Reported savings are defaulting to 655 kWh and 0.0733 kW.	Guidehouse recommends using the IMP to capture replacement UEC when calculating savings.	0.96	0.96

[33] PA PUC. *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards*. Dated June 2016, errata update February 2017.

Measure	Discrepancy	Observations	kWh Realization Rate	kW Realization Rate
Refrigerator Replacement	Guidehouse calculated savings of 551 kWh and 0.0617 kW using the IMP average of replacement UEC for all refrigerator types (439) except compact size. Reported savings are defaulting to 548 kWh and 0.0613 kW.	Guidehouse recommends using the IMP to capture replacement UEC when calculating savings.	1.01	1.01
Floor Insulation	Missing key inputs to complete TRM calculation (where no deemed value exists).	Guidehouse recommends calculating savings based on the floor insulation IMP. Key inputs such as heating system type, heating system efficiency, cooling system type, cooling system efficiency, floor area, and floor R-values need to be captured to calculate savings.	N/A	N/A
Packaged Terminal Heat Pump	Missing key inputs to complete TRM calculation (where no deemed value exists).	Guidehouse recommends including key inputs such as COP_base and COP_efficient into the tracking data.	0.93	0.85

COP = coefficient of performance

Source: Guidehouse analysis

Discrepancies between reported savings and verified savings identified in the tracking database review are present in the phone verification savings results detailed in Section G.1.1.2. Although Guidehouse confirmed measure installation, the phone verification realization rates reflect TRM inputs and tracking database review results.

G.1.1.2 Phone Verification and File Review

Guidehouse used phone surveys to confirm measure installation. Multifamily projects (all sizes), large SF (>1,692 kWh), medium SF (1,015 kWh-1,691 kWh), and small SF (282 kWh-1,014 kWh) projects were sampled for phone verifications. The evaluation team did not sample very small projects (<282 kWh); instead, the small project stratum realization rates were applied to the very small project strata.

The Low-Income Whole Home Solution serves income-eligible multifamily properties. Projects are implemented and reported based on meter configuration. Projects are reported individually at the apartment level on individually metered buildings. Conversely, projects are reported at the building level for master-metered buildings. The evaluation team worked with the CSP to identify groups of SF projects that belonged to a larger multifamily building. By sampling multifamily buildings in their own stratum, the team accounted for program implementation differences due to the split incentive barriers common in multifamily buildings (where property owners are responsible for building upgrades but the energy savings benefits are realized by residents). Guidehouse sampled eight multifamily apartments from eight multifamily buildings in the population. The average measure realization rate of a verified apartment was applied to the unverified apartments within each building within the multifamily sample.

The impact evaluation sampling strategy used a random sample of projects from the population of program participants in the PY11 tracking database. Guidehouse selected sampled projects based on project size to confirm the sample reflected the participant population.

The evaluation team used phone verifications to confirm product installation. In cases where a customer could not remember the quantity of products installed, the team verified the reported savings. In cases where a customer provided definitive quantity values, the team used the customer's reported values and adjusted the verified savings accordingly.

Differences between reported and verified savings were due to the following reasons:

- **Multifamily strata phone verification:** Guidehouse verified measure installations in eight apartments within a sample of eight multifamily buildings.
    - **Lighting:** Two customers reported ENERGY STAR® LED bulbs were left behind but not installed.
    - **Bathroom aerators:** Two aerator measures were reported as not installed. One tenant specified this was because of the faucet configuration.
    - **Smart strip plug outlets:** One customer had two smart strips removed by the CSP at the customer's request. However, only one smart strip was reported removed in the data, instead of two as specified by the customer.
- **Single-family small, medium, and large strata phone verification:** Guidehouse verified measure installations in 27 SF home projects.
    - **Lighting:** Eleven customers reported ENERGY STAR LED bulbs had not been installed or were removed because of performance issues (not working, burnt out, brightness, color).
    - **Smart strip plug outlets:** Three customers reported the smart strip's usage is unspecified. One customer reported only one of three reported smart strips are installed—one broke and one is in storage.

Guidehouse conducted file reviews for a sample of project files. The team did not identify discrepancies between the sampled project files and reported savings in most files reviewed. The one discrepancy identified was due to the project file reporting a different efficient wattage of an installed LED nightlight compared to the efficient wattage used to calculate reported savings. Guidehouse verified savings using the project file's reported efficient wattage.

The evaluation team calculated final program realization rates by applying TRM tracking database review findings to all projects. Phone verification project results were applied to the sampled population, as detailed in this section.

G.1.2 Process Evaluation

As described in the Phase III Evaluation Plan,[34] Guidehouse did not complete in-depth process evaluation activities for the Low-Income Whole Home Solution this year. Instead, the evaluation team interviewed the PECO program manager to identify significant implementation changes to

[34] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

inform the impact evaluation activities. No significant changes were found. The team carried out in-depth process evaluations in PY8.

Appendix H. Small and Large C&I EE Programs

This appendix details the evaluation sample design, methods, and activities deployed in PY11 for select Small and Large C&I EE Program solutions (listed below). Refer to Sections 3.3 and 3.4 in the main body report for evaluation findings, results, and conclusions for these solutions.

- Equipment and Systems Solution
- New Construction Solution
- Whole Building Solution
- Data Centers Targeted Market Segment

H.1 Equipment and Systems Solution

The Equipment and Systems Solution offers incentives for existing building retrofit projects with either deemed, partially deemed, or custom measures. Typical measures include lighting, variable frequency drives (VFDs), HVAC systems, refrigeration, and controls. Participation is defined as an activity with a unique project number; more than one measure per participant is permitted. In addition, a single customer is permitted to participate in multiple projects with unique project numbers. PECO's C&I and Government/Education/Nonprofit (G/E/NP) customers that own or rent their space are eligible to participate in this solution. Participating customers must first identify EE projects at their facility, including deemed, partially deemed, or custom measures. Next, the customer must submit a pre-application to ICF, the CSP, before completing the project. Once approved, each project is implemented by the customer's own contractor. Either the customer or the contractor submits the rebate paperwork to the CSP.

The PECO Instant Lighting Discounts (PILD) pathway allows customers to receive discounts on qualified products without completing application paperwork. Customers must provide basic information on the facility where lighting will be installed, including verification that the facility is associated with a PECO C&I account. The distributor completes a simplified application on behalf of the customer; the customer must submit proof of installation within 45 days of purchase.

PECO introduced the Grand Slam limited time offer program in PY11 to encourage additional participation. From March through May 2020, PECO offered increased incentives on popular measures, leading to increased participation in the solution.

During the early months of the pandemic, CSP implementation teams were unable to conduct onsite walkthroughs and inspections but continued to support customers through phone calls, webinars, Skype/Zoom calls, and other remote channels. In some cases, inspections were delayed until onsite visits could resume. Implementation teams were able to return to customer sites in July 2020 with additional safety and training protocols in place.

H.1.1 Gross Impact Evaluation

H.1.1.1 Methodology

H.1.1.1.1 Engineering Desk Reviews and Phone Verification

Guidehouse conducted desk reviews for all projects in the evaluation sample. The desk reviews used 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, important emails, and memoranda.

The evaluation team supplemented desk reviews with phone verification, which the team assigned to projects per the sampling memo.[35] Phone verifications consisted of interviews with customers about their projects. Common discussion points included 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.

H.1.1.1.2 Onsite Verification

Guidehouse conducted onsite verification for sampled projects per the sampling memo.[36] Projects assigned an onsite visit first received a desk review to create the Site-Specific Measurement and Verification Plan (SSMVP).

The primary objective of the site visits was to collect the data required by the TRM[37] and the Phase III Evaluation Framework.[38] This data included verifying the quantities and type of each measure, equipment nameplate data, and operating schedules, as well as carefully describing the site conditions. Guidehouse verified this information through visual inspection of the measures and by interviewing the customers.

