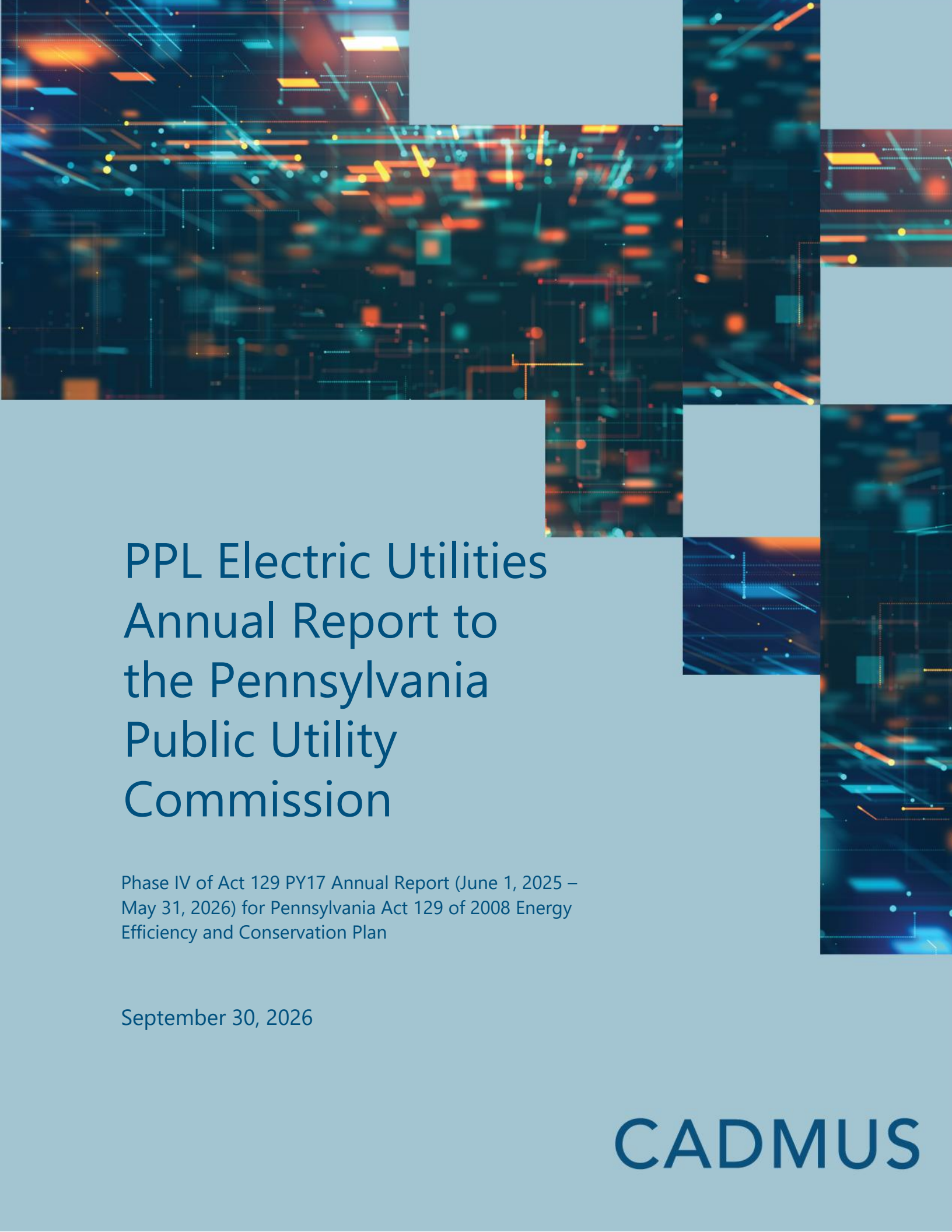




PPL Electric Utilities Annual Report to the Pennsylvania Public Utility Commission

Phase IV of Act 129 PY17 Annual Report (June 1, 2025 –
May 31, 2026) for Pennsylvania Act 129 of 2008 Energy
Efficiency and Conservation Plan

September 30, 2026

CADMUS

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Acronyms

AHRI	Air Conditioning, Heating, and Refrigeration Institute	HPWH	Heat pump water heater
AMI	Advanced metering infrastructure	HSPF	Heating seasonal performance factor
ASHP	Air-source heat pump	HVAC	Heating, ventilating, and air conditioning
C&I	Commercial and industrial	ICSP	Implementation Conservation Service Provider
CADR	Clean air delivery rate	IECC	International Energy Conservation Code
CDD	Cooling degree day	IMC	Incremental measure cost
CEI	Continuous energy improvement	IMP	Interim measure protocol
CF	Coincidence factor	IPMVP	International Performance Measurement and Verification Protocol
CHP	Combined heat and power	ISR	In-service rate
C.L.	Confidence limit	kW	Kilowatt
CSP	Conservation service provider or curtailment service provider	kWh	Kilowatt-hour
CSS	Cross-sector sales	KPI	Key performance indicator
Cv	Coefficient of variation	LED	Light-emitting diode
DLC	DesignLights Consortium	LIURP	Low-Income Usage Reduction Program
DR	Demand response	M&V	Measurement and verification
DHW	Domestic hot water	MMMF	Master-metered multifamily
DY	Delivery Year	MW	Megawatt
EDC	Electric distribution company	MWh	Megawatt-hour
EDT	Eastern Daylight Time	NPV	Net present value
EER	Energy efficiency ratio	NTG	Net-to-Gross
EE&C	Energy efficiency and conservation	N/A	Not Applicable
EFLH	Equivalent fuel load hours	O&M	Operations and maintenance
EM&V	Evaluation, measurement, and verification	OEM	Original equipment manufacturer
EISA	Energy Independence and Security Act	P3TD	Phase III to date
EUL	Effective useful life	P4TD	Phase IV to date
EV	Electric Vehicle	PA PUC	Pennsylvania Public Utility Commission
FCM	Forward Capacity Market	PAC	Program administrator cost
GNE	Government, nonprofit, educational	PIV TD	Phase IV to date
GPM	Gallons per minute	PSA	Phase IV to date preliminary savings achieved; equal to VTD + PYRTD
HDD	Heating degree day	PSA+CO	PSA savings plus carryover from Phase III
HER	Home energy report	PV	Photovoltaic (solar)
HEW	Home energy worksheet	PY	Program Year: for example, PY16, from June 1, 2024, to May 31, 2025
HIM	High-impact measure	PYRTD	Program year reported to date
HOU	Hours of use	PYVTD	Program year verified to date
HP	Horsepower		

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PYTD	Program year to date
QA/QC	Quality assurance/quality control
REA	Remote energy assessment
RTD	Phase IV to date reported gross savings
SEEE	Student Energy Efficient Education
SEER	Seasonal energy efficiency ratio
SKU	Stock keeping unit
SMI	Secondary market impacts
SWE	Statewide evaluator
T&D	Transmission and distribution
tLED	Tubular LED
TOU	Time of use
TRC	Total resource cost
TRM	Technical reference manual
UEC	Unit energy consumption
VTD	Phase IV to date verified gross savings
VTD+CO	Phase IV to Date Preliminary Savings Achieved + Carryover
WACC	Weighted average cost of capital
ZERH	Zero energy ready homes

Types of Savings

Gross Savings: The change in energy consumption and/or 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/or 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 changes 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 (ICSP) and stored in the program tracking system.

Unverified Reported Gross: The Phase IV 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 multi-year 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 application of 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/or 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/year or MW/year. The Pennsylvania Technical Reference Manual (PA 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 semi-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 IV to Date (P4TD): The energy and peak demand savings achieved by an EE&C program or portfolio within Phase IV of Act 129. Reported in several permutations described below.

Phase IV to Date Reported (RTD): The sum of the reported gross savings recorded to date in Phase IV of Act 129 for an EE&C program or portfolio.

Phase IV to Date Verified (VTD): The sum of the verified gross savings recorded to date in Phase IV of Act 129 for an EE&C program or portfolio, as determined by the impact evaluation finding of the independent evaluation contractor.

Phase IV to Date Preliminary Savings Achieved (PSA): The sum of the verified gross savings (VTD) from previous program years in Phase IV where the impact evaluation is complete plus the reported gross savings from the current program year.

Phase IV to Date Preliminary Savings Achieved + Carryover (PSA+CO): The sum of the verified gross savings from previous program years in Phase IV plus the reported gross savings from the current program year plus any verified gross carryover savings from Phase III of Act 129. This is the best estimate of an EDC's progress toward the Phase IV compliance targets.

Phase IV to Date Verified + Carryover (VTD + CO): The sum of the verified gross savings recorded to date in Phase IV plus any verified gross carryover savings from Phase III of Act 129.

PORTFOLIO COMPLIANCE TARGETS

PPL Electric Utilities offers energy efficiency programs to large and small commercial and industrial, residential, and income-eligible customers.

VERIFIED ENERGY SAVINGS

Phase IV
has saved
1,626,068 MWh/yr*

130%
of the compliance
target

134%
of planned

PY17 saved
336,775 MWh/yr

*Includes Phase III carryover savings

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
242.65 MW/yr

106%
of the compliance
target

129%
of planned

PY17 has
reductions of
63.76 MW/yr

LOW-INCOME PROGRAM

Phase IV
has saved
97,227 MWh/yr*

134%
of the compliance
target

114%
of planned

PY17 saved
14,524 MWh/yr

*Includes Phase III carryover energy savings

EXPENDITURES (\$1,000)

Phase IV
expenditures
\$278,100

89%
of planned

114%
of planned

PY17
expenditures
\$72,922

PORTFOLIO PARTICIPATION AND SATISFACTION

PY17 PARTICIPATION

A total of **579,590** participants



536,746 Residential

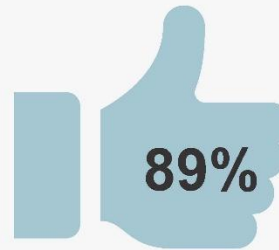


36,534 Low-Income



6,310 Non-Residential

PROGRAM SATISFACTION



89%

Overall Portfolio Satisfaction

92%

satisfied with Non-Residential Program

90%

satisfied with Residential Program

87%

satisfied with Low-Income Program

PARTICIPANT COMMENTS



"The wait time was short and the workers were effective, efficient, and helpful."



"Nice to be able to buy quality devices with rebate possible."



"The contractor was very responsive throughout the project, promptly answering questions and addressing any concerns that arose. Any issues we encountered were resolved quickly and professionally. Their communication, attention to detail, and commitment to customer satisfaction contributed to a very positive experience."



"The PPL [Electric Utilities] Think Energy Program makes a real difference in the classroom. It provides students with hands-on, engaging lessons about energy conservation and safety-concepts that are often difficult to make tangible at the elementary level."



"The whole process was great and easy to work with. It had flexibility that's crucial in this day and age. I was able to complete everything over the phone, get the recommendations and have everything delivered quickly."

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 Phases I (2008 through 2013), II (2013 through 2016), and III (2016 through 2021). In late 2020, each EDC filed a new Energy Efficiency and Conservation (EE&C) plan with the Pennsylvania Public Utility Commission (PA PUC) detailing the proposed design of its portfolio for Phase IV. These plans were updated based on stakeholder input and subsequently approved by the PUC in 2021.

Implementation of Phase IV of the Act 129 programs began on June 1, 2021. This report documents the progress and effectiveness of the Phase IV EE&C accomplishments for PPL Electric Utilities in program year 17 (PY17), as well as the cumulative accomplishments of the Phase IV programs since inception. This report also documents the energy savings carried over from Phase III. The Phase III carryover savings count toward EDC savings compliance targets for Phase IV.

This report details the participation, spending, reported gross, verified gross energy (MWh), peak demand (MW), and verified net impacts of the energy efficiency programs in PY17. 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.¹

PPL Electric Utilities has retained Cadmus as an independent evaluation contractor for Phase IV of Act 129. Cadmus is responsible for the measurement and verification of the savings and calculation of gross verified and net verified savings.

Cadmus also performed a process evaluation to examine the design, administration, implementation, and market response to the EE&C plan. This report presents the key findings and recommendations identified by the process evaluation and documents any changes to the EE&C plan delivery that were considered based on the recommendations.

1.1. Executive Summary

PPL Electric Utilities continued to successfully implement all energy efficiency programs for Phase IV Act 129 in PY17. In PY17, programs operated effectively, met their program objectives, and exceeded the PY17 energy savings and demand reduction goals (134% and 129%, respectively).

¹ 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. The 2021 TRC Test Order for Phase IV of Act 129 was adopted by PUC Order at Docket No. M-2019-3006868 on December 19, 2019.

PPL Electric Utilities has met the Phase IV portfolio energy savings compliance target, including Phase III carryover savings (306,275 MWh/yr), and has achieved gross verified energy savings of 1,626,068 MWh/yr, accounting for 130% of the Phase IV overall five-year compliance target of 1,250,157 MWh/yr. In PY17, PPL Electric Utilities achieved 336,775 MWh/yr in verified savings.

In Phase IV, PPL Electric Utilities achieved system-level demand reductions of 242.65 MW/yr, which represents 106% of the Phase IV overall five-year compliance target of 229 MW/yr. In PY17, PPL Electric Utilities exceeded the PY17 projected estimate of 49.56 MW/yr and achieved 63.76 MW/yr in system-level verified demand reductions, or 129% of demand projections.