To reduce risks associated with the pandemic, Guidehouse hosted discussions with the SWE to prioritize onsite visits for those projects where data could not be obtained through a phone call, video call, or a separate data request made to the customer. The evaluation team and the SWE reviewed site-specific project details and the SSMVP, deciding whether to solicit additional data from the customer remotely or to conduct a site visit to collect verification data or metered data.

Five projects received onsite verification (including three with supplemented metering or trend data collection) and 47 projects received additional phone verification or virtual verification.[39]

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[35] PECO. *PY11 Small and Large C&I EE Impact Sampling Design*. Dated March 23, 2020.

[36] PECO. *PY11 Small and Large C&I EE Impact Sampling Design*. Dated March 23, 2020.

[37] PA PUC. *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards*. Dated June 2016, errata update February 2017.

[38] SWE. *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs*. October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[39] Virtual verification included virtual tours and interviews using videoconferencing software as allowed by the SWE according to its June 3, 2020 memo RE: "PY11 EM&V and the Coronavirus Outbreak."

H.1.1.1.3 Onsite Verification with Metering

For projects that surpassed the expected energy (kWh) savings thresholds set in Table 1-2 of the TRM and for which the evaluation team and the SWE agreed that onsite metering was advised, Guidehouse conducted onsite verification and collected site-specific information for open variables used to calculate energy and demand savings. Site-specific information included end-use metered data and trend data from building management systems. Three projects received onsite verification supplemented with metering or trend data.

H.1.1.1.4 Handling Non-Response and Customer Refusal

Guidehouse made every attempt to complete its verification efforts. The evaluation team made repeated attempts via email and phone calls to schedule site visits or complete phone interviews. For projects that were unresponsive and assigned an onsite verification or onsite metering, the team dropped the sample point and replaced it with another from the same stratum. For projects assigned a phone verification and in alignment with the Evaluation Plan,[40] the team converted the project to a file review only after making at least five attempts to call or email the customer. One project was replaced and 16 projects were converted to file review only after the team exhausted all customer contact attempts. Several of these businesses were affected by the pandemic, including schools, gyms, and retail establishments, which contributed to the lower response rates for these strata.

H.1.1.2 Sampling

Using tracking data from PY11, Guidehouse obtained the total number of projects and the total amount of energy savings in the population. With this project data, the evaluation team sampled at the project level for the impact evaluation activities in PY11 to bin projects within seven strata, as outlined in the PY11 sample design memo.[41]

Guidehouse first created a census stratum (Stratum 1 – Very Large Projects) for projects exceeding the kilowatt-hour thresholds described in the main body Stratum Structure table. Next, the evaluation team excluded all projects making up the lowest 2% of total solution energy savings. Projects completed through the midstream pathway were then separated and put into their own strata. Finally, the team sorted the remaining projects by size and divided the population into three additional strata: those projects making up the top third, the middle third, and the lowest third of the total energy savings.

During a preliminary midyear review of the verification data, the evaluation team identified several retrocommissioning (RCx) and VFD projects with large differences between the reported and verified savings. The team decided, in consultation with the SWE, to re-stratify all RCx projects into a separate stratum to address the large variability of these types of projects.

For the VFD projects, Guidehouse found that the implementer misapplied the savings from the TRM entry "3.3.4 VSD on Kitchen Exhaust Fans" for projects where the actual VFD application is not explicitly deemed in the TRM. This included VFDs on sewage pumps, boiler supply fans, and dryer motors. Through discussions with the SWE, the evaluation team decided to re-stratify

[40] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[41] PECO. *PY11 Small and Large C&I EE Impact Sampling Design.* Dated March 23, 2020.

all kitchen exhaust fan projects in the population that could be identified as non-kitchen fan VFDs into their own stratum.[42]

After re-stratifying the RCx and non-kitchen fan VFD projects, the evaluation team chose additional projects to achieve the original sample target by strata as presented in the sampling memo.

For Small C&I Equipment and Systems, of the 30 projects evaluated:

- 28 included lighting or lighting control retrofits
- 1 was classified as custom HVAC
- 1 was classified as custom motors and drives

For Large C&I Equipment and Systems, of the 38 projects evaluated:

- 24 included lighting or lighting control retrofits
- 2 were classified as HVAC
- 1 was classified as custom motors and drives
- 4 were classified as custom
- 3 were classified as kitchen ventilation
- 4 were classified as RCx

The SWE conducted site visits for three of the projects and desk reviews on seven additional projects. Details of the impact sample by stratum can be seen in Table 3-23 and Table 3-35 in the main body report.

H.1.1.3 Findings

The majority of sampled projects for the Equipment and Systems Solution achieved realization rates for both energy and demand within 20% of the expected values. Eleven projects had verified energy savings values fall below 80% of the reported values, while 16 projects had verified energy savings values above 120% of reported values. For demand savings, eight projects fell below 80% of reported values while 22 projects were above 120% of reported values. Guidehouse analyzed these projects to capture any trends in the verified data. The following factors led to variation between the reported and verified savings and to the observed project-level realization rates:

- The most common discrepancy between ex ante and ex post calculations was in the annual HOU for lighting measures. The evaluation team uncovered discrepancies both higher and lower than reported. In most of these cases, the verified HOU was greater than 10% different from the deemed HOU.[43] In one case, the building type was misapplied in the ex ante calculations, and the difference resulted from the evaluators changing the building type. Discrepancies discovered during peak demand hours or

[42] The evaluation team requested additional project files from PECO to support the identification of non-kitchen fan VFDs for all applicable projects in the solution.

[43] As allowed by the evaluation protocols described in Section 3.1.1 of the TRM.

summertime operating schedules had the additional consequence of changing the demand calculation.

- Other primary drivers for lighting measure realization rates differing from 1.00 include the following:
  - One sampled project revealed fixture wattages that differed from reported values.
  - Four sampled projects verified a different heating fuel type than reported values, affecting the HVAC interactive factors.
  - In two cases, the evaluation team found pre- or post-retrofit lighting control types that differed from reported values.
- The implementer miscategorized VFDs for three sampled projects. In these projects, the implementer categorized VFDs on sewage pumps, boiler supply fans, and dryer motors as VFDs on kitchen exhaust fans, using the deemed HOU and energy and demand savings factors for kitchen exhaust fans. The evaluation team estimated custom savings for these applications.
- For four RCx projects, the evaluation team incorporated additional months of post-retrofit billing and advanced metering infrastructure data to improve the savings estimate for all seasons throughout the year. The team also modified some of the regression models or used temperature bins in the analysis to improve the estimate of pre- and post-retrofit consumption and measure impacts.
- The evaluation team adjusted the power factor for one custom project based on onsite data collection.

H.1.2 Net Impact Evaluation

Guidehouse conducted NTG research in PY11 using the customer survey described in Section H.1.3 to ask a battery of questions regarding free ridership and spillover.

H.1.2.1 Methodology

Guidehouse surveyed a sample of participants to gather information on free ridership and spillover and to estimate NTG ratios by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[44]

Using the Phase III Evaluation Framework[45] methodology, Guidehouse asked program participants identified as decision makers what they would have done in the absence of the Equipment and Systems Solution. The evaluation team also asked participants to rate the influence of several key program elements in their decision to participate, including the program incentive, marketing materials, and the recommendations of program staff and contractors.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE upgrades influenced by the Equipment and Systems Solution but completed without receiving an incentive. Guidehouse applied deemed savings values to quantify the responses.

[44] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[45] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

H.1.2.2 Sampling

Guidehouse stratified the population of Equipment and Systems participants by project size as defined in Section 3.3.3 of the main body report.

H.1.2.3 Results

Free ridership for the Equipment and Systems Solution is higher than the results estimated in PY9 as awareness of EE opportunities has increased in the C&I market. Customers also reported spillover savings from additional projects completed without an incentive in PY11, including additional LED fixtures and exterior area streetlights. These spillover results are also higher than those collected during the PY9 evaluation. See Sections 3.3.3 and 3.4.3 in the main body report for full NTG results.

H.1.3 Process Evaluation

Guidehouse completed a process evaluation for the Equipment and Systems Solution to assess PY11 activities. The evaluation team reviewed program materials, conducted in-depth interviews with PECO and CSP staff, and conducted online surveys with participants. Process evaluation of the Equipment and Systems Solution was last conducted in PY9.

H.1.3.1 Methodology

Guidehouse interviewed PECO and CSP program managers to better understand any changes to the program design, updates to measure mix, program successes and challenges, and barriers to participation. The evaluation team also surveyed customers who participated in the program in PY11. The objective of these surveys was to gain insight into participant awareness about the program, assess their satisfaction with different aspects of the program, and identify potential barriers to participation in the future. The evaluation team thoroughly reviewed the PY11 program tracking data to identify the customer population before developing the online and phone survey samples. The sampling methodology is discussed in Sections 3.3.4 and 3.4.4 in the main body report.

Guidehouse completed 37 online surveys and 24 phone surveys with PECO Equipment and Systems Solution participants. The evaluation team surveyed a census of participants and met or exceeded targets for the medium and small strata.[46] The team made concerted efforts (listed below) to achieve the target sample size without burdening participants:

- Increasing the incentive from $25 to $50
- Trialing a $100 sweepstakes in place of a guaranteed incentive
- Reaching out to nonresponsive participants via phone
- Contacting each participant up to six times.

[46] In the large savings strata, the evaluation team was one participant short of the target for Small C&I and was three participants short for Large C&I.

H.1.3.2 Findings

Interviews with the PECO and CSP program managers covered topics such as the current state of the solution, current challenges, opportunities for improvement, the customer rebate application, midstream pathways, the solution tracking database, and forward-thinking opportunities for Phase IV. Findings from the interview included the following:

- **As in previous programs years, the application process was identified as a barrier to participation because of the amount of required documentation.** PECO has taken several steps to reduce the burden on customers where possible given TRM documentation requirements. These steps include providing a resource page on the application portal with blank copies of the applications and reference documents, such as guides for completing the various application forms, the program manual, and the program's terms and conditions. Beginning in PY12, PECO added a step-by-step guide to using the online portal, providing detailed information on the data and documentation necessary to complete the application. PECO expects this level of detail will help set expectations upfront about the application process and may reduce dissatisfaction stemming from the amount of time needed to complete the application.
- **PECO promotes use of the online application portal.** While most applications are submitted via email with the Excel application, PECO encourages use of the online portal by offering a 25% bonus incentive for projects submitted online by trade allies. Additionally, PECO published a new resource documenting the benefits of using the online portal.
- **The midstream pathway saw increased participation during PY11, and PECO focused on adding distributors to the program.** The requirement to collect account number at the point of sale remains a hindrance for this pathway.[47]

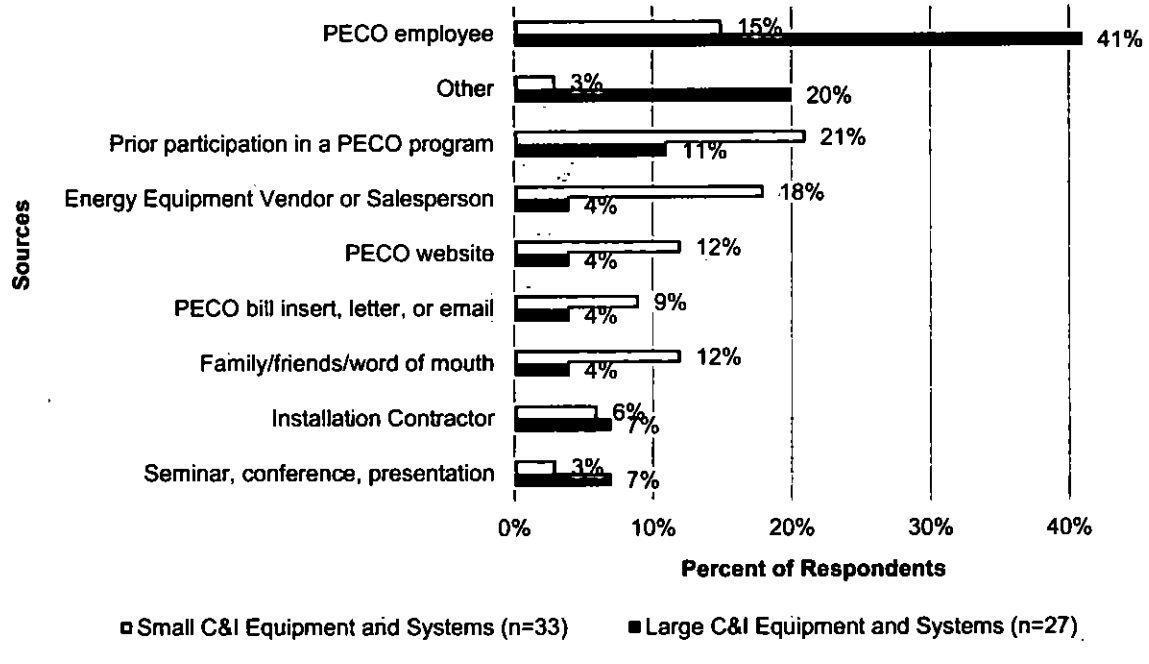
As Figure H-1 shows, prior participation in a PECO program (21%), energy equipment vendors or salespersons (18%), and PECO employees (15%) drove awareness for Small C&I participants, similar to PY9.[48] Unlike in PY9, the PECO website (12%) was not as commonly identified as a source of awareness in PY11. The other category response for Small C&I awareness included the Pennsylvania Act 129 outreach program.

PECO employees (41%) play the largest role in driving program awareness for Large C&I participants, similar to PY9. PECO partners with its Large Customer Service account team to promote its EE programs to customers, which may explain why this was a leading source of awareness for Large C&I participants. Prior participation (11%), installation contractors (7%), and seminars, conferences, and presentations (7%) also contributed to awareness. The other category responses for Large C&I awareness included in-house knowledge and an engineer.

[47] Collecting the account number at the point of sale allows the distributor to verify the customer is a PECO C&I customer before they receive the point-of-sale rebate.

[48] Equipment and Systems participants were last surveyed in PY9.

Figure H-1. Sources of Awareness by Small and Large C&I Equipment and System Solutions



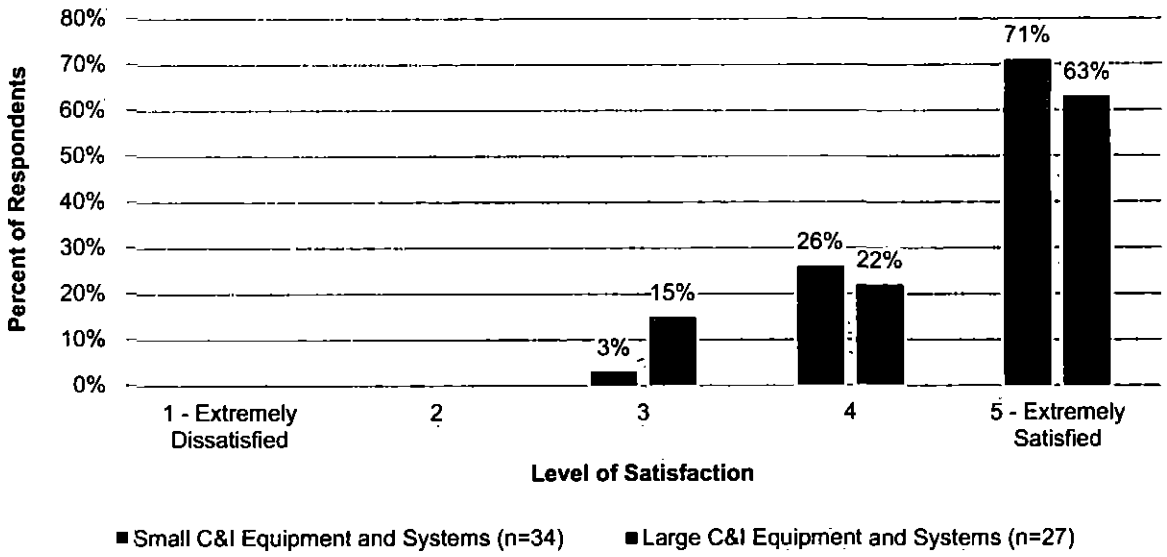
Question: "How did you learn about the Smart Ideas for your Business program?"
Note: Do Not Know responses have been excluded.
PECO employee includes account representatives and customer service representatives.
Other responses include in-house knowledge, a client, a patient, PA Act 129 outreach program, and an engineer.
Source: Guidehouse analysis

Nearly all Small C&I respondents (97%) reported satisfaction or extreme satisfaction, an increase of 13 percentage points from PY9. Small C&I participants reporting extreme satisfaction (71%) increased from PY9, showing a 35 percentage point increase. On average, Small C&I respondents reported the highest satisfaction with the contractor and the measures themselves.