PPL Electric Utilities has met the compliance target of 72,509 MWh/yr of verified gross energy savings for the low-income sector for Phase IV. PPL Electric Utilities has achieved 134% of the Phase IV low-income energy-savings compliance target through PY17 (97,227 MWh/yr), including carryover savings from Phase III (31,089 MWh/yr).

PPL Electric Utilities delivered programs for 89% of the Phase IV cumulative projected budget through PY17, estimated in the EE&C plan, expending \$278,099,566.² The acquisition cost in PY17 is \$0.22 per annual kWh and is \$0.21 per annual kWh for Phase IV (EDC expenditures/first-year savings). The portfolio-level PY17 total cost of conserved energy (TRC costs/net present value [NPV] lifetime kWh, at generation) is \$0.052/kWh. In PY17, the portfolio-level utility cost of conserved energy (program administrator cost [PAC]/NPV lifetime kWh, at generation) is \$0.021/kWh. The TRC includes PPL Electric Utilities' and the customers' costs, while the PAC only includes PPL Electric Utilities' costs.

A portfolio is cost-effective when the TRC benefit-cost ratio exceeds 1.0. The PY17 and phase-to-date portfolio is cost-effective with a portfolio-level TRC of 1.40 (PY17) and 1.41 (phase-to-date).

In PY17, the evaluated net-to-gross (NTG) ratio is 0.72, which includes spillover attributable to the Energy Efficient Homes components of the Residential Program.

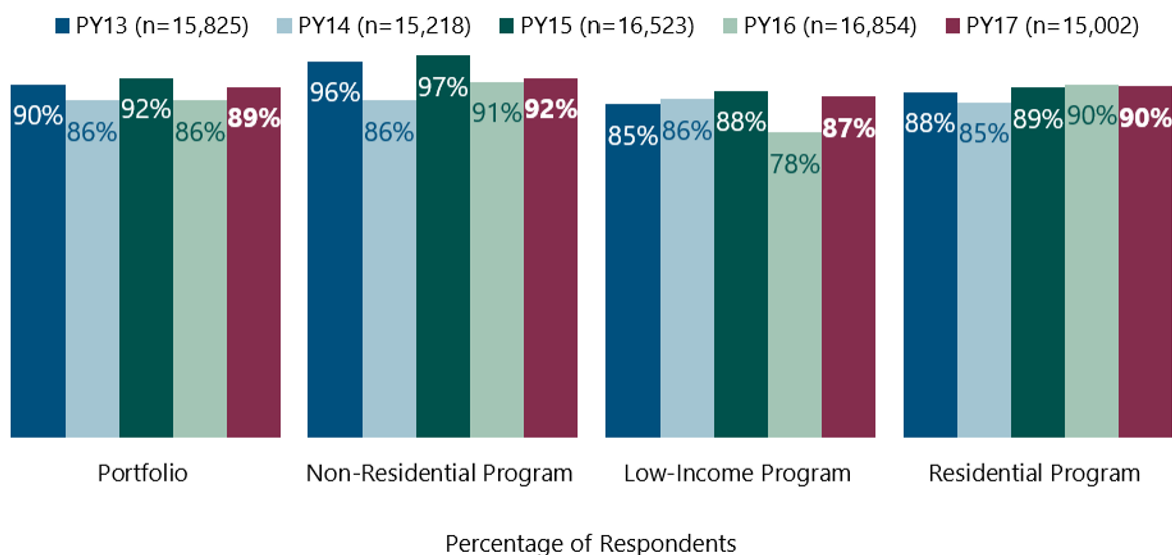
In Phase IV, PPL Electric Utilities established a goal to achieve 85% or greater of *very satisfied* and *somewhat satisfied* customers in each program, as shown in Figure 1-1.³ Respondents to participant satisfaction surveys across the programs reported satisfaction levels between 87% to 92%. In PY17, satisfaction ratings for the portfolio overall and the Low-Income Program increased significantly compared to PY16.⁴ Satisfaction ratings for the Non-Residential Program also increased, but not significantly. Ratings for the residential program remained the same.

² PPL Electric Utilities estimated a budget of \$312,491,409 including SWE costs.

³ The customer satisfaction goal is listed in PPL Electric Utilities' EE&C Plan (Docket No. M-2020-3020824) revised March 27, 2025.

⁴ Differences between PY17 and PY16 results are statistically different at the 90% confidence level, p-value < 0.10.

Figure 1-1. Portfolio-Level Program Satisfaction
Very and Somewhat Satisfied Combined



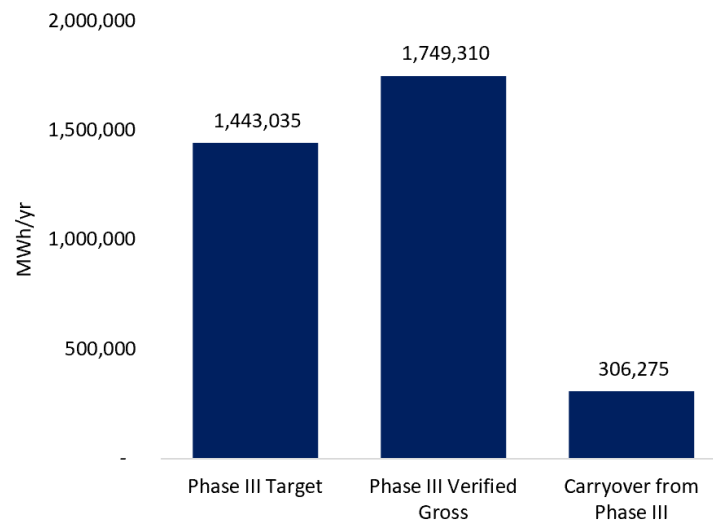
Source: Participant survey question, "Thinking about your overall experience with the PPL Electric Utilities program/component, how would you rate your overall satisfaction?" Program satisfaction results include all responses to the satisfaction question, averaged to compute the portfolio-level satisfaction. These totals may not reflect the number of "completed" surveys as reflected in Table 4-4. Non-Residential includes Custom and Efficient Equipment downstream survey respondents. Low-Income includes remote energy assessment and direct install survey respondents. Residential includes Appliance Recycling; Energy Efficient Homes Equipment, Audit, and Weatherization, and Marketplace; and student and teacher survey respondents. PY16 overall portfolio and residential satisfaction results shown here differ from those reported in the filed PY16 Annual Report because satisfaction results from the Home Energy Reports component (a non-opt-in program) were excluded from this analysis.

2. Summary of Achievements

2.1. Carryover Savings from Phase III of Act 129

PPL Electric Utilities has a total of 306,275 MWh/year of portfolio-level carryover savings from Phase III. Figure 2-1 compares PPL Electric Utilities' Phase III verified gross savings total to the Phase III compliance target to illustrate the carryover calculation.

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

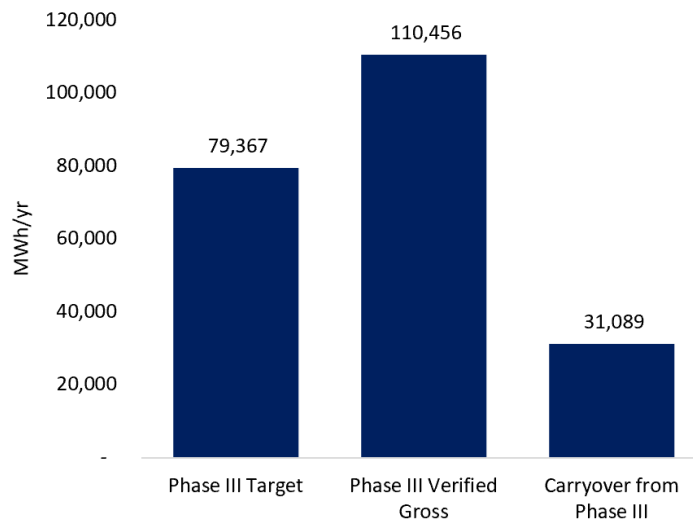


The PA PUC's Phase IV Implementation Order also allows EDCs to carry over savings in excess of the Phase III low-income savings goal.^{5,6} Figure 2-2 shows the calculation of carryover savings for the low-income customer segment.

⁵ Pennsylvania Public Utility Commission. *Energy Efficiency and Conservation Program Implementation Order*, at Docket No. M-2020-3015228, (*Phase IV Implementation Order*), entered June 18, 2020.

⁶ Proportionate to those savings achieved by dedicated low-income programs in Phase III.

Figure 2-2. Low-Income Carryover from Phase III



2.2. Phase IV Energy Efficiency Achievements to Date

The Phase IV energy savings targets (MWh) were established at the meter level, and peak demand reduction targets (MW) were set at the system level. Accordingly, this report presents MWh totals at the meter level and peak demand savings adjusted for transmission and distribution losses to reflect system-level savings.

Table 2-1 shows the achievements since the beginning of PY17 on June 1, 2025, through the end of May 31, 2026.

Table 2-1. PY17 Energy and Demand Achievements to Date⁽¹⁾

PYTD	Reported Gross Savings (PYRTD) ⁽²⁾	Verified Savings (PYVTD)	System-Level Verified Savings (PYVTD)	Realization Rate ⁽³⁾
Energy Savings (MWh/yr) ⁽⁴⁾	320,121	336,775	N/A	105%
Peak Demand Reductions (MW/yr) ⁽⁴⁾	60.89	59.36	63.76	105% ⁽⁵⁾

⁽¹⁾Savings do not include unverified PY15 or PY16 savings verified in PY17.

⁽²⁾Reported savings do not include the application of distribution losses.

⁽³⁾Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽⁴⁾Savings may not match other tables or figures due to rounding.

⁽⁵⁾Realization rates in this table were applied to verified demand reductions with application of distribution losses.

Table 2-2 shows the Phase IV achievements through the end of Phase IV (PY17), including carryover savings. Including carryover savings from Phase III, PPL Electric Utilities has met the compliance target and achieved 1,626,068 MWh/yr of verified savings. This represents 130% of the Phase IV energy savings compliance target of 1,250,157 MWh/yr. PPL Electric Utilities has achieved 242.65 system-level demand reductions or 106% of the Phase IV demand reduction savings compliance target of 229 MW/yr.

Table 2-2. Phase IV Energy and Demand Achievements to Date

P4TD	Reported Gross Savings (P4RTD)	Verified Savings (P4VTD)	System-Level Verified Savings (P4VTD)	Realization Rate ⁽¹⁾
Energy Savings (MWh/yr) ⁽²⁾	1,323,991	1,626,068 ⁽³⁾	N/A	100% ⁽⁴⁾
Peak Demand Reductions (MW/yr) ⁽²⁾	235.96 ⁽⁵⁾	226.29	242.65	103% ⁽⁶⁾

⁽¹⁾Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings. Realization rates include unverified savings. Realization rates across chapters were calculated by excluding unverified reported savings from the denominator.

⁽²⁾Savings may not match other tables or figures due to rounding.

⁽³⁾Verified energy savings include Phase III carryover of 306,275 MWh/yr.

⁽⁴⁾Realization rate excludes Phase III carryover of 306,275 MWh/yr.

⁽⁵⁾Reported savings do not include the application of distribution losses.

⁽⁶⁾Realization rates were applied to verified demand reductions with the application of distribution losses.

Looking ahead to Phase V:

- With 1,319,793 MWh/yr of VTD energy savings achieved during Phase IV without Phase III carryover, PPL Electric Utilities has achieved an estimated 69,636 MWh/yr of carryover energy savings from Phase IV to Phase V.⁷ This represents 8% of the Phase V portfolio energy savings target.
- With 242.65 MW/yr of VTD peak demand reductions achieved during Phase IV, PPL Electric Utilities has achieved an estimated 6.82 MW/yr of carryover peak demand reductions from Phase IV to Phase V.⁸ This represents 5% of the Phase V portfolio peak demand savings target.

Figure 2-3 summarizes PPL Electric Utilities' performance compared to the Phase IV MWh portfolio compliance target, and Figure 2-4 summarizes performance compared to the Phase IV MW/yr portfolio compliance target. Verified savings include previously unverified savings from PY15 and PY16 Energy Efficient Homes Deep Energy Retrofits, PY16 Energy Efficient Homes New Homes, and one large stratum Custom PY16 project.