A majority (85%) of Large C&I participants reported satisfaction or extreme satisfaction, similar to PY9. Similar to Small C&I, participants reporting extreme satisfaction (63%) increased from PY9, improving by 25 percentage points. On average, Large C&I respondents reported the highest satisfaction with the measures themselves and the amount of communication from the program staff.

No Large C&I or Small C&I respondents reported dissatisfaction with the program overall. Key themes among respondents who provided lower satisfaction ratings with some aspect of the program included low incentive values, length of time to receive the rebate, difficulty completing the application, and communication with PECO.

Figure H-2. Overall Satisfaction by Small and Large C&I Equipment and System Solutions



Question: "Using a scale of 1 to 5, with 5 meaning extremely satisfied and 1 meaning extremely dissatisfied, how would you rate your OVERALL satisfaction with the Smart Ideas for your Business program?"

Source: Guidehouse analysis

H.2 New Construction Solution

The C&I New Construction Solution is designed to accelerate adoption of energy efficient design and construction practices in new and retrofit facilities. The program covers both new construction and buildings undergoing major renovation; major renovation is defined as construction projects that involve the complete removal, redesign, and replacement of two or more major building systems. The program provides facility designers and builders with training, design assistance, and financial incentives to incorporate energy efficient systems into their building designs. Many of the projects within the C&I New Construction Solution involve efficient lighting and heating and cooling technologies and controls.

The eligible customer population for the program includes all C&I and G/E/NP new construction and major renovation projects in the PECO service territory. Participation is defined as an activity with a unique project number; more than one measure per participant is permitted. In addition, a single customer is permitted to participate in multiple projects with unique project numbers. ICF is the CSP for the C&I New Construction Solution.

During the early months of the pandemic, the CSP implementation teams were unable to conduct onsite walkthroughs and inspections but continued to support customers through phone calls, webinars, Skype/Zoom calls, and other remote channels. In some cases, inspections were delayed until onsite visits could resume. Implementation teams were able to return to customer sites in July 2020 with additional safety and training protocols in place.

H.2.1 Gross Impact Evaluation

H.2.1.1 Methodology

H.2.1.1.1 Engineering Desk Reviews and Phone Verification

Guidehouse conducted desk reviews for all projects in the evaluation sample. The desk reviews used 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, important emails, and memoranda. In the case of whole building projects and some new construction projects, PECO provided executable modeling files and related model output files.

The evaluation team supplemented the desk reviews with phone verifications, which the team assigned to projects per the sampling memo.[49] Phone verifications consisted of interviews with customers about their projects. Common discussion points included 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.

H.2.1.1.2 Onsite Verification

Guidehouse conducted onsite verification for all sampled projects per the sampling memo.[50] Projects assigned an onsite visit first received a desk review to create the SSMVP.

The primary objective of the site visits was to collect the data required by the TRM and the Phase III Evaluation Framework.[51] This data included verifying the quantities and type of each measure, equipment nameplate data, and operating schedules, as well as carefully describing the site conditions. Guidehouse verified this information through visual inspection of the measures and by interviewing the customers.

To reduce risks associated with the pandemic, Guidehouse hosted discussions with the SWE to prioritize onsite visits for those projects where data could not be obtained through a phone call, video call, or through a separate data request made to the customer. The evaluation team and the SWE reviewed site-specific project details and the SSMVP, deciding whether to solicit additional data from the customer remotely or to conduct a site visit to collect verification data or metered data.

Five projects received onsite verification and 13 projects received additional phone verification or virtual verification.[52]

[49] PECO. *PY11 Small and Large C&I EE Impact Sampling Design*. Dated March 23, 2020.

[50] PECO. *PY11 Small and Large C&I EE Impact Sampling Design*. Dated March 23, 2020.

[51] SWE. *Evaluation Framework for Pennsylvania Act 129 Phase III Energy Efficiency and Conservation Programs*. October 21, 2016. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

[52] Virtual verification included virtual tours and interviews using videoconferencing software as allowed by the SWE according to its June 3, 2020 memo RE: "PY11 EM&V and the Coronavirus Outbreak."

H.2.1.1.3 Onsite Verification with Metering

For projects that surpassed the expected energy (kWh) savings thresholds set in Table 1-2 of the TRM and for which the evaluation team and the SWE agreed that onsite metering was advised, Guidehouse conducted onsite verification and collected site-specific information for open variables used to calculate energy and demand savings. Site-specific information included end-use metered data and trend data from building management systems. There were no metered projects in PY11.

H.2.1.1.4 Handling Non-Response and Customer Refusal

Guidehouse made every attempt to complete its verification efforts. The evaluation team made repeated attempts via email and phone calls to schedule site visits or complete phone interviews. For projects that were unresponsive and assigned an onsite verification or onsite metering, the team dropped the sample point and replaced it with another from the same stratum. For projects assigned a phone verification and in alignment with the Evaluation Plan,[53] the team converted the project to a file review only after making at least five attempts to call or email the customer. Nine projects were converted to file review only after the team exhausted all customer contact attempts. No projects were replaced.

H.2.1.2 Sampling

Using tracking data from PY11, Guidehouse obtained the total number of projects and the total amount of energy savings in the population. With this project data, the evaluation team created four strata of sampled projects, as outlined in the PY11 sample design memo.[54]

Guidehouse first created a census stratum (Stratum 1 – Very Large Projects) for projects exceeding the kilowatt-hour thresholds described in the main body Stratum Structure table. Next, the evaluation team excluded all projects making up the lowest 2% of total solution energy savings. Finally, the team sorted the remaining projects by size and divided the population into two additional strata: those projects making up the top half and lowest half of total energy savings.

For Small C&I New Construction, Guidehouse verified 13 projects in PY11. These projects included the following:

- 9 projects including lighting and lighting controls
- 4 projects including HVAC measures

The SWE conducted three site visits for Small C&I New Construction projects in PY11.

For Large C&I New Construction, Guidehouse verified 14 projects in PY11. The evaluation team initially sampled eight projects per the PY11 Evaluation Plan. The verified savings and realization rates for these projects had larger variability than assumed during the sample design process, which resulted in a solution-level relative precision that did not meet the targets. In consultation with the SWE, the team pulled six additional sample points to meet the relative precision targets for the solution. The sample included the following projects:

[53] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[54] PECO. *PY11 Small and Large C&I EE Impact Sampling Design.* Dated March 23, 2020.

- 7 projects including lighting or lighting controls
- 2 projects including HVAC measures
- 2 projects including refrigeration measures
- 2 projects including whole building energy models
- 1 whole building project including multiple measure types

The SWE conducted three site visits for Large C&I New Construction projects in PY11. Details of the New Construction participation numbers and impact sample by stratum can be seen in Table 3-23 and Table 3-35 in the main body report.