⁷ Carryover of Phase IV MWh is capped at a maximum of 20% of the respective portfolio and low-income consumption reduction targets. See Pennsylvania Public Utility Commission, Energy Efficiency and Conservation Program Implementation Order, at Docket No. M-2025-3052826, (Phase V Implementation Order), entered June 18, 2025. <https://www.puc.pa.gov/pcdocs/1883669.pdf>

⁸ Carryover of Phase IV MW is capped at 50% of the excess peak demand savings acquired in Phase IV. See Pennsylvania Public Utility Commission, Energy Efficiency and Conservation Program Implementation Order, at Docket No. M-2025-3052826, (Phase V Implementation Order), entered June 18, 2025. <https://www.puc.pa.gov/pcdocs/1883669.pdf>

Figure 2-3. EE&C Plan Performance Toward Phase IV Portfolio Compliance Target (MWh/yr)

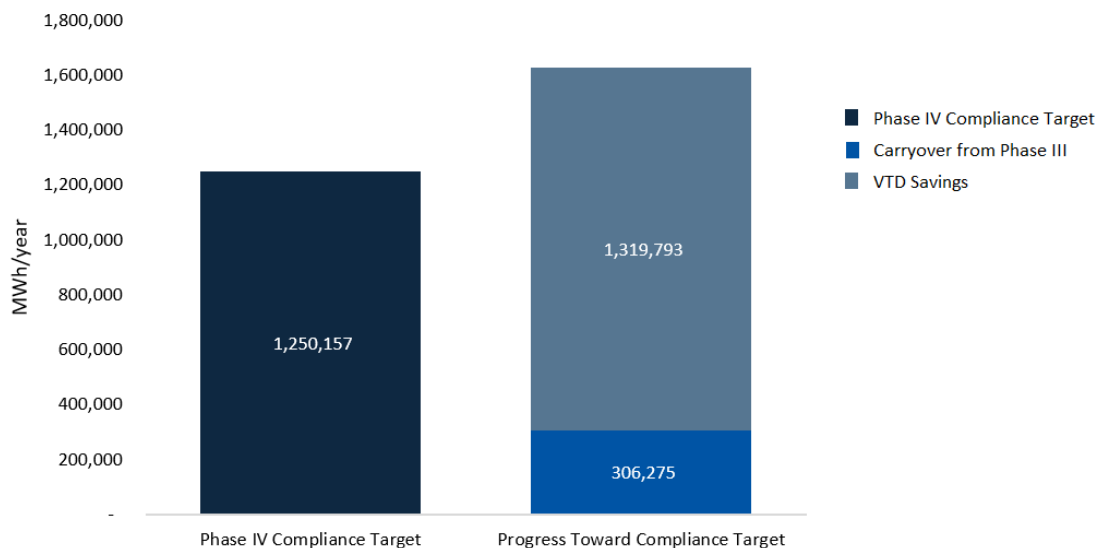
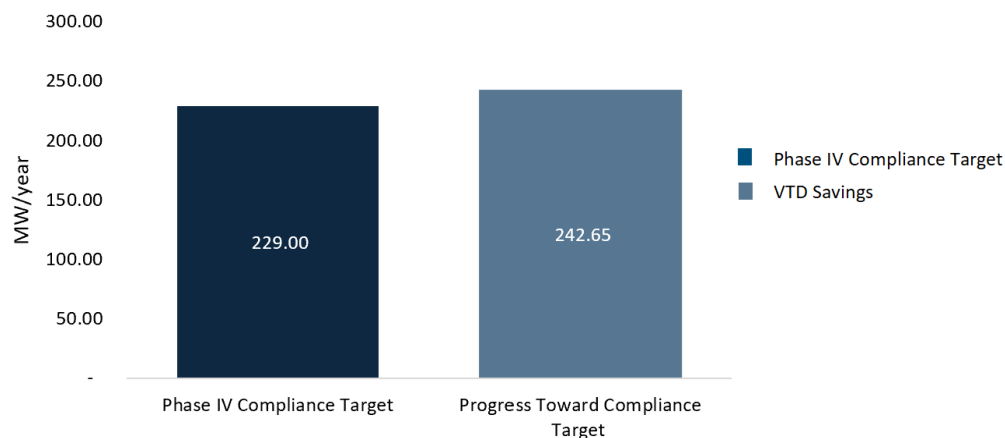


Figure 2-4. EE&C Plan Performance Toward Phase IV Portfolio Compliance Target (MW/yr)

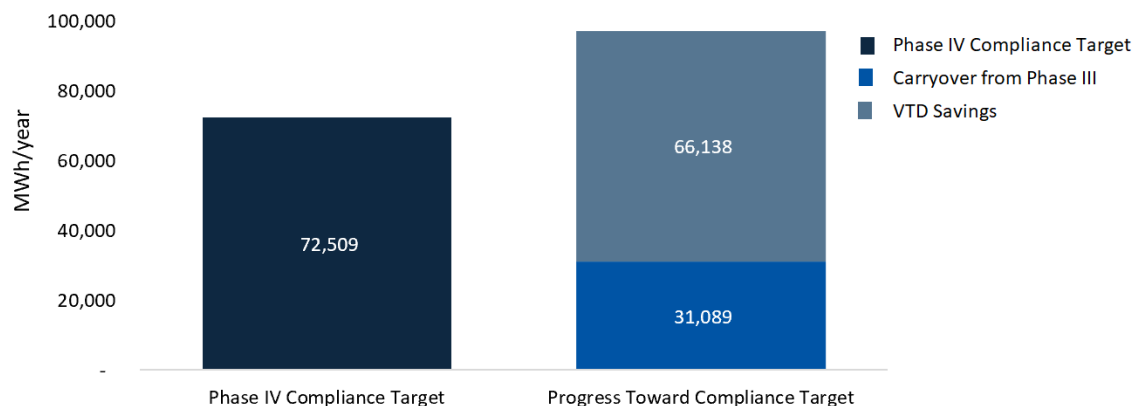


The Phase IV Implementation Order directed EDCs to offer conservation measures to the low-income customer segment based on the proportion of electric sales attributable to low-income households. PPL Electric Utilities' target proportion is 9.95%. PPL Electric Utilities offers a total of 85 EE&C measures to its residential and non-residential customer classes. There are 16 distinct measures available to the low-income segment at no cost to the customer. This represents 18.8% of the total measures offered in the EE&C plan and exceeds the proportionate number of measures targeted.

The PA PUC also established a low-income energy-savings target of 5.8% of the portfolio savings goal. The low-income savings target for PPL Electric Utilities is 72,509 MWh/yr verified gross savings. Figure 2-5 compares the VTD performance for the low-income customer segment to the Phase IV savings target. Including Phase III Low-Income carryover savings, PPL Electric Utilities achieved 134% of the Phase IV low-income energy-savings compliance target, with total savings of 97,227 MWh/yr.

Looking ahead to Phase V, low-income energy savings from Phase III carryover were fully utilized to support Phase IV performance. As a result, no low-income carryover savings are available for Phase V.

Figure 2-5. EE&C Plan Performance Toward Phase IV Low-Income Compliance Target (MWh/yr)



2.2.1. Phase IV Performance, Multifamily Housing

Table 2-3 lists verified gross electric energy savings (PYVTD) from multifamily housing across all programs, including energy savings from low-income households.

Table 2-3. PY17 and Phase IV Multifamily Housing Summary

Program	PYVTD (MWh/yr)	Phase IV VTD (MWh/yr)
Low-Income	4,279	18,462
Portfolio Total	11,537	32,669

Master-Metered Multifamily Housing Summary

In compliance with the June 2023 settlement agreement, PPL Electric Utilities agreed to several reporting requirements on its expanded efforts with master-metered multifamily (MMMF) customers. PPL Electric Utilities worked with eight property managers at eight MMMF locations throughout its service territory. The Low-Income Program treated 1,518 units at 70 buildings in PY17. The units (and tenants) received LED lighting, water-saving measures, smart strips, and energy education. One hundred and ninety-one customers received comprehensive measures during their appointments. The cost of the direct installation, comprehensive measures, and labor was \$434,536.

The Low-Income Program achieved 355 MWh/yr of energy savings and 0.04 MW/yr of system-level demand reductions in MMMF housing in PY17. PPL Electric Utilities updated marketing collateral, completed outreach to customers in prior phases, and worked with nonprofit housing authorities to develop additional MMMF opportunities. Additionally, PPL Electric Utilities' Low-Income ICSP used multiple proprietary software and database resources to locate additional opportunities. These efforts, as well as collaboration with Pennsylvania Department of Environmental Protection, will continue in Phase V.

Additionally, the Non-Residential Program treated the common areas of 19 affordable MMMF buildings in PY17. The common areas in these buildings received lighting improvements and HVAC upgrades. These buildings achieved 244 MWh/yr of verified gross electric energy savings, 0.04 MW/yr of verified demand reductions, and \$27,653 in incentives for these projects.

2.3. Phase IV Performance by Customer Segment

Table 2-4 presents participation, savings, and spending by customer sector for PY17. The EDC tariff defines residential, small C&I, and large C&I sectors, and statute (66 Pa. C.S. § 2806.1) defines the residential low-income sector and government, nonprofit, educational (GNE) sector. The residential low-income segment is a subset of the residential customer class, and the GNE segment includes customers in the residential, small C&I, or large C&I rate classes. Cadmus removed the savings, spending, and participation values for the low-income and GNE segments from the parent sectors.

Table 2-4. PY17 Summary Statistics by Customer Segment⁽¹⁾

Parameter	Residential (Non-LI)	Low- Income	Small C&I (Non-GNE)	Large C&I (Non-GNE)	GNE	Total ⁽²⁾
Reported Number of Participants ⁽³⁾	534,668	36,507	5,611	771	2,033	579,590
PYRTD MWh/yr ⁽⁴⁾	75,349	15,489	94,762	86,584	47,936	320,121
PYRTD MW/yr ⁽⁴⁾	11.43	1.71	24.50	15.77	7.49	60.89
PYVTD MWh/yr ⁽⁴⁾	78,088	14,169	107,358	87,693	49,467	336,775
System-Level PYVTD MW/yr ⁽⁴⁾	12.64	1.70	25.63	16.00	7.79	63.76
PY17 Incentives (\$1000) ^{(4),(5)}	\$6,986	\$4,126	\$12,252	\$8,258	\$4,524	\$36,146

⁽¹⁾ This table does not include PY15, and PY16 unverified savings verified in PY17.

⁽²⁾ Columns may not sum to totals due to rounding.

⁽³⁾ Verified participation totals discussed in each chapter and appendix and shown in the infographics may differ from the reported participation in this table.

⁽⁴⁾ Savings may not match other tables or figures due to rounding.

⁽⁵⁾ PPL Electric Utilities reports the number of participants and PYRTD using their participant tracking database; however, they use the incentive amounts from a separate accounting system since they are reported along with the other expenditures.

Table 2-5 shows savings for the GNE sector as defined by statute (66 Pa. C.S. § 2806.1) for residential, small, and large C&I customer sectors defined by the EDC tariff.

Table 2-5. PY17 Energy and Demand Summary of Government, Nonprofit, and Education Sector Customers

Parameter	GNE Customers with Residential Rate Codes	GNE Customers with Small C&I Rate Codes	GNE Customers with Large C&I Rate Codes	GNE Total ⁽¹⁾
PYRTD MWh/yr ⁽²⁾	24	12,510	35,403	47,936
PYRTD MW/yr ⁽²⁾	-	2.99	4.80	7.49
PYVTD MWh/yr	26	13,938	35,503	49,467
System-Level PYVTD MW/yr	-	2.99	4.80	7.79

⁽¹⁾ Columns may not sum to totals due to rounding. These totals will not match the values in other tables showing totals by customer sector.

⁽²⁾ Does not include PY15 and PY16 unverified savings verified in PY17.

Table 2-6 summarizes plan performance by sector since the beginning of Phase IV.

Table 2-6. Phase IV Summary Statistics by Customer Segment

Parameter	Residential (Non-LI)	Low-Income	Small C&I (Non-GNE)	Large C&I (Non-GNE)	GNE	Total ⁽¹⁾
Reported Number of Participants ⁽²⁾	2,789,398	138,605	137,584	4,092	8,390	3,078,070
RTD MWh/yr ⁽³⁾	271,433	67,915	448,971	382,953	152,719	1,323,991
RTD MW/yr ⁽³⁾	37.00	7.30	94.51	69.43	27.71	235.96
VTD MWh/yr ^{(3),(4)}	262,158	95,790 ⁽⁴⁾	460,890	378,082	153,963	1,626,068 ^{(4),(5)}
System-Level VTD MW/yr ⁽³⁾	39.07	7.39	98.17	69.66	28.36	242.65 ⁽⁵⁾
Phase IV Incentives (\$1000) ⁽⁶⁾	\$33,703	\$19,748	\$53,490	\$26,243	\$16,064	\$149,248

⁽¹⁾ Columns may not sum to totals due to rounding.

⁽²⁾ Verified participation totals discussed in each chapter and appendix and shown in the infographics may differ from the reported participation in this table.

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Verified energy savings include Phase III carryover for the low-income sector of 31,089 MWh/yr. The total includes Phase III carryover savings of 306,275 MWh/yr not attributed to individual sectors; therefore, the sum of savings by sector will not match the total.

⁽⁵⁾ Includes adjustments to savings made by the statewide evaluator (193 MWh/yr and 0.17 MW/yr). Includes PY15 and PY16 unverified savings that were verified in PY17 for Energy Efficient Homes Deep Energy Retrofits and New Homes subcomponents, and Non-Residential Custom program component. Details are in sections 2.5 and 2.6.1. Due to an evaluation clerical error in the PY16 report, a portion of the Deep Energy Retrofits savings was already included in the PY16 verified savings. The values presented in the Phase IV totals reflect the corrected savings and will not reconcile with the originally reported PY16 results.

⁽⁶⁾ PPL Electric Utilities reports the number of participants and PYRTD using their participant tracking database; however, they use the incentive amounts from a separate accounting system since they are reported along with the other expenditures.

2.4. Summary of Participation by Program

Participation is defined differently for some programs and program components, depending on the program delivery channel and data tracking practices. Table 2-7 shows the participant definition by program and component, along with the current participation totals for PY17 and Phase IV.

Table 2-7. EE&C Plan Participation by Program

Program/Component	Participant Definition	PYTD Participation ⁽¹⁾	P4TD Participation ⁽¹⁾
Non-Residential Program			
Custom	Unique job number; commercially operable job that received an incentive payment during the reporting period.	295	971
Efficient Equipment (Downstream)	Unique job number; corresponds to each unique job that received a rebate.	730	3,375
Efficient Equipment (Midstream)	Unique job number; corresponds to each purchase of discounted products.	5,285	24,291
Low-Income Program			
Low-Income Assessment	Unique bill account number; corresponds to an income-eligible household that receives an audit and program services or receives a welcome kit.	36,534	138,690
Residential Program			
Appliance Recycling	Unique job number; corresponds with each unique appliance decommissioned through the program component during the program year.	26,435	81,744
Efficient Lighting	Number of discounted bulbs sold.	-	1,588,224
Energy Efficient Homes New Homes	Unique job number; corresponds to a rebated project.	1,587	7,878 ⁽²⁾
Energy Efficient Homes Audit and Weatherization	Unique job number; corresponds to a rebated project. Households could have more than one rebated project.	2,431	8,171 ⁽³⁾
Energy Efficient Homes Online Marketplace	Unique job number; corresponds to a rebated project.	2,666	21,809
Energy Efficient Homes Equipment (Downstream)	Unique job number; corresponds to a rebated project. Households could have more than one rebated project.	11,158	49,470 ⁽³⁾
Energy Efficient Homes Equipment (Midstream)	Unique job number; corresponds to each purchase of discounted products.	28	70
Energy Efficient Homes Instant Discount	Unique job number; corresponds to each discounted item purchased.	44,959	197,721
Energy Efficient Homes EV Pilot	Unique job number; corresponds to each rebated measure or discounted item purchased.	481	481
Home Energy Reports ⁽⁴⁾	Unique household that received at least one report	426,905	854,497
Student Energy Efficient Education	The number of participants is counted as the number of energy conservation kits delivered.	20,096	100,678
Portfolio Total		579,590	3,078,070

⁽¹⁾ Includes incentive adjustments and may differ from total participants shown in infographics.

⁽²⁾ Includes High-Performance Homes pilot participants.

⁽³⁾ Includes Deep Energy Retrofits pilot participants.

⁽⁴⁾ Differs from total participants reported in the impact analysis. Does not include Energy Analyzer participants.

2.5. Summary of Impact Evaluation Results

During PY17, Cadmus completed impact evaluations for all program components in the portfolio.

Table 2-8 summarizes the realization rates and NTG ratios by program component.

Table 2-8. PY17 Impact Evaluation Results Summary

Program	Component	Energy Realization Rate ⁽¹⁾	Demand Realization Rate ⁽¹⁾	Net-to-Gross Ratio
Non-Residential	Custom	95%	97%	0.72 ⁽²⁾
	Efficient Equipment	124%	96%	0.67 ⁽³⁾
Low-Income	Low-Income	91%	91%	1.0 ⁽⁴⁾
Residential	Appliance Recycling	99%	99%	0.50 ⁽⁵⁾
	Energy Efficient Homes	105%	124%	0.56 ⁽⁶⁾
	Home Energy Reports	105%	84%	1.0 ⁽⁴⁾
	Student Energy Efficient Education	96%	98%	1.0 ⁽⁴⁾
Portfolio Total		105%	97%	0.72⁽⁷⁾

⁽¹⁾ Realization rates were applied to verified demand reductions before application of distribution losses.

⁽²⁾ PY17 evaluated NTG ratio.

⁽³⁾ PY15 evaluated NTG ratios used for midstream lighting stratum. PY14 NTG ratios used for downstream, direct discount, direct install lighting stratum and downstream, direct discount, direct install non-lighting stratum. PY15 benchmarking NTG ratios used for midstream non-lighting stratum. The NTG ratio for the overall component is the verified gross population energy savings weighted average of the NTG ratios applied to the stratum.

⁽⁴⁾ No free ridership is expected or measured per the evaluation plan. Therefore, the NTG ratio is 1.00.

⁽⁵⁾ PY15 evaluated NTG ratio.

⁽⁶⁾ PY16 evaluated NTG ratios used for Downstream Equipment. Cadmus applied measure-level NTG ratios from the PY16 Downstream Equipment NTG research for measures similar to Midstream Equipment stratum measures. PY16 Downstream Equipment evaluated NTG ratios used for the Midstream Equipment stratum. PY15 evaluated NTG ratios used for the Online Marketplace stratum. PY14 evaluated NTG ratios used for the Audit and Weatherization stratum. PY13 evaluated NTG ratio used for the New Homes stratum. PY15 and PY16 evaluated measure-level NTG ratios from Downstream Equipment and Online Marketplace stratums used for PY17 Instant Discount stratum measures that were like PPL Electric Utilities program measures, and PY15 benchmarking NTG ratios used where there was not a similar PPL Electric Utilities NTG researched value to leverage. For the PY17 Electric Vehicle Charging Pilot stratum, Cadmus administered online self-report surveys in PY17 to assess free ridership and spillover, per the evaluation plan. The NTG ratio for the overall component is the verified gross population energy savings weighted average of the NTG ratios applied to each stratum.

⁽⁷⁾ Weighted by PY17 program-verified gross energy savings.

2.6. Summary of Energy Impacts by Program

Act 129 compliance targets are based on annualized savings estimates (MWh/year). Each program year, the annual savings achieved by program activity are recorded as incremental annual, or first-year savings and added to an EDC's progress toward compliance (Section 2.6.1 *Incremental Annual Energy Savings by Program* presents incremental annual savings estimates). Lifetime energy savings incorporate the effective useful life (EUL) of installed measures and estimate the total energy savings associated with program activity. Cadmus used participant lifetime savings in the TRC test to assess the economics of statewide evaluator (SWE) upgrades and calculate the emissions benefits of Act 129 programs. Section 2.6.2 *Lifetime Energy Savings by Program* presents the lifetime energy savings by program.

2.6.1. Incremental Annual Energy Savings by Program

Table 2-9 summarizes PY17 PYTD energy savings by program and for Phase IV to date. This report presents energy impacts at the meter level, which do not reflect adjustments for transmission and distribution losses. Cadmus adjusted verified gross savings by the energy realization rate and verified net savings by the realization rate and the NTG ratio.

Table 2-9. Incremental Annual Energy Savings by Program (MWh/Year)

Program	PYRTD (MWh/yr) ⁽¹⁾	PYVTD Gross (MWh/yr) ⁽¹⁾	PYVTD Net (MWh/yr) ⁽¹⁾	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
Non-Residential	227,653	243,010	168,977	983,326	991,939	672,781
Low-Income	15,936	14,524	14,524	69,776	97,227 ⁽²⁾	66,138 ⁽³⁾
Residential	76,532	79,241	58,427	270,889	261,717	179,108
Portfolio Total⁽⁴⁾	320,121	336,775	241,928	1,323,991	1,626,068⁽²⁾	918,027⁽³⁾

⁽¹⁾ Does not include unverified PY15/PY16 savings verified in PY17.

⁽²⁾ Includes 31,089 MWh/yr of carryover savings for the Low-Income Program and a total of 306,275 MWh/yr carryover savings for the Portfolio. The sum of the VTD Gross column will not match the Portfolio total row because carryover savings are not attributed to either the Non-Residential Program or the Residential Program.

⁽³⁾ VTD Net does not include carryover savings from Phase III of 31,089 MWh/yr for the Low-Income Program or 306,275 MWh/yr for the portfolio.

⁽⁴⁾ Total may not match the sum of rows due to rounding.

The previously reported VTD savings from prior years, for the following programs, have changed since the PY16 final annual report was submitted:

Non-Residential

- Custom component: 1,317 MWh/yr savings were reported but not verified in the PY16 final annual report. Those savings have since been verified with an energy realization rate of 100% and an NTG ratio of 0.74, which yields an additional 1,317 MWh/yr of gross verified energy savings and an additional 975 MWh/yr of net verified energy savings. These verified gross savings are attributed to the small C&I sectors' VTD savings in PY16.

Residential

- Energy Efficient Homes Deep Energy Retrofit (PY15): 17 MWh/yr savings were reported but not verified in the PY15 final annual report. Those savings have since been verified with an energy realization rate of 45% and an NTG ratio of 1.00, which yields an additional 8 MWh/yr of gross verified energy savings and an additional 8 MWh/yr of net verified energy savings. These savings are attributed to the Residential customer sector.
- Energy Efficient Homes Deep Energy Retrofit (PY16): 7 MWh/yr savings were reported but not verified in the PY16 final annual report. Those savings have since been verified with an energy realization rate of 45% and an NTG ratio of 1.00, which yields an additional 3 MWh/yr of gross verified energy savings and an additional 3 MWh/yr of net verified energy savings. These savings are attributed to the Residential customer sector. Due to an evaluation clerical error in PY16, a

portion of these savings was already reported as verified, so the PY16 totals and Phase IV incremental difference is 1 MWh of gross and net reported savings.⁹

- Energy Efficient Homes New Homes: 6,140 MWh/yr savings were reported but not verified in the PY16 final annual report. Those savings have since been verified with an energy realization rate of 100.1% and an NTG ratio of 0.64, which yields an additional 6,148 MWh/yr of gross verified energy savings and an additional 3,935 MWh/yr of net verified energy savings. These savings were attributed to the Residential customer sector.
- Energy Efficient Homes Downstream Equipment: SWE audit activities recommended an increase of PY16 gross verified energy savings of 193 MWh/yr, and net verified energy savings of 100 MWh/yr.

⁹ In the evaluation results, several records associated with one PY16 Deep Energy Retrofit project were incorrectly assigned the stratum-level realization rate and were treated as verified in the PY16 Annual Report rather than being treated as unverified, affecting the PY16 verified savings estimates included in the PY16 Annual Report.

2.6.2. Lifetime Energy Savings by Program

Table 2-10 summarizes the PYTD and P4TD lifetime energy savings by program. Cadmus adjusted the lifetime savings to account for reduced lighting savings following the 2020 Energy Independence and Security Act (EISA) backstop. Specifically, after the 2020 EISA implementation, Cadmus reduced screw-based LED savings to the difference in energy usage between the efficient bulb and the new baseline. Savings do not include those beyond 15 years for any rebated item, per the Pennsylvania TRC Order.¹⁰

Table 2-10. Lifetime Energy Savings by Program (MWh)

Program Name	PYVTD Gross Lifetime (MWh)	PYVTD Net Lifetime (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
Non-Residential	3,621,121	2,529,361	14,195,103	9,639,033
Low-Income	96,780	96,780	500,736	500,736
Residential	641,000	410,934	2,303,459	1,438,001
Portfolio Total⁽¹⁾	4,358,900	3,037,075	17,053,387	11,577,770

⁽¹⁾ Total may not match the sum of rows due to rounding.

2.7. Summary of Peak Demand Reduction Impacts by Program

Act 129 defines peak demand savings from energy efficiency 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. Unless indicated otherwise, verified peak demand impacts from energy efficiency in this report are presented at the system level, meaning they have been adjusted to account for transmission and distribution losses.

PPL Electric Utilities uses the following line loss percentages/multipliers by sector:^{11, 12}

- Residential: 1.0875
- Small C&I: 1.0875
- Large C&I: 1.042
- GNE: 1.0741

Table 2-11 summarizes the peak demand impacts by the energy efficiency program through the current reporting period.

¹⁰ The 2019 TRC Test Order for Phase IV of Act 129 was adopted by PA PUC order at Docket No. M-2019-3006868 on December 19, 2019.

¹¹ Pennsylvania Public Utility Commission. February 2021. *Technical Reference Manual*. Act 129 Energy Efficiency and Conservation Program & Act 213 Alternative Energy Portfolio Standards.

¹² For GNE records, the line loss multiplier was calculated as a blended rate of 1.0741 using the proportion of reported demand reductions of the residential and small C&I sectors compared to the large C&I sector (70% and 30%, respectively).

Table 2-11. Peak Demand Reductions by Energy Efficiency Program (MW/Year)

Program Name	PYRTD (MW/yr)	System-Level PYVTD Gross (MW/yr)	System-Level PYVTD Net (MW/yr)	RTD (MW/yr)	System-Level VTD Gross (MW/yr)	System-Level VTD Net (MW/yr)
Non-Residential	47.39	49.04	34.24	191.92	196.53	141.81
Low-Income	1.75	1.73	1.73	7.49	7.56	7.56
Residential	11.75	12.99	8.64	36.54	38.56	24.97
Portfolio Total⁽¹⁾	60.89	63.76	44.62	235.96	242.65	174.33

⁽¹⁾ Total of individual program demand reductions may not sum to the total due to rounding.

The previously reported VTD reductions from prior years, for the following programs, have changed since the PY16 final annual report was submitted:

Non-Residential

- Custom Component: 0.39 MW/yr demand reductions were reported but not verified in PY16 final annual report. These demand reductions have since been verified with a realization rate of 100% and an NTG ratio of 0.74, which yields an additional 0.42 MW/yr of gross verified demand reductions and an additional 0.31 MW/yr of net verified demand reductions (system-level). These verified gross demand reductions were attributed to the small C&I sector's VTD demand reductions in PY16.