H.2.1.3 Findings

The majority of sampled New Construction projects achieved realization rates for both demand and energy within 20% of expected values. Four projects had verified energy savings values fall above 120% or below 80% of the reported values and four fell outside the same zone for demand savings only. Guidehouse analyzed these projects to capture any trends in verified data. The following factors led to variation between the reported and verified savings and to the observed project-level realization rates:

- The most common discrepancy between ex ante and ex post calculations was in the annual HOU for lighting measures. In all three cases, the evaluation team verified HOU higher than the ex ante value. In one case, the team verified the building type as manufacturing three shift with commensurate HOU higher than the ex ante building type assumption (manufacturing one shift). In another case, the evaluation team verified separate areas of the facility as manufacturing and warehouse with higher HOU than the ex ante assumption (warehouse for the entire facility). The CSP typically used TRM deemed HOU in ex ante calculations. If the team verified the customer's reported HOU was more than 10% greater or less than the TRM deemed HOU, the customer-reported site-specific HOU were used.
- For one whole building energy simulation project, ex ante peak demand savings were calculated as annual energy savings divided by 8,760. This calculation represents the average annual demand savings but does not represent peak demand savings. Because building simulation software produces 8,760 hourly analyses, Guidehouse used these outputs to estimate peak demand savings rather than using average annual demand. This change in peak demand calculation methodology typically resulted in verified peak demand savings of more than double the reported savings.
- For one refrigeration project, the team found that the ex ante calculation used the overall unit wattage in the place of the single motor wattage (the unit contains multiple motors). The evaluation team adjusted the calculation to use the correct motor wattage, which deceased energy and demand savings.

H.2.2 Net Impact Evaluation

Guidehouse conducted NTG research in PY11 using the customer experience survey described in Section H.1.3 to ask a battery of questions regarding free ridership and spillover.

H.2.2.1 Methodology

Guidehouse surveyed a sample of construction contractors (builders) to gather information on free ridership and spillover and to estimate NTG ratios by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[55]

Using the Phase III Evaluation Framework[56] methodology, Guidehouse asked builders identified as decision makers what they would have done in the absence of the New Construction Solution. The evaluation team also asked builders to rate the influence of several key program elements in their decision to participate, including the program incentive, marketing material, and recommendations from program staff.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE upgrades influenced by the New Construction Solution but completed without receiving an incentive. Guidehouse applied deemed savings values, where applicable, to quantify the responses.

H.2.2.2 Sampling

Guidehouse stratified the population of New Construction projects by size as defined in Sections 3.3.3 and 3.4.3 in the main body report.

H.2.2.3 Results

Free ridership for the New Construction Solution is consistent with the results collected in PY9 as customers continue to report pushing for more efficient building projects even without the influence of the PECO New Construction Solution. Customers also reported spillover savings from projects completed without an incentive, including additional LED fixtures and heat pumps. See Sections 3.3.3 and 3.4.3 in the main body report for full NTG results.

H.2.3 Process Evaluation

Guidehouse completed a process evaluation for the New Construction Solution to assess PY11 activities. The evaluation team reviewed program materials, conducted in-depth interviews with PECO and CSP staff, and conducted online surveys with participants. Process evaluation of the New Construction Solution was last conducted in PY9.

H.2.3.1 Methodology

Guidehouse interviewed PECO and CSP program managers to better understand any changes to the program design, updates to measure mix, program successes and challenges, and barriers to participation. The evaluation team also surveyed customers who participated in the program in PY11. Through these surveys the team gained insight into participant awareness about the program, assessed participant satisfaction with different aspects of the program, and identified potential barriers to participation in the future. The evaluation team thoroughly

[55] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[56] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

reviewed the PY11 program tracking data to identify the customer population before developing the phone survey sample. The sampling methodology is discussed in Sections 3.3.4 and 3.4.4 in the main body report.

The evaluation team completed phone surveys with 10 Small C&I customers and nine Large C&I customers, exceeding the target of nine responses for Small C&I and falling below the Large C&I target of 15 responses. Though the Large C&I final sample did not meet the target, the response rate was high, with 38% (see Table 3-40 in the main body report) of Large C&I customers completing the survey. The team made concerted efforts to achieve the target sample size without burdening participants by offering a $100 incentive and contacting each participant up to six times.

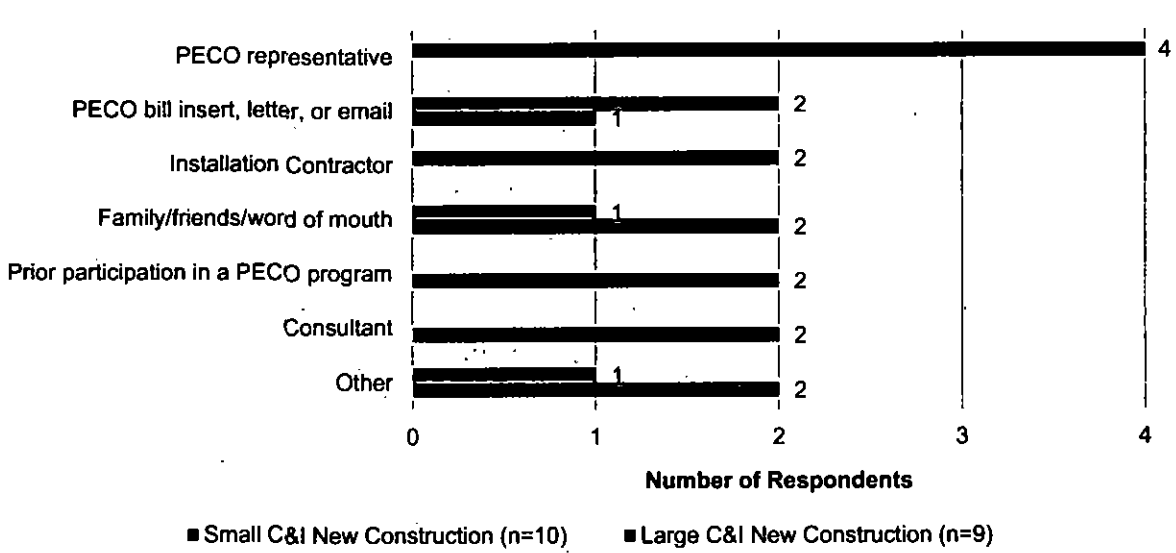
H.2.3.2 Findings

Interviews with the PECO and CSP program managers covered topics such as the current state of the solution, current challenges, opportunities for improvement, the customer rebate application, midstream pathways, the solution tracking database, and forward-thinking opportunities for Phase IV.

Similar to the Equipment and Systems Solution, the application process was identified as a barrier to participation. See H.1.3.2 for details on efforts PECO is making to improve the application process.

As Figure H-3 shows, the most common source of awareness for Small C&I respondents was a PECO representative (PECO employee, account representative, or customer service representative); for Large C&I respondents, word of mouth, prior participation in a PECO program, and a consultant were most common. Other sources of awareness for Small C&I respondents included a PECO bill insert, letter, or email, an installation contractor, word of mouth, and a third party. Other sources of awareness for Large C&I respondents included a PECO bill insert, letter, or email, a vendor, and in-house expertise.