Residential

- Energy Efficient Homes Deep Energy Retrofit (PY15): 0.0004 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a demand realization rate of 73% and an NTG ratio of 1.00, which yields an additional 0.0004 MW/yr of gross and net verified demand reductions (system level). These demand reductions are attributed to the Residential customer sector.
- Energy Efficient Homes Deep Energy Retrofit (PY16): 0.0004 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a demand realization rate of 73% and an NTG ratio of 1.00, which yields an additional 0.00026 MW/yr of gross and net verified demand reductions (system-level). These demand reductions are attributed to the Residential customer sector. Due to an evaluation clerical error in PY16,¹³ a portion of these savings was already reported as verified, so the PY16 totals and Phase IV incremental difference are 0.00021 MW/yr of gross and net reported savings.
- Energy Efficient Homes New Homes: 1.34 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a

¹³ In the evaluation results, several records associated with one PY16 Deep Energy Retrofit project were incorrectly assigned the stratum-level realization rate and were treated as verified in the PY16 Annual Report rather than being treated as unverified, affecting the PY16 verified savings estimates included in the PY16 Annual Report.

demand realization rate of 147% and an NTG ratio of 0.64, which yields an additional 2.13 MW/yr of gross verified system-level demand reductions and an additional 1.36 MW/yr of net verified system-level demand reductions. These savings were attributed to the Residential customer sector.

- Energy Efficient Homes Downstream Equipment: SWE audit activities recommended an increase of PY16 gross verified demand reductions of 0.17 MW/yr (system-level) and an increase of net verified demand reductions of 0.09 MW/yr (system-level).

2.7.1. Peak Demand Savings Nominated to PJM Forward Capacity Market (FCM)

For Phase IV of Act 129, EDCs are expected to retain the capacity rights to Act 129 projects and nominate a portion of the resources acquired to the PJM Forward Capacity Market. If the resources clear, proceeds flow back to the rate class that generated the Act 129 savings to offset cost recovery via riders.

Table 2-12 summarizes PPL Electric Utilities' plans for wholesale recognition of Phase IV peak demand savings by Act 129 program year and PJM delivery year (DY), including nominated MW savings from PY17.

Table 2-12. Planned FCM Nominations by Act 129 Program Year and PJM DY

Act 129 Program Year	Estimated MW Acquisition for FCM	DY 22/23 MW Range	DY 23/24 MW Range	DY 24/25 MW Range	DY 25/26 MW Range	DY 26/27 MW Range	DY 27/28 MW Range	DY 28/29 MW Range	DY 29/30 MW Range
PY13	1.4	1.4	1.4	1.4	0				
PY14	[1 to 10]		1.5	1.5	0	N/A			
PY15	[1 to 10]			1.9	1.9	N/A	N/A		
PY16	[1 to 10]				5.9	N/A	N/A	N/A	
PY17	[1 to 10]					N/A	N/A	N/A	N/A
Phase IV Total⁽¹⁾	[5.4 to 41.4]	1.4	2.8	4.8	7.8	N/A	N/A	N/A	N/A

⁽¹⁾ Sum of rows may not match total due to rounding.

Table 2-13 lists the measures selected by PPL Electric Utilities to be offered into the PJM. Nothing was bid into the PJM in PY17.

Table 2-13. PY17 Measures Selected for PJM

Measure Category	Measure	PY13	PY14	PY15	PY16	PY17
Large C&I Commercial Lighting	LED fixtures	✓	✓	✓	✓	
	LED linear replacements	✓	✓	✓	✓	
	LED screw-ins	✓	✓		✓	
	Custom			✓	✓	
Large C&I Commercial Lighting - Midstream	LED linear fixture				✓	
	LED linear lamp				✓	
	Exterior LED fixture				✓	
	LED downlight/trim kit				✓	
	LED fluorescent replacement				✓	
	LED high bay/low bay				✓	
	Pin-based LED bulb				✓	
Small C&I Commercial Lighting	LED fixtures	✓	✓	✓		
	LED linear replacements	✓	✓	✓		
Small C&I and Residential Efficient Lighting	LED bulged reflector	✓				
	LED candelabra base	✓	✓	✓		
	LED globe	✓	✓	✓		
	LED multifaceted reflector	✓		✓		
	LED parabolic aluminized reflector	✓		✓		
	LED reflector	✓	✓	✓		
	LED retrofit kit	✓	✓	✓		
	LED specialty	✓		✓		
Low-Income	LED bulbs		✓	✓	✓	

In PY13 through PY16, PPL Electric Utilities nominated lighting measures to qualify into the PJM based on the ease of project measurement and verification and the availability of PJM-required information.

All resources that resulted in PJM revenues from 2025-2026 DY have been paid in full to PPL Electric Utilities through the PJM-member curtailment service provider (CSP) and distributed proportionally to the associated rate classes. No further revenue will be collected as the PJM program was sunset after PY16; therefore, no measures were nominated in PY17.

2.8. Summary of Fuel-Switching Impacts

Act 129 allows EDCs to achieve electric savings by converting electric equipment to non-electric equipment. Table 2-14 summarizes key fuel-switching metrics in PY16 and to date in Phase IV.

Table 2-14. PY17 and Phase IV Fuel Switching Summary

Metric	PY17	P4TD
Number of Products Offered and Implemented		
Air-Source Heat Pump (ASHP)	1	21
Electric Baseboards	6	40
Electric Furnaces	1	14
Water Heaters Gas - Electric Resistance	0	43
Water Heaters Propane - Electric Resistance	0	36
Combined heat and power (CHP)	5	9
Verified Savings		
VTD Energy Savings Achieved via Fuel Switching (MWh/yr)	205	32,286
Phase IV Verified To-Date Increased Fossil Fuel Consumption Due to Fuel Switching Measures (MMBTU/yr)	0.70	110
Incentives		
Phase IV Verified To-Date Incentive Payments for Fuel Switching Measures (\$1,000)	\$1,943	\$3,476

2.9. Summary of Renewable Energy Impacts

Act 129 allows EDCs to incentivize behind-the-meter solar photovoltaics and other renewable energy generation measures that offset the need for electricity from the grid. Table 2-15 summarizes the energy savings, peak demand reduction, and incentive totals for renewable energy measures in PY17 and Phase IV to date by customer sector.

Table 2-15. PY17 and Phase IV Renewables Summary

Metric	PY17		P4TD	
	Residential	Non-Residential	Residential	Non-Residential
Renewable Energy Measures Implemented	Solar PV	Solar PV	Solar PV	Solar PV
VTD Energy Savings Achieved via Renewables (MWh/yr)	0.00	24,786	3,748	132,086
VTD System-Level Peak Demand Savings Achieved via Renewables (MW/yr)	0.00	10.17	1.39	48.69
Incentive Payments for Renewable Energy Measures (\$1,000)	0.00	\$7,503	\$12,459	\$30,358

2.10. Summary of Cost-Effectiveness Results

Table 2-16 presents a detailed breakdown of portfolio finances and cost-effectiveness. Cadmus calculated TRC benefits using gross verified impacts. PY17 NPV costs and benefits are expressed in 2025 dollars. NPV costs and benefits for P4TD financials are expressed in 2021 dollars.

Cadmus calculated TRC benefit-cost ratios by comparing the total NPV TRC benefits and the total NPV TRC costs. It is important to note that TRC costs are materially different from the EDC spending and rate recovery tables presented later in the report. 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. Appendix C shows the TRC ratios by program and for the portfolio.

Table 2-16. Summary of Portfolio Finances – Gross Verified

Row	Cost Category	PYTD (\$1,000)		P4TD ⁽²⁾ (\$1,000)	
1	Incremental Measure Costs (IMCs)	\$143,334		\$517,133	
2	Rebates to Participants and Trade Allies	\$25,428		\$96,754	
3	Upstream/Midstream Incentives	\$5,676		\$15,886	
4	Material Cost for Self-Install Programs (EE&C Kits)	\$1,096		\$7,063	
5	Direct Installation Program Materials and Labor	\$3,945		\$13,637	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5) ⁽⁶⁾	\$107,188		\$383,793	
		EDC	CSP	EDC	CSP
7	Program Design	\$0	\$0	\$697	\$462
8	Administration and Management ⁽³⁾	\$1,618	\$6,219	\$7,097	\$19,595
9	Marketing	\$331	\$6,250	\$4,733	\$15,647
10	Program Delivery ⁽⁴⁾	\$0	\$19,648	\$0	\$56,143
11	EDC Evaluation Costs	\$2,446		\$8,961	
12	SWE Audit Costs	\$264		\$1,811	
13	Program Overhead Costs (Sum of rows 7 through 12)⁽⁶⁾	\$36,776		\$115,146	
14	Total NPV TRC Costs (Sum of rows 1 and 13)^{(5),(6)}	\$180,110		\$633,796	
15	Total NPV Lifetime Electric Energy Benefits	\$142,632		\$490,439	
16	Total NPV Lifetime Electric Capacity Benefits	\$95,318		\$318,366	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$8,741		\$29,533	
18	Total NPV Lifetime Fossil Fuel Impacts	(\$7,522)		\$7,549	
19	Total NPV Lifetime Water Impacts	\$12,401		\$46,342	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)⁽⁶⁾	\$251,569		\$892,229	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.40		1.41	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021

⁽²⁾ P4TD benefits do not include carry-over energy savings from Phase III

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as program delivery costs.

⁽⁵⁾ Row 14 (portfolio-level TRC costs) includes excess incentives from the Residential Efficient Lighting program component; \$1,516,214 in P4TD. Per Phase IV TRC Order, excess incentives are to be treated as a TRC cost, so the sum of rows 1 and 13 does not add up to row 14.

⁽⁶⁾ Sum of rows may not add up to the total due to rounding.

2.11. Comparison of Performance to Approved EE&C Plan

Table 2-17 presents PY17 expenditures compared to the budget estimates set forth in the EE&C plan for PY17 and P4TD. PY17 values are expressed in 2025 dollars, and P4TD values are expressed in 2021 dollars. *Appendix C* presents program-level comparisons of expenditures to plans.

Table 2-17. Comparison of Expenditures to Phase IV EE&C Plan (\$1,000)

Expenditures	Budget from EE&C Plan	Actual Expenditures ⁽¹⁾	Ratio (Actual/Plan)
PY17 Portfolio	\$64,066	\$72,922	114%
PIV TD	\$312,491	\$278,100	89%

Source: PPL Electric Utilities Phase IV EE&C plan, Table 6.

⁽¹⁾ Includes SWE audit costs.

Table 2-18 compares PY17 and P4TD verified gross program savings to the energy savings projections set forth in the EE&C plan. PPL Electric Utilities exceeded PY17 planned energy savings and demand reductions and has met the Phase IV compliance targets. *Appendix C* presents program-level comparisons of actual savings to plans.

Table 2-18. Comparison of Actual Program Savings to EE&C Plan Projections

Savings	EE&C Plan Projections Through PY17	VTD Gross Savings	Ratio (Actual/Plan)
PY17 Portfolio MWh/yr	252,158	336,775	134%
PIV TD MWh/yr	1,376,015 ⁽¹⁾	1,319,793 ⁽¹⁾	96%
PY17 Portfolio MW/yr (System-Level)	49.56	63.76	129%
PIV TD MW/yr (System-Level)	249.81	242.65	97%

Source: PPL Electric Utilities Phase IV EE&C plan, Table 4 and Table 5.

⁽¹⁾ Excludes Phase III carryover.

2.11.1. Program Summary

This section summarizes the reasons PY17 program savings varied from those estimated in the EE&C plan. The individual program chapters and appendices include more detail.

Non-Residential Program Components

The Non-Residential Program exceeded the PY17 planned energy savings, as estimated in the EE&C plan, by 19% and demand savings by 17%. The two main drivers causing savings to exceed the plan were strong performance from the Custom component and midstream lighting. The Custom component achieved nearly 1.5 times its planned energy savings and 1.3 times its planned demand reductions. The Midstream Lighting component delivered nearly four times the planned PY17 energy savings and demand reductions. The performance of these offerings contributes to the Non-Residential Program exceeding its PY17 plans.

The Efficient Equipment component realization rates were influenced by differences in building types and fixture-wattage assumptions within the Efficient Equipment Lighting subcomponents and differences in

installed equipment quantities and capacities for the Efficient Equipment non-lighting subcomponents. These differences resulted in an increase in energy savings realization rates for PY17. Additional details about the factors that led to differences between reported and verified savings and the overall realization rate for the Non-Residential Program in PY17 are included in Section 5. *Non-Residential Program*, Appendix D, and Appendix E.

Residential Program Components

The Residential Program exceeded projected PY17 energy savings, as estimated in the EE&C plan, by approximately 127%, primarily due to the addition of the Home Energy Reports component. The program also exceeded the PY17 projected demand reductions by 116%. The Appliance Recycling component also tripled demand reduction targets. Additionally, both the Appliance Recycling and Energy Efficient Homes components exceeded projected energy savings by nearly 50%.

In PY17, the energy realization rate was 104%, and the demand realization rate was 102% for the program overall. The Home Energy Reports component had a demand reduction realization rate lower than 100% because PY17 was the first year of the primary analysis of peak savings for the component, while the New Homes subcomponent had a realization rate of 167%, resulting from the hourly Ekotrope analysis identifying greater coincident summer peak demand reductions than the reported demand savings. Additional details about the factors that led to differences between reported and verified savings and the overall realization rate for the Residential Program in PY17 are provided in Section 7. *Residential Program*, Appendix G, Appendix I, Appendix J, and Appendix N.

Low-Income Program

The Low-Income Program exceeded planned levels by about 14% while demand reductions were slightly below planned levels by about 4%. Increased welcome kit participation contributed to the energy savings results.

The Low-Income Program's energy and demand reduction realization rates in PY17 were both 91%. Verified savings differed from reported savings because Cadmus updated key electric water heating assumptions using participant survey and baseline study data, excluding savings from duplicate welcome kit deliveries, and applied verified household-type classifications when calculating savings. Additional details on the factors that led to differences between reported and verified savings and the overall realization rate for the Low-Income Program in PY17 are included in Section 6. *Low-Income Program*.