Figure H-3. Sources of Awareness by Small and Large C&I New Construction Solutions

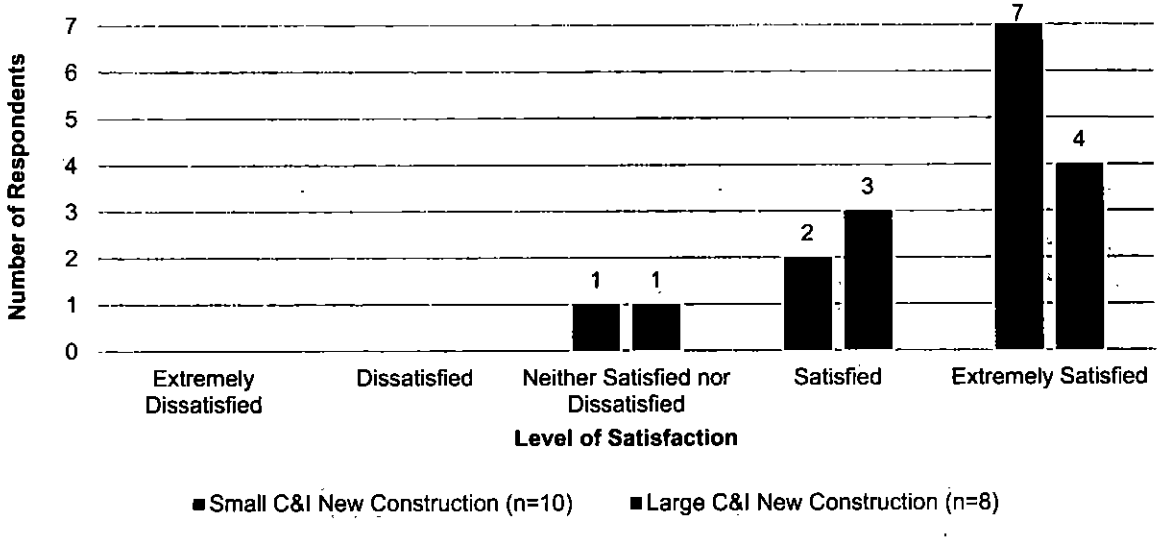


Question: "How did you learn about the Smart Ideas for your Business program?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

Overall, participants report high satisfaction with the program. On a rating scale of 1 to 5, 16 out of 18 participants stated they were either satisfied or extremely satisfied with their participation in the New Construction Solution (Figure H-4). On average, both Small and Large C&I respondents reported the highest satisfaction with the contractor(s) that installed the EE upgrades and the measures themselves.

Dissatisfaction for both Small C&I and Large C&I respondents stems from receiving insufficient rebate amounts compared to the level of effort and the complexity of the application; some respondents spent a significant amount of time to complete the application or hired a third party for assistance, reducing the net benefit of the rebate.

Figure H-4. Overall Satisfaction by Small and Large C&I New Construction Solutions



Question: "Using a scale of 1 to 5, with 1 meaning "Extremely Dissatisfied" 5 meaning "Extremely Satisfied," how would you rate your OVERALL satisfaction with the Smart Ideas for your Business program?"
Note: Do Not Know responses have been excluded.
Source: Guidehouse analysis

H.3 Whole Building Solution

The Whole Building Solution offers the direct installation of EE measures to customers who want to improve the overall energy performance of their small businesses. PECO and SmartWatt, the CSP, identify eligible small C&I customers with a monthly demand of 100 kW or less.[57] The CSP audits the customer's site and creates a proposal detailing the potential project upgrades, costs, and simple payback estimates. On average, PECO covers between 30% and 40% of the project cost, up to a minimum of a 1-year simple payback for the customer. PECO offers two financing options to cover the remaining costs: 12-month, 0% interest, or long-term financing at 7% interest. The CSP tracks energy savings and participation in PECO's eTrack

[57] Religious institutions and nonprofits with monthly demand of 200 kW or less are also eligible to participate in the Whole Building Solution.

database and defines participation as an activity at a customer premise with a unique project number. A project can include the installation of more than one measure.

The pandemic caused SmartWatt to halt direct customer outreach operations for approximately 3 months. During this time the CSP did not actively visit and recruit businesses to the program and did not engage customers at their place of business. SmartWatt used this opportunity to review previously rejected project proposals and reexamine ways to make the projects more attractive. One of the strategies SmartWatt employed was removing difficult-to-install fixture locations that required specialized lifts and other costly equipment, lowering overall project costs. SmartWatt was able to successfully sell many of these adjusted projects to customers once outreach operations resumed.

H.3.1 Gross Impact Evaluation

H.3.1.1 Methodology

The Phase III Evaluation Plan, written and approved before the pandemic, specified phone verifications for small strata impact projects, requiring the evaluation team to cold call businesses to discuss their participation in the Whole Building Solution. In place of the cold calling task, Guidehouse conducted online verification surveys in PY11 to reduce the burden on businesses that may have been negatively affected by the pandemic. The team also used responses to the online impact and process surveys as warm leads for the medium impact strata prior to calling and scheduling onsite visits. The SWE approved the online verification survey methodology in April 2020.

H.3.1.1.1 Engineering Desk Reviews

Guidehouse used the measure-specific variables provided in the eTrack database to populate the energy and demand savings algorithms (as detailed in the TRM and SWE-approved IMPs) to recalculate the reported energy and demand savings estimates. The team completed this task for all projects reported in the program tracking database.

H.3.1.1.2 Engineering File Reviews and Verification

This activity included a detailed engineering review of project files for a representative sample of Whole Building participants to ensure the eTrack database properly captures project details. Guidehouse stratified the Whole Building population using kilowatt-hour savings generated by the solution.[58]

H.3.1.2 Sampling

Guidehouse sampled at the project level for the impact evaluation activities in PY11 to identify medium impact (>70,000 kWh), low impact (6,750 kWh-70,000 kWh), and bottom 2% impact

[58] Guidehouse did not cold call small business customers in PY11 to avoid upsetting customers severely affected by the pandemic. The evaluation team used an online survey to allow customers to opt in to the onsite or phone verification activities.

(<6,750 kWh) projects.[59] Table H-1 summarizes the sampling targets and verification activity efforts by strata.

Table H-1. Small C&I Whole Building Sampling and Verification Activity Summary

Stratum	Targeted Sample Size	Achieved Sample Size	Verification Method	Description
Medium	5	4	Onsite visit	Conducted onsite visits with four out of five medium impact strata customers
	5	5	Phone verification	Conducted phone verification with all five customers
Small	7	9	Phone verification	Conducted phone verification calls with nine low impact strata customers
	7	4	Online verification survey	Received online impact verification surveys from five low impact strata customers but could only verify data with four participants
Bottom 2%	-	-	None	Did not conduct impact evaluation activities on this stratum

Source: Guidehouse analysis

H.3.1.3 Findings

The PY11 verification efforts identified the following findings:

- For lighting and lighting controls projects, the CSP used the General Information tab of the Appendix C: Lighting Audit and Design Tool to calculate custom HOU and CFs for all records in the tracking data. Guidehouse corroborated the custom HOU and CF for lighting and lighting control projects through phone and onsite interviews, as described in the TRM, with a sample of medium and low impact participants. The evaluation team did not find adequate variation in the results to adjust the tracking data.
- The most common discrepancy Guidehouse identified between ex ante and ex post savings calculations was the annual HOU for lighting measures. This affected five of the 14 verified customer facilities. The evaluation team aligned the HOU verification approach with the SWE memo on the pandemic.[60]
- Guidehouse found discrepancies with the count of lighting fixtures replaced at one facility, leading to a realization rate of less than 1.00.
- The evaluation team also found a discrepancy with the types of lighting controls installed at a facility, also resulting in a realization rate of less than 1.00.

[59] PECO. *PECO PY11 Whole Building Sample Design Memo FINAL-SWE APPROVED.* Revised March 12, 2020.
[60] PECO. *PA SWE Memo COVID-19 EMV Guidance.* July 7, 2020.

H.3.2 Net Impact Evaluation

Guidehouse conducted NTG research in PY11 using the customer survey described in Section H.3.3 to ask a battery of questions regarding free ridership and spillover.

H.3.2.1 Methodology

Guidehouse surveyed a sample of participants to gather information on free ridership and spillover and to estimate NTG ratios by strata. The evaluation team developed online survey instruments consistent with the Phase III Evaluation Plan.[61]

Using the Phase III Evaluation Framework[62] methodology, Guidehouse asked program participants identified as decision makers what they would have done in the absence of the Small Business Direct Install Program.[63] For example, responses such as "would have done the same project at the same time" and "already had money set aside" identified them as free riders. The evaluation team also asked participants to rate the influence of several key program elements in their decision to participate, including the information provided by the program representative, marketing materials, the discount or incentive, and payback on their investment.

The NTG evaluation estimates spillover by quantifying energy savings from customer-reported EE upgrades influenced by the Small Business Direct Install Program but completed without receiving an incentive. Guidehouse applied deemed savings values to quantify the responses.

H.3.2.2 Sampling

Guidehouse stratified the population of Whole Building participants by project size as defined in Section 3.3.3 in the main body report.

H.3.2.3 Results

Free ridership for the Whole Building Solution is slightly higher than the results collected in PY9 as awareness of EE opportunities increases in the small business market. Customers also reported spillover savings from additional projects completed without an incentive, including LED fixtures and LED refrigeration case lighting. These spillover results align with those collected during the PY9 evaluation. See Sections 3.3.3 and 3.4.3 in the main body report for full NTG results.

H.3.3 Process Evaluation

Guidehouse completed a process evaluation for the Whole Building Solution to assess PY11 activities. The evaluation team conducted in-depth interviews with PECO and CSP staff and online surveys with participants. Process evaluation of the Whole Building Solution was last conducted in PY9.

[61] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[62] Pennsylvania PUC. *Phase III Evaluation Framework.* http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf
[63] Small Business Direct Install Program is the customer-facing name for the Whole Building Solution.

H.3.3.1 Methodology

Guidehouse interviewed PECO and CSP program managers to understand changes to the program design, updates to measure mix, program successes and challenges, and barriers to program participation. The evaluation team also surveyed customers who participated in the program in PY11 to gain insight into how participants learned about the program, assess program satisfaction, gather free ridership and spillover information, and identify potential barriers to participation in the future.

The team sampled at the customer level for the customer satisfaction and NTG surveys by aggregating project-level savings by customer ID. This approach ensured customers did not receive multiple survey links when completing multiple projects.[64] Guidehouse used similar strata thresholds as the impact evaluation—medium (>70,000 kWh), small (6,750 kWh-70,000 kWh), and very small (<6,750 kWh)—but aggregating project savings shifted the total participant counts within each strata. The sampling targets are detailed in Section 3.3.4 in the main body report.

The PY11 process evaluation also included online surveys with participating customers to assess program satisfaction and gather primary NTG data. Guidehouse sent online surveys to a census of Whole Building participants, offering a $50 e-gift card as an incentive for completion. The survey effort had a 24% response rate, generating 39 completed surveys.

H.3.3.2 Findings

Interviews with the PECO and CSP program managers covered changes made to the Whole Building Solution in PY11 and the impacts of the pandemic on PY11 savings forecasts. Findings from the interviews included the following:

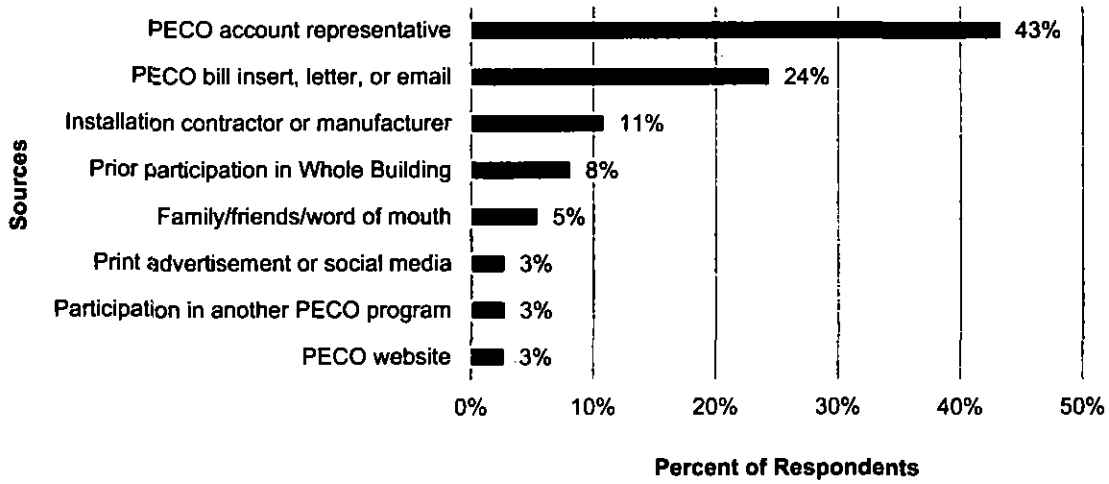
- **The CSP adjusted the eligibility of fixtures requiring specialized installation equipment.** Installation projects requiring lifts and other specialized equipment increase project costs and extend project times, often with limited return on kWh savings. In PY11, the CSP removed these difficult-to-install projects from proposals to reduce costs and increase the number of contracts signed by customers.
- **Hispanic community outreach.** PECO and the CSP built a Spanish language landing page of the website to improve participation from the Hispanic small business community. PECO also began a Spanish language email campaign late in PY11 to inform these customers about the opportunities to save energy through the Whole Building Solution.
- **Technical review and approval of contract prior to the customer signature.** The CSP improved QC processes in PY11 to include a technical review of each proposal prior to the customer signing the contract. The technical review step was added in response to customer dissatisfaction and technical errors created by inexperienced sales representatives.

For the Small C&I Whole Building Solution, the majority (43%) of surveyed customers reported hearing about the program directly from a PECO program representative (Figure H-5).

[64] Guidehouse surveyed customers about the multiple projects they completed through the program.

Participants also heard about the program through PECO bill inserts and letters (24%), installation contractors (11%), and prior participation in PECO's EE programs (8%).

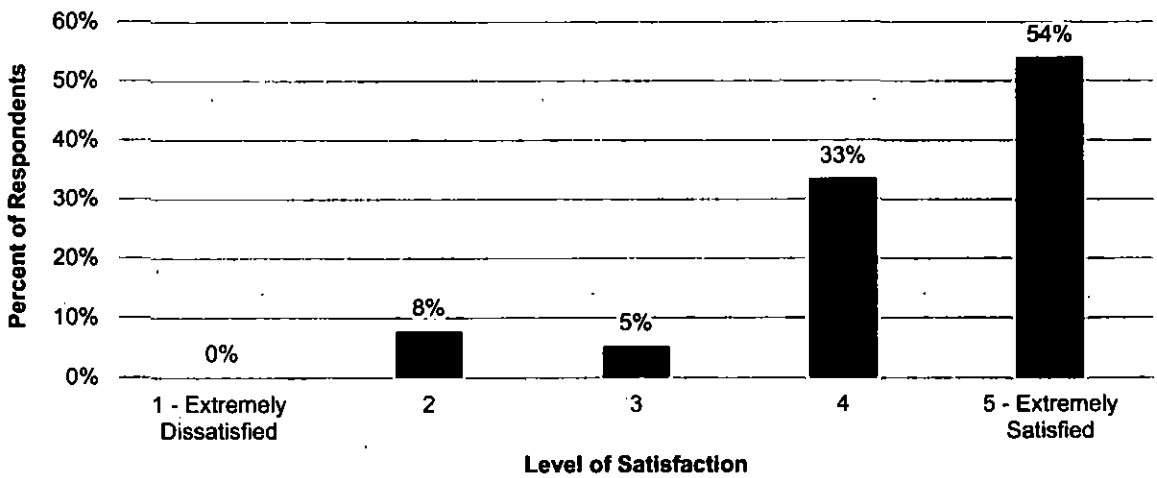
Figure H-5. Sources of Whole Building Awareness, n=37



Question: "How did you learn about PECO's Small Business Direct Install Solutions?"
Note: Do Not Know responses have been removed.
Source: Guidehouse analysis

Satisfaction with the Whole Building Solution is high, with 87% of respondents rating it a 4 or 5 on a scale of 1 to 5 (Figure H-6). Drivers of high satisfaction include the PECO incentive, the performance of the equipment installed, and the type of equipment offered by the program. Eight percent of respondents who reported dissatisfaction with the solution cited the scheduling process, communication issues with program staff post-installation, and delays in project completion.

Figure H-6. Overall Satisfaction for the Whole Building Solution, n=39



Question: "Using a scale of 1 to 5, with 5 meaning extremely satisfied and 1 meaning extremely dissatisfied, how would you rate your OVERALL satisfaction with the Small Business Direct Install program?"