2.11.2. Phase V Programs

This section outlines the Phase V programs as included in PPL Electric Utilities' Phase V Energy Efficiency and Conservation Plan.¹⁴

¹⁴ PPL Electric Utilities Corporation. Revised May 26, 2026. Energy Efficiency and Conservation Plan Act 129 Phase V. Docket No. M-2025-3052826.

Business Energy Efficiency Program Components and Channels¹⁵

- **Small and Large C&I Business Solutions Component.** PPL Electric Utilities' Small and Large C&I Business Solutions components provide education and technical assistance for all business types and financial incentives to drive energy efficiency market transformation and offset project costs, while providing verified savings for a wide variety of measures in new and existing facilities. The primary delivery channels include the following:
 - *Downstream.* This channel provides end-use level, or downstream, incentives for business customers for prescriptive measures found in the PA TRM.
 - *Custom Measures.* This channel offers incentives to customers and trade allies for complex and comprehensive projects generally not found in the PA TRM.
 - *Direct Discount.* The Direct Discount channel, available exclusively to small commercial and industrial customers, allows qualified trade allies to provide lower project costs for customers through an incentive paid directly to the trade ally.
 - *Midstream.* This comprehensive channel offers a variety of available products, providing incentives to distributors rather than customers, to reduce program participation barriers through quick access to efficient products.
 - *Business Support Services.* Business Support Services is a new offering in Phase V dedicated to supporting the business community and ensuring high participation for as many industries and sectors as possible. Business Support Services are structured in tiers according to customer need and provide basic engineer support, deep engineering support in the form of feasibility studies and virtual commissioning, customer training and certifications, and strategic energy management, which braids all areas of Business Support Services and available rebates into an integrated behavioral, operational, and overarching energy management strategy.
 - *C&I Load Shift Pilot.* PPL Electric Utilities may launch this pilot sometime in Phase V. The pilot would operate for 12 to 24 months and would evaluate participation, customer experience, technology performance, and cost-effectiveness to determine whether a broader program offering is warranted.

Residential Program Components and Channels

- **Energy Efficient Homes Component.** There are four primary delivery channels within the Energy Efficient Homes component, including new construction, home rebates, instant discount through point-of-sale and online marketplace discounts, and Home Energy Reports, where customers receive email reports, education, and other program recommendations.
- **Appliance Recycling Component.** PPL Electric Utilities continues to offer scheduling, free pickup, and recycling for a variety of appliances, including refrigerators and compact refrigerators, freezers, dehumidifiers, room air conditioners, and other appliances. Additionally, PPL Electric

¹⁵ The Business Energy Efficiency Program was the Non-Residential Program in Phase IV.

Utilities is offering appliance recycling events where customers can bring eligible appliances for recycling and receive an incentive.

- **Student Energy Efficient Education.** PPL Electric Utilities is continuing to provide in-class presentations and/or school-based events to educate students and their families about energy safety, use, management, and conservation through hands-on activities, discussions, multimedia, and other materials.
- **Persistent Peak Demand Component.** The Persistent Peak Demand Reduction component is designed to reduce electric system demand during the defined peak periods through the coordinated deployment of thermostat optimization, managed electric vehicle (EV) charging, and battery storage.
- Residential Pilots.¹⁶
 - *Conservation Voltage Reduction (CVR) Pilot.* If launched, this pilot would assess the feasibility of reducing energy use and peak demand through voltage optimization on the electric distribution system. The pilot would evaluate existing utility infrastructure, establish feeder performance baselines, implement and monitor voltage-reduction strategies where viable, and track operational metrics such as voltage levels, voltage adjustments, operating time, and energy impacts. The pilot may operate for up to 24 months.
 - *Peak Time Rebate Pilot.* PPL Electric Utilities may launch this behavior-based pilot during Phase V over a 24-month period. The pilot would encourage customers to reduce or shift electricity use through seasonal performance-based incentives.

Resource Constrained Program Components and Channels¹⁷

- **Energy Efficient Homes Component.** This component offers the following improvements and services:
 - *Single-Family Energy Assessment.* This channel provides customers with energy education and a broad array of available measures, similar to the Residential Energy Efficiency Program, though at no cost to qualifying customers. Customers receive an in-person or virtual assessment, and qualified technicians determine the appropriate measures based on assessment findings.
 - *Electric Heat Customers.* Customers who have existing electric heating systems may also be eligible for HVAC system maintenance, HVAC replacement, building shell measures, and controls, such as smart thermostats.
 - *Multifamily Energy Assessment.* Individually and master-metered customers and/or tenants are eligible for participation with landlord, owner, or building operator approval and have access to the same measures as Single-Family Energy Assessment customers. Additionally, to

¹⁶ PPL Electric Utilities is also exploring the addition of a residential financing pilot.

¹⁷ This program was previously called Low-Income in Phase IV.

encourage participation, landlords may be provided with a direct incentive per building site for consent on improvements.

- *Instant Discount.* The Instant Discount channel is new in Phase V and offers select online marketplace products with associated savings for income-verified customers at no cost. Customers will be able to select products via the online marketplace at no cost. PPL Electric Utilities also offers select instant discount measures at no cost through retail partners such as Habitat ReStore and Salvation Army, which serve income-eligible customers.
- **Appliance Recycling Component.** PPL Electric Utilities has added appliance recycling to the Resource Constrained Energy Efficiency Program, a new offering for income-eligible customers, tailored to this customer subset's needs. This component mirrors the Residential Energy Efficiency Program and includes scheduling, free pickup, and environmentally responsible recycling of a variety of appliances, including refrigerators and compact refrigerators, freezers, dehumidifiers, room air conditioners, and other appliances. Additionally, PPL Electric Utilities is offering appliance recycling events where customers can bring eligible appliances for recycling and receive an incentive.
- **Window Saddle Heat Pump Pilot.** PPL Electric Utilities is offering a Window Saddle Heat Pump Pilot program for multifamily tenants.

2.12. Findings and Recommendations

Cadmus does not have any overarching recommendations that affect more than one program. Specific recommendations for each program are in their respective sections.

3. Portfolio Finances and Cost Recovery

This section provides an overview of the expenditures associated with PPL Electric Utilities' portfolio and the recovery of those costs from ratepayers.

3.1. Program Finances

Table 3-1 shows program-specific and portfolio total finances for PY17. The columns in this table are adapted from the Direct Program Cost categories in the PA PUC's EE&C plan template for Phase IV.¹⁸ Non-incentives include EDC materials, labor, and administration costs (including costs associated with an EDC's own employees) as well as ICSP materials, labor, and administration costs (including the program implementation contractor and the costs of any other outside vendors EDCs employ to support program delivery). The dollar figures shown in Table 3-1 are based on EDC tracking of expenditures with no adjustments to account for inflation.¹⁹

Table 3-1. PY17 Program and Portfolio Total Finances (\$1,000)

Program	Incentives	Non-Incentives	Total Cost ⁽²⁾
Non-Residential	\$24,634	\$15,265	\$39,899
Low-Income	\$4,444	\$3,183	\$7,626
Residential	\$7,068	\$9,134	\$16,202
Common Portfolio Costs ⁽¹⁾	\$0	\$8,931	\$8,931
Portfolio Total⁽²⁾	\$36,146	\$36,512	\$72,658
SWE Costs ⁽³⁾	\$0	\$0	\$264
Total⁽²⁾	\$36,146	\$36,512	\$72,922

⁽¹⁾ Common portfolio costs are applicable to more than one customer class or more than one program or that provide portfolio-wide benefits. These costs include PPL Electric Utilities' labor and materials, legal review, tracking system, EE&C plan development, etc.

⁽²⁾ Totals may not sum due to rounding.

⁽³⁾ SWE costs are outside of the 2% spending cap.

¹⁸ Pennsylvania Public Utility Commission. September 9, 2020. "Implementation of Act 129 of 2008—Phase IV. Energy Efficiency and Conservation Plan Template. Docket No. M-2020-3015228." <https://www.puc.pa.gov/pcdocs/1676672.docx>.

¹⁹ The cost-recovery of program expenses through riders generally happens promptly so that costs are recovered from ratepayers in the same dollars that they are incurred.

Table 3-2 shows program-specific and portfolio total finances since the inception of Phase IV.

Table 3-2. Phase IV Program and Portfolio Total Finances (\$1,000)

Program	Incentives	Non-Incentives	Total Cost ⁽²⁾
Non-Residential	\$95,735	\$46,868	\$142,602
Low-Income	\$20,738	\$16,613	\$37,351
Residential	\$32,775	\$29,874	\$62,649
Common Portfolio Costs ⁽¹⁾	\$0	\$33,517	\$33,517
Portfolio Total⁽²⁾	\$149,248	\$126,871	\$276,120
SWE Costs ⁽³⁾	\$0	\$0	\$1,980
Total⁽²⁾	\$149,248	\$126,871	\$278,100

⁽¹⁾ Common portfolio costs are those applicable to more than one customer class or more than one program or that provide portfolio-wide benefits. These costs include PPL Electric Utilities' labor and materials, legal review, tracking system, EE&C plan development, etc.

⁽²⁾ Totals may not sum due to rounding.

⁽³⁾ SWE costs are outside of the 2% spending cap of \$307,506 (\$1,000).

3.2. Cost Recovery

Act 129 allows Pennsylvania EDCs to recover EE&C plan costs through a cost-recovery mechanism. PPL Electric Utilities' cost-recovery charges are organized separately by four customer sectors to ensure that the electric rate classes that finance the programs are the same rate classes that receive the direct energy conservation benefits. Cost-recovery is governed by tariffed rate class, so it is necessarily tied to the way customers are metered and charged for electric service. As a result, differences between customer segments in Table 3-3 and the information presented in Section 2.3. *Phase IV Performance by Customer Segment*. For example, since the low-income customer segment is a subset of PPL Electric Utilities' residential tariffs, it is not listed in Table 3-3.

Table 3-3. EE&C Plan Expenditures by Cost-Recovery Category (\$1,000)

Cost Recovery Sector	Rate Classes Included	PY17 Spending	P4TD Spending
Residential & Low-Income (100/200)	Residential (primarily RS)	\$26,629	\$114,193
Small C&I (300)	Small C&I (primarily GS1 & GS3)	\$21,926	\$86,396
Large C&I (400)	Large C&I (primarily LP4 & LP5)	\$15,604	\$46,962
GNE	Residential, Small C&I, and Large C&I	\$8,762	\$30,548
Portfolio Total⁽¹⁾⁽²⁾	-	\$72,922	\$278,100

⁽¹⁾ Includes costs for SWE audit.

⁽²⁾ Totals may not sum due to rounding.

For Phase IV of Act 129, PPL Electric Utilities nominated a portion of peak demand reduction acquired via EE&C programs into the PJM FCM. Proceeds from resources that clear in the FCM flow back to the rate

class that generated the savings to offset cost recovery. Table 3-4 shows the proceeds received in PY17 and P4TD net of CSP fees and other administrative costs.²⁰

Table 3-4. FCM Proceeds from Recognized Peak Demand Reductions (\$1,000)

Cost Recovery Sector	Rate Classes Included	PY17 Proceeds	P4TD PJM Proceeds
Residential and Low-Income (100/200)	Residential (primarily RS)	\$300.12	\$326.96
Small C&I (300)	Small C&I (primarily GS1 and GS3)	\$235.90	\$276.98
Large C&I (400)	Large C&I (primarily LP4 and LP5)	\$81.70	\$113.15
GNE	Residential, Small C&I, and Large C&I	N/A	N/A
Portfolio Total ⁽¹⁾	-	\$617.72	\$717.10

⁽¹⁾ Includes costs for SWE audit.

At the portfolio level, PY17 cost recovery requirements were reduced by 0.85% due to the FCM proceeds associated with the recognition of 7.8 MW for the 2025-2026 DY. P4TD cost recovery requirements have been reduced by 0.26% due to the FCM proceeds associated with the recognition of 1.4 MW for the 2022-2023 DY, 2.8 MW for the 2023-2024 DY, 4.8 MW for the 2024-2025 DY, and 7.8 MW for the 2025-2026 DY. Beginning with the 2026/2027 DY, peak demand reduction from energy efficiency is no longer an eligible resource. As a result, Phase V cost recovery will not be affected by proceeds from Phase IV peak demand reductions.

²⁰ Due to FERC review of complaints seeking to disqualify some energy efficiency capacity earlier than the end of the current year and/or invalidate prior year participation, the values shown are subject to change.

4. Evaluation Activities

This section documents the gross impact and process evaluation activities conducted in PY17 and discusses the outcomes of those activities. Not every program or program component receives an evaluation every year. Table 4-1 lists the activities for each program and component in PPL Electric Utilities' portfolio.

Table 4-1. PY17 Evaluation Activity Matrix

Program/Component	Gross Impact	Net Impact	Process
Non-Residential Program			
Custom	✓ ^(2,3)	✓	✓
Efficient Equipment Non-Lighting (Downstream)	✓ ⁽²⁾	✓ ⁽¹⁾	✓
Efficient Equipment Lighting (Downstream)	✓	✓ ⁽¹⁾	✓
Efficient Equipment Non-Lighting (Midstream)	✓	✓ ⁽¹⁾	-
Efficient Equipment Lighting (Midstream)	✓	✓ ⁽¹⁾	-
Low-Income Program			
Low-Income Assessment	✓ ⁽²⁾	-	✓
Residential Program			
Appliance Recycling	✓ ⁽²⁾	✓ ⁽¹⁾	✓
Efficient Lighting	-	-	-
Energy Efficient Homes New Homes	✓ ^(2,3)	-	✓
Energy Efficient Homes Audit and Weatherization	✓ ⁽²⁾	✓ ⁽¹⁾	✓
Energy Efficient Homes Equipment (Downstream)	✓ ⁽²⁾	✓ ⁽¹⁾	✓
Energy Efficient Homes Equipment (Midstream)	✓ ⁽²⁾	✓ ⁽¹⁾	✓
Energy Efficient Homes Online Marketplace	✓	✓ ⁽¹⁾	✓
Energy Efficient Homes Instant Discount	✓	✓ ⁽¹⁾	✓
Energy Efficient Homes EV Pilot	✓	✓	✓
Home Energy Reports	✓	-	✓
Student Energy Efficient Education	✓	-	✓

⁽¹⁾ Applying a historical NTG ratio to verified savings.

⁽²⁾ Applying a historical realization rate to verify a portion or all of PY17.

⁽³⁾ Unverified savings from previous years were verified in PY17.

4.1. Impact Evaluation

Table 4-2 provides an overview of the impact evaluation for Phase IV with two rows for each initiative. The first row indicates the sampling and data collection frequency, or the years in which the impact evaluation was conducted. The second row shows how savings from the initiative were presented in that year's final annual report, where V, H, and U mean the following:

V = verified using the results of the impact evaluation completed that year.

H = verified using the results of a historical impact evaluation.

U = unverified until the results of the impact evaluation are available.

Table 4-2. Gross Impact Overview

Initiative	Plan	PY13	PY14	PY15	PY16	PY17
Non-Residential						
Custom Large	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V ⁽²⁾	V
Custom Small	Sampling	Two-year sample ⁽¹⁾		Two-year sample ⁽¹⁾		None
	Reporting	U	V	U	V	H
Custom CHP	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V	V
Efficient Equipment Non-Lighting (Downstream)	Sampling	Impact	Impact	Impact	Impact	None
	Reporting	V	V	V	V	H
Efficient Equipment Non-Lighting (Midstream)	Sampling	None	Two-year sample ⁽¹⁾		Impact	Impact
	Reporting		U	V	V	V
Efficient Equipment Lighting (Downstream)	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V	V
Efficient Equipment Lighting (Midstream)	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V	V
Low-Income						
Low-Income (Remote Energy Assessments)	Sampling	Impact	Impact	None	Impact	Impact
	Reporting	V	V	H	V	V ⁽⁴⁾
Low-Income (In-Home Assessments)	Sampling	Two-year sample ⁽¹⁾		None	Impact	Impact
	Reporting	U	V	H	V	V ⁽⁴⁾
Low-Income (Welcome Kits)	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V	V
Residential						
Appliance Recycling (Refrigerators and Freezers)	Sampling	Impact	Impact	Impact	None	None
	Reporting	V	V	V	H	H
Appliance Recycling (Room Air Conditioners and Dehumidifiers)	Sampling	Impact	Impact	Impact	Impact	Impact
	Reporting	V	V	V	V	V
Energy Efficient Home (Audit and Weatherization)	Sampling	None	Impact	None	Impact	None
	Reporting		V	H	V	H
Energy Efficient Home (Midstream Equipment)	Sampling	None	None	Two-year sample ⁽¹⁾		None
	Reporting			U	V	H
Energy Efficient Home (Downstream Equipment)	Sampling	Impact	None	Impact	Impact	None
	Reporting	V	H	V	V	H
	Sampling	Impact	Two-year sample ⁽¹⁾		None	Impact

Initiative	Plan	PY13	PY14	PY15	PY16	PY17
Energy Efficient Home (Online Marketplace)	Reporting	V	U	V	H	V
Energy Efficient Home (New Homes)	Sampling	Two-year sample ⁽¹⁾		Impact	None	Impact
	Reporting	U	V	V	U	V
Energy Efficient Home (Instant Discount)	Sampling	None	Two-year sample ⁽¹⁾		None	Impact
	Reporting		U	V	H ⁽³⁾	V
Energy Efficient Home (EV Charging Pilot)	Sampling	None	None	None	None	Impact
	Reporting					V
Efficient Lighting	Sampling	Impact	None	None	None	None
	Reporting	V	H	H		
Home Energy Reports	Sampling	None	None	None	Impact	Impact
	Reporting				V	V
Student Energy Efficient Education (All Strata)	Sampling	Impact	Two-year sample ⁽¹⁾		None	Impact
	Reporting	V	U	V	H	V

⁽¹⁾ In general, the two-year sample includes the first through fourth quarters (Q1-Q4) of the first year in the sample and Q1 and Q2 of the second year in the sample.

⁽²⁾ One large project was left unverified in previous years and was verified in PY17.

⁽³⁾ Savings for spray foam were verified in PY16, and a historical realization rate was applied to verified savings for other measures.

⁽⁴⁾ Only full cost jobs were verified in PY17. A historical realization rate was applied to verified savings for other job types.

Impact evaluation activities varied by program in PY17. Table 4-3 lists the impact evaluation activities conducted for each program component in PY17. The individual program chapters and corresponding appendices discuss the impact evaluation activities, methodology, analysis, and findings.

Table 4-3. PY17 Impact Evaluation Activities by Program Component

Program and Component	Database Review	Desk Reviews	Interviews/ Surveys	Site Visits	Metering ⁽¹⁾	Engineering Analysis	Billing Analysis
Non-Residential Program							
Custom	✓	✓		✓	✓	✓	
Efficient Equipment Non-Lighting (Downstream)	✓						
Efficient Equipment Lighting (Downstream)	✓	✓	✓	✓	✓	✓	
Efficient Equipment Non-Lighting (Midstream)	✓	✓	✓	✓		✓	
Efficient Equipment Lighting (Midstream)	✓	✓	✓			✓	
Low-Income Program							
Low-Income Assessment	✓	✓	✓			✓	
Residential Program							
Appliance Recycling	✓						
Energy Efficient Homes New Homes	✓	✓				✓	
Energy Efficient Homes Audit and Weatherization	✓						
Energy Efficient Homes Equipment (Downstream)	✓						
Energy Efficient Homes Equipment (Midstream)	✓						
Energy Efficient Homes Online Marketplace	✓		✓			✓	
Energy Efficient Homes Instant Discount	✓					✓	
Energy Efficient Homes Deep Energy Retrofits Pilot	✓						✓
Energy Efficient Homes High Performance Home Pilot	✓						
Energy Efficient Homes EV Pilot	✓	✓	✓		✓	✓	
Home Energy Reports	✓						✓
Student Energy Efficient Education	✓		✓				

⁽¹⁾ Performed meter or performance data analysis using either Cadmus or ICSP collected meter/performance data.

4.2. Process Evaluation

This section summarizes the process evaluation activities of PPL Electric Utilities' PY17 portfolio.

Table 4-4 lists the process evaluation activities conducted for each program in PY17, along with the total number of survey and interview respondents reached for each component and delivery channel. More

detailed explanations of survey methodologies used to evaluate individual program components are in the corresponding appendices.

Table 4-4. PY17 Portfolio Process Evaluation Activities by Component

Program and Component	Number of Completed Participant Survey or Interview ⁽¹⁾	Number of Stakeholder & Trade Ally Interviews	Number of Market Actor Interviews
Non-Residential Program	20	N/A	N/A
Custom	8	N/A	N/A
Efficient Equipment	12	N/A	N/A
Low-Income Program	486	N/A	N/A
Low-Income Assessment	486	N/A	N/A
Residential Program	15,688	7	2
Appliance Recycling	93	N/A	N/A
Energy Efficient Homes Audit and Weatherization	77	N/A	N/A
Energy Efficient Homes Equipment (Downstream)	73	N/A	N/A
Energy Efficient Homes Online Marketplace	74	N/A	N/A
Energy Efficient Homes EV Charging Pilot	137	3	2
Home Energy Reports	644	2	N/A
Student Energy Efficient Education	14,590	2	N/A
Total	16,194	7	2

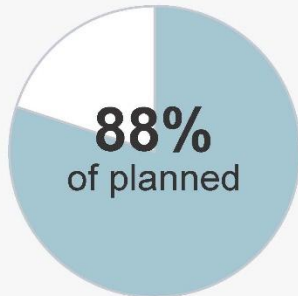
⁽¹⁾ Includes all survey modes: online, telephone, and paper. For additional details, see the program chapter and appendix. The survey counts may not match the totals used for program satisfaction, net-to-gross, or impact inputs.

NON-RESIDENTIAL PROGRAM

The Non-Residential Program offers financial incentives to all large and small commercial and industrial customers, including government and education institutions and master metered low-income multifamily buildings.

VERIFIED ENERGY SAVINGS

Phase IV
has saved
991,939 MWh/yr



PY17 saved
243,010 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
196.53 MW/yr



PY17 has
reductions of
49.04 MW/yr

PY17 PARTICIPATION

A total of 6,290 participants*



278 Custom



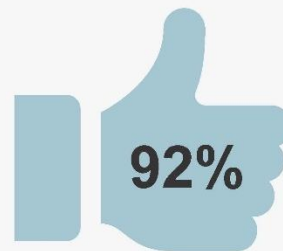
292 Efficient Equipment
Non-Lighting



5,720 Efficient Equipment
Lighting

*Does not include incentive adjustments

PARTICIPANT SATISFACTION



92%

Satisfied with
overall program

100%

satisfied with Custom

83%

satisfied with Efficient Equipment

5. Non-Residential Program

PPL Electric Utilities' Non-Residential Program offers financial incentives to customers in a non-residential rate class and for any building or business type. The program ICSP, CLEAResult, manages program operations and oversees rebate and incentive delivery.

The program comprises these two distinct components:

- **Efficient Equipment**, which offers lighting and equipment (non-lighting) through four delivery channels: downstream rebates, direct discount, direct install, and midstream.
- **Custom**, which provides financial incentives to customers who install products or offer services through a downstream delivery channel that are not offered in PPL Electric Utilities' other programs.

The evaluation methodology and findings for the two Non-Residential Program components are described in *Appendix D* and *Appendix E*.

5.1. Participation and Reported Savings by Customer Segment

Table 5-1 presents the participation counts, reported energy and demand savings, and incentive payments for the Non-Residential Program in PY17 by customer segment.

Table 5-1. PY17 Non-Residential Participation and Reported Impacts

Parameter	Small C&I (Non-GNE)	Large C&I (Non-GNE)	GNE	Total ^{(1),(2)}
PYTD # Participants	3,883	771	1,656	6,310
PYRTD MWh/yr	93,311	86,584	47,758	227,653
PYRTD MW/yr	24.20	15.77	7.43	47.39
PYVTD MWh/yr	106,030	87,693	49,287	243,010
System-Level PYVTD MW/yr	25.32	16.00	7.72	49.04
PY17 Incentives (\$1000)	\$11,861	\$8,258	\$4,515	\$24,634

⁽¹⁾ The totals in this table do not include PY16 unverified savings verified in PY17.

⁽²⁾ Total may not sum due to rounding.

Table 5-2 shows the Non-Residential Program's verified gross energy savings and demand reductions.

Table 5-2. Non-Residential Program Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified ⁽¹⁾	PY17 Verified	Phase IV Verified ⁽²⁾
MWh/yr	129,833	210,406	172,385	236,304	243,010	991,939
System-Level MW/yr	21.26	36.65	33.96	55.61	49.04	196.53

⁽¹⁾ Includes PY16 savings verified in PY17.

⁽²⁾ Phase IV verified savings may not match the sum of program years due to rounding and do not include unverified savings.

5.2. Gross Impact Evaluation

Cadmus calculated gross verified savings using data from the PPL Electric Utilities' tracking database and a combination of evaluation activities, including records review, desk review, engineering analyses, site visits, and billing analysis. Table 5-3 and Table 5-4 show the gross energy savings and demand reduction realization rates for Non-Residential Program components in PY17. Additional details about the evaluation approach and findings are presented in *Appendix D* and *Appendix E*.

Table 5-3. PY17 Non-Residential Gross Impact Results for Energy

Need Component	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 90% C.L. ⁽²⁾	PYVTD (MWh/yr)
Custom	134,796	95%	0.11	3.3%	128,202
Efficient Equipment Non-Lighting	5,031	100%	0.20	5.5%	5,009
Efficient Equipment Lighting	87,826	125%	1.00	19.1%	109,798
Verified Total^{(3),(4)}	227,653	107%	0.61	8.7%	243,010
PY16 Custom (PY16 verified in PY17)	1,317	100%	N/A	N/A	1,317

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings. Realization rates in this table do not include unverified savings in the denominator.

⁽²⁾ Relative precision in this table is reported at the 90% confidence level and will not match tables in the appendices, where relative precision is reported at the 85% confidence level.

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Totals may not sum due to rounding.

Table 5-4. PY17 Non-Residential Gross Impact Results for Demand

Component	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 90% C.L. ⁽²⁾	PYVTD (MW/yr)	System- Level PYVTD (MW/yr)
Custom	26.39	97%	0.27	7.9%	25.60	27.27
Efficient Equipment Non-Lighting	1.09	92%	0.36	10.4%	1.00	1.08
Efficient Equipment Lighting	19.92	97%	0.45	10.1%	19.22	20.68
Verified Total^{(3),(4)}	47.39	98%	0.39	6.0%	45.82	49.04
PY16 Custom (PY16 verified in PY17)	0.39	100%	N/A	N/A	0.39	0.42

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified demand reductions. Realization rates were applied to verified demand reductions before application of distribution losses.