Source: Guidehouse analysis

H.4 Data Centers Targeted Market Segment

Projects in the Data Centers Targeted Market Segment are eligible to participate in the Equipment and Systems or C&I New Construction Solutions, depending on the project details. Data centers, on account of their high energy usage profiles and specialized technologies, are given special attention from the Small and Large C&I EE Programs, allowing for tailored recruitment and implementation of such projects. Much of the energy savings in this segment come from cooling technologies, although the implementation of control systems and lighting are also possible. Participation is defined as an activity with a unique project number. More than one measure per participant is permitted, with the impact sample defined on the project level. ICF is the CSP for data center projects.

H.4.1 Gross Impact Evaluation

Guidehouse did not conduct an impact evaluation for data centers in PY11 because there was no participation. The evaluation team will conduct impact evaluation in PY12, pending participation.

H.4.2 Net Impact Evaluation

Guidehouse has not completed NTG research for the Data Centers Targeted Market Segment because participation has not been high enough to complete a full NTG calculation. No data center projects were completed in PY11.

H.4.3 Process Evaluation

As described in the Phase III Evaluation Plan,[65] Guidehouse did not complete any in-depth process evaluation activities for the Data Centers Targeted Market Segment due to lack of participation in PY11. Instead, the evaluation team interviewed the PECO program manager and CSP to identify significant implementation changes to inform the impact evaluation activities. No significant changes were found.

[65] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

Appendix I. Multifamily Targeted Market Segment

This appendix details the evaluation sample design, methods, and activities deployed in PY11 for the Multifamily Targeted Market Segment. Refer to Section 3 in the main body report for evaluation findings, results, and conclusions for this targeted market segment.

The Multifamily Targeted Market Segment is unique in that it contributes savings to the Residential EE, Small C&I EE, and Large C&I EE Programs. The decision makers for the projects in this targeted market segment consist of condominium owners, small multifamily building owners, property managers of large multifamily complexes, and executives at real estate investment companies that own multiple buildings in the PECO territory. Franklin Energy is the CSP for this program. The program offers direct install, prescriptive, and custom measures installed in common areas and in-unit tenant spaces of participating multifamily buildings.

The Multifamily Targeted Market Segment stopped building assessments and measure installations in March 2020 due to the pandemic.

I.1 Gross Impact Evaluation

I.1.1 Methodology

The PY11 impact evaluation focused on verifying reported savings; activities conducted included tracking system review and engineering file reviews of a sample of projects.

I.1.1.1 Tracking System Review

Guidehouse reviewed the program tracking data quarterly to verify the program-reported savings and confirmed that all the inputs needed to quantify the energy and demand savings were provided, as specified in the TRM.[66]

I.1.1.2 Engineering File Reviews with Verification

The evaluation team conducted ex post engineering file reviews for a sample of multifamily buildings that participated in the program in PY11. The team reviewed the project files for a subsample of projects in the impact evaluation sample[67] to confirm the data in the project files aligned with the corresponding program tracking data and documented any discrepancies in measure locations, quantities, and reported savings.

The engineering file reviews also involved evaluating the input assumptions used to perform the ex ante calculations. The evaluation team reviewed project-specific data such as make, model, count, and installation location of each measure. Section I.1.2 details the sampling methodology.

[66] PA PUC. *Technical Reference Manual; State of Pennsylvania Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards.* Dated June 2016, errata update February 2017.

[67] The subsample is developed to sample individual apartment units within the multifamily buildings in our impact evaluation sample.

The Phase III Evaluation Plan[68] included onsite verification visits, but they could not be conducted due to pandemic health and safety considerations (for more detail about how Guidehouse adapted its field plans, see Section 3.1.2 in the main report). The evaluation team applied the realization rates calculated in PY10 to the PY11 reported energy and demand savings results to arrive at PY11 gross impact results. The detailed impact evaluation results by program are available in Sections 3.1.2, 3.3.2, and 3.4.2 in the main body report.

I.1.2 Sampling

Guidehouse developed a representative sample for conducting PY11 verification work. The Multifamily PY11 measure mix and project sizes were similar to PY10, and the program structure did not change in PY11. The only change from PY10 was in the sample size, which reflects the PY11 participation levels in each stratum. Guidehouse submitted a revised sampling plan[69] with an updated sample size for the impact evaluation during the beginning of PY11's verification activities.

The complex blend of market segments and audience types requires a comprehensive sampling stratification methodology for evaluation, measurement, and verification (EM&V). Guidehouse stratified the population to develop a sample representative of all three program types (Residential EE, Small C&I EE, and Large C&I EE), buildings of all sizes and ownership structures, and direct install versus prescriptive measures. The evaluation team selected projects at random from each stratum to avoid biasing the sample. Table I-1 shows the final stratification.

Table I-1. Multifamily Targeted Market Segment Impact Evaluation Strata

Stratum Name	Stratum Description	Market Segments	Unit Basis	Impact Verification Method
Large – C&I	Buildings in the Large C&I market segment	Large C&I	Building	Engineering File Review
Small – C&I	Buildings in the Small C&I market segment	Small C&I	Building	Engineering File Review
Multisector – C&I and Res	Buildings with common areas in the C&I segments and units in the Residential segment	Small C&I, Large C&I, Residential	Building	Engineering File Review
Large – Residential	Buildings in the Residential market segment with a single decision maker for all projects in the building	Residential	Building	Engineering File Review
Small – Residential	Projects in the Residential market segment with individual decision makers	Residential	Project (in-unit)	Engineering File Review

Source: Guidehouse

Guidehouse further sub-subsampled apartments and common area projects for engineering file review from each building in the sample. The PY11 sampling activities targeted the following confidence and precision levels for impact verification activities:

[68] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.
[69] PECO. *PY11 Small and Large C&I EE Impact Sampling Design.* Dated March 23, 2020.

- Overall Multifamily Targeted Market Segment minimum: 85% confidence at 15% precision level
- Individual stratum minimum: 85% confidence at 50% precision level
- Individual sampled building or project minimum: 80% confidence at 20% precision level

The target sample size provided in the sampling plan is based on estimated program participation levels. Table I-2 summarizes the estimated population size, the actual population size, and the final sample size for each stratum needed to meet the target precision requirements. Guidehouse decided not to change the final sample size despite differences in the estimate and actual population sizes because the same sample size was estimated to exceed the target precision despite the greater population.

Table I-2. Multifamily Targeted Market Segment Updated Sample Size

Stratum Name	Unit Basis	Estimated Population Size	Original Sample Size	Actual Population Size	Final Sample Size
Large – C&I	Building	40	5	30	5
Small – C&I	Building	74	6	66	6
Multisector – C&I and Res	Building	26	5	25	5
Large – Residential	Building	48	6	38	6
Small – Residential	Project (in-unit)	2,793	6	3,073	6
Total	**Building**	**2,981**	**28**	**3,232**	**28**

Source: Guidehouse

The detailed gross impact evaluation sample design is provided in Table 3-4, Table 3-23, Table 3-35 in the main body report.

I.1.3 Findings

Guidehouse did not find any major discrepancies as a result of its engineering file reviews. No onsite verification was conducted in PY11 due to pandemic-related health and safety considerations, and the verified energy and demand savings were calculated using the realization rates developed in PY10.

I.2 Net Impact Evaluation

As described in the Phase III Evaluation Plan,[70] Guidehouse did not conduct any NTG research for the Multifamily Targeted Market Segment in PY11 and used the PY10 NTG ratios to calculate the net verified impact results.

I.3 Process Evaluation

The evaluation team interviewed the PECO program manager and CSP to identify any implementation changes to inform the impact evaluation activities. No significant changes were

[70] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

found. As described in the Phase III Evaluation Plan,[71] Guidehouse did not complete any other in-depth process evaluation activities for the Multifamily Targeted Market Segment in PY11. The evaluation team carried out an in-depth process evaluation in PY10.

[71] PECO. *Phase III Evaluation Plan, Energy Efficiency and Conservation Portfolio.* Revised March 3, 2020.

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