⁽²⁾ Relative precision in this table is reported at the 90% confidence level and will not match tables in the appendices, where relative precision is reported at the 85% confidence level.

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Totals may not sum due to rounding.

The following factors affected the reported and verified savings and led to the observed realization rates:

- **Non-lighting projects.** The most significant adjustments affecting the overall realization rate occurred in the midstream agriculture stratum and food service stratum projects. These adjustments corrected for fan size for high-volume, low-speed agriculture fans and the idle steam and convection energy rates for combination ovens. See [Appendix D](#) for more information on factors that affected observed realization rates for the Efficient Equipment component.
- **Lighting projects.** Adjustments were primarily driven by inconsistencies between the reported and verified hours of use, coincidence factors, fixture wattages, and fixture control strategies. Many fixture wattage updates involved minor changes due to rounding and alignment with DesignLights Consortium (DLC) listings. See [Appendix D](#) for more information on factors that affected observed realization rates for the Efficient Equipment component.
- **Custom projects.** Adjustments to realization rates were primarily driven by three CHP projects reviewed through the SWE's ride-along process. The verified savings reflect methodological updates identified during those reviews. The revisions were limited to calculation approaches, with no changes to baselines and no need for additional data collection. See [Appendix E](#) for more information on factors that affected observed realization rates for the Custom component.

5.3. Net Impact Evaluation

The methods Cadmus used to determine net savings for downstream, upstream, and midstream delivery channels are provided in the Phase IV Evaluation Framework,²¹ which discusses common methods used to determine free ridership and spillover. For the Custom component, Cadmus used a self-report survey, administered online and by telephone, to assess free ridership and spillover. Additional information about the NTG methodology is provided in [Appendix E](#) and [Appendix K](#).

Because Cadmus did not conduct new primary research to assess net savings for the Efficient Equipment or Midstream channels in PY17, the team used the historical NTG ratios listed in Table 5-5.²² Findings from net savings research are not used to adjust compliance savings in Pennsylvania. Instead, this research provides directional information for program planning purposes.

Table 5-5 presents NTG ratios for the components of the Non-Residential Program in PY17.

²¹ Pennsylvania Public Utility Commission. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

²² PPL Electric Utilities. September 30, 2023. *Phase IV of Act 129 Program Year 14 Annual Report (June 1, 2022–May 31, 2023)*. Presented to Pennsylvania Public Utility Commission. Prepared by Cadmus.

Table 5-5. PY17 Non-Residential Net Impact Evaluation Results

Component	Program Year	PYVTD (kWh/yr)	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (at 85% CL)
Custom	PY17	128,202,354	28%	0%	0.72	37%
Efficient Equipment Non-Lighting	PY14	4,338,665	84%	0%	0.16	84%
Efficient Equipment Lighting	PY14	30,059,733	35%	0%	0.65	10%
Midstream Lighting	PY15	79,738,741	30%	0%	0.70	10%
Midstream Equipment Non-Lighting	PY15 Benchmarking	670,192	7%	0%	0.93 ⁽¹⁾	-
Program Total	-	243,009,685⁽²⁾	30%⁽³⁾	0%⁽³⁾	0.70⁽³⁾	26%

⁽¹⁾ Midstream agriculture NTG ratio is 0.95, and midstream food service is 0.81.

⁽²⁾ May not sum due to rounding.

⁽³⁾ Weighted by PY17 component verified gross energy savings.

5.4. Verified Savings Estimates

Cadmus determined and applied realization rates and NTG ratios to the reported energy and demand savings estimates to calculate the verified savings estimates for the Non-Residential Program in PY17. Cadmus added these totals to the verified savings achieved in previous program years to calculate the P4TD program impacts (Table 5-6).

Table 5-6. PY17 and P4TD Savings Summary for the Non-Residential Program

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	227,653	47.39
PYVTD Gross	243,010 ⁽¹⁾	49.04 ⁽¹⁾⁽²⁾
PYVTD Net	168,977 ⁽¹⁾	34.24 ⁽¹⁾⁽²⁾
RTD	983,326	191.92
VTD Gross	991,939 ⁽³⁾	196.53 ⁽²⁾⁽³⁾
VTD Net	672,781 ⁽³⁾	141.81 ⁽²⁾⁽³⁾

⁽¹⁾ Does not include PY16 unverified savings verified in PY17.

⁽²⁾ Verified peak demand reductions include application of distribution losses.

⁽³⁾ Includes PY16 unverified savings verified in PY17.

The VTD savings contribution from PY16 has changed since the final PY16 annual report. Cadmus verified savings for one PY16 large stratum Custom job in PY17 and included these savings in the VTD gross totals (1,317 MWh/yr and 0.42 system-level MW/yr) and net totals (975 MWh/yr and 0.31 system-level MW/yr).

5.5. Forecasted Savings and Expenditures

Table 5-7 and Table 5-8 show Phase IV Non-Residential Program performance by sector compared to the original and revised EE&C plan projections and Phase III performance, as per the June 2023 settlement agreement.

Table 5-7. Phase IV Anticipated Total Large and Small C&I Savings (MWh/yr)

Sector	Program Component	Current Actuals (MWh/yr) ⁽¹⁾	Original Plan (MWh/yr)	Revised Plan (MWh/yr)	Phase III Totals (MWh/yr) ⁽²⁾
Small C&I	Efficient Equipment	287,498	409,239	387,268	350,079
	Custom	168,222	161,077	257,545	42,276
Large C&I	Efficient Equipment	120,073	256,122	247,810	162,130
	Custom	258,004	544,117	233,298	133,388

⁽¹⁾ Includes PY13 VTD, PY14 VTD, PY15 VTD, PY16 VTD, and PY17 VTD. Does not include Residential or GNE customer sector savings for Phase IV. Residential accounted for another 3,881 MWh/yr for Custom and 932 MWh/yr for Efficient Equipment and GNE accounted for an additional 76,736 MWh/yr for Custom and 76,593 MWh/yr for Efficient Equipment in Phase IV.

⁽²⁾ GNE accounted for an additional 89,000 MWh/yr for Efficient Equipment and 134,000 MWh/yr for Custom in Phase III.

Table 5-8. Phase IV Anticipated Large and Small C&I Savings (MW/yr)

Sector	Program Component	Current System-Level Actuals (MW/yr) ⁽¹⁾	Original Plan (MW/yr)	Revised Plan (MW/yr)	Phase III Totals (MW/yr) ⁽²⁾
Small C&I	Efficient Equipment	51.30	62.51	60.30	48.33
	Custom	45.71	22.90	63.57	5.00
Large C&I	Efficient Equipment	19.08	38.32	37.40	22.06
	Custom	50.58	68.30	30.64	15.41

⁽¹⁾ Includes PY13 VTD, PY14 VTD, PY15 VTD, PY16 VTD, and PY17 VTD. Does not include verified Residential or GNE customer sector savings Phase IV. Residential accounted for an additional 1.39 MW/yr for Custom and 0.27 MW/yr for Efficient Equipment and GNE accounted for an additional 15.11 MW/yr for Custom and 13.10 MW/yr for Efficient Equipment in Phase IV.

⁽²⁾ GNE accounted for an additional 13.85 MW/yr for Efficient Equipment and 19.73 MW/yr for Custom in Phase III.

Table 5-9 shows the projected and planned expenditures for the Small and Large C&I sectors for Phase IV. Because this was the last year of the phase, the table does not include any pipeline projects.

Table 5-9. Phase IV Large and Small C&I Planned Expenditures (per \$1,000)

Sector	Spend Type	Current Actuals (\$) ⁽¹⁾	Original Plan (\$)	Actual/Pipeline vs. Original Plan	Revised Plan (\$)	Actual/Pipeline vs. Revised Plan
Small C&I ⁽²⁾	Incentives	\$62,501	\$52,422	119%	\$69,501	90%
	Non-Incentives	\$28,809	\$24,416	118%	\$31,337	92%
Large C&I	Incentives	\$31,890	\$57,690	55%	\$40,611	78%
	Non-Incentives	\$17,758	\$28,216	63%	\$21,295	83%

⁽¹⁾ Includes PY13 VTD, PY14 VTD, PY15 VTD, PY16 VTD, and PY17 VTD. GNE costs used a ratio of 67% applied to Small C&I and 33% applied to Large C&I. Does not include costs associated with verified Residential customer sector savings of Phase IV pipeline costs.

⁽²⁾ Plans include \$2,000,000 allocated to the Low-Income Program for Master-Metered Multifamily

5.6. Process Evaluation

This section provides high-level results and findings from the process evaluation of the Non-Residential Program. Methodology and additional details for the Efficient Equipment and Custom components are

discussed in *Appendix D* and *Appendix E*, respectively. Cadmus conducted a process evaluation in PY17 to assess participant satisfaction, identify what worked well and what could be improved, determine the component’s influence on participant decision-making, and make recommendations for program modification and improvement. The evaluation activities are summarized in Table 5-10.

Table 5-10. Non-Residential Process Evaluation Activities

Activity	Audience ⁽¹⁾	Methodology
Efficient Equipment Downstream, Direct Install, and Direct Discount Delivery Channels		
In-depth Interviews	Administration staff (n=1)	Meeting via Telephone(2)
Surveys	Participants (n=12)	Telephone and online
Custom		
Surveys	Participants (n=8)	Telephone and online

⁽¹⁾ Survey and interview respondents could skip questions, and not all answered each question, so the number of responses may differ from what is reported here.

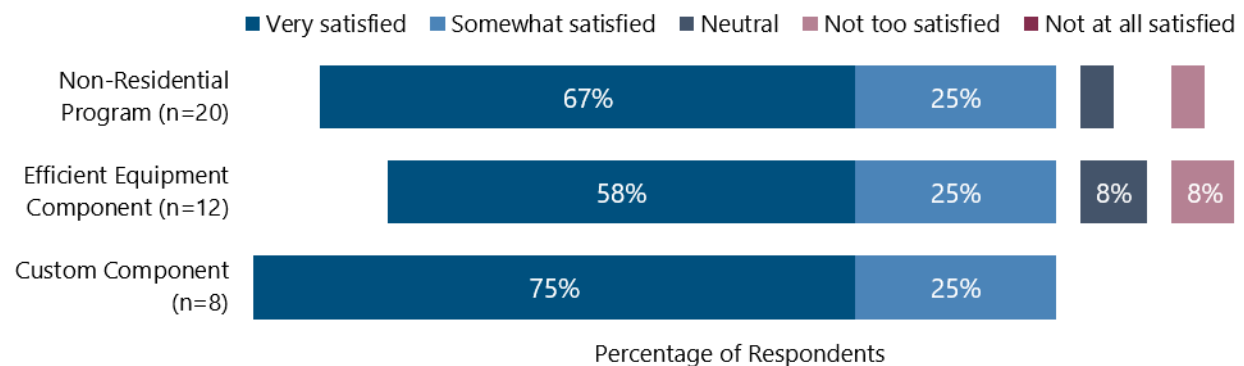
⁽²⁾ Cadmus asked the program manager about program status via regularly scheduled meetings with PPL Electric Utilities.

The team completed surveys with Custom and downstream and direct install Efficient Equipment participants between April and June 2026.

5.6.1. Process Evaluation Key Findings

For Phase IV, PPL Electric Utilities established a goal to achieve 85% or more satisfied participants in the Non-Residential Program. As shown in Figure 5-1, the program exceeded this goal, with 92% of Non-Residential Program survey respondents reporting they were satisfied with their program experience in PY17.

Figure 5-1. PY17 Non-Residential Program Overall Satisfaction



Source: Custom and downstream Efficient Equipment survey question: “Thinking about your overall experience with the PPL Electric Utilities Business Energy Efficiency Rebate Program, how would you rate your satisfaction?” Values less than 5% are not labeled in the chart.

Not all respondents answered this question.

Table 5-11 shows key findings from individual process evaluations for components in the Non-Residential Program.

Table 5-11. Non-Residential Program Key Process Evaluation Findings

Program Component	Finding
Efficient Equipment – Downstream and Direct Install	Participants were satisfied with the component overall (83% satisfied, or 10 out of 12), and the most common driver of satisfaction was the rebate amount (six of 10 satisfied participants). Participant comments with positive feedback mostly praised staff from PPL Electric Utilities and the ICSP, while negative feedback mostly concerned the application and documentation process. <i>(See Appendix D, Section D.3. Process Evaluation)</i>
Custom	All eight survey respondents were satisfied with the component overall (100% satisfied), and the most common drivers of high satisfaction were the rebate amount and increased energy savings (both mentioned by five of eight), with four of eight also mentioning good communications with staff from PPL Electric Utilities and the ICSP. <i>(See Appendix D, Section D.3. Process Evaluation)</i>

5.7. Program Finances and Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 5-12. Cadmus calculated the TRC benefits using gross verified impacts. PY17 NPV costs and benefits are expressed in 2025 dollars. NPV costs and benefits for P4TD financials are expressed in 2021 dollars.

Table 5-12. Summary of Non-Residential Program Finances – Gross Verified

Row	Cost Category	PYTD (\$1,000)		P4TD ⁽²⁾ (\$1,000)	
1	IMCs	\$107,801		\$404,172	
2	Rebates to Participants and Trade Allies	\$19,565		\$75,414	
3	Upstream/Midstream Incentives	\$5,069		\$9,887	
4	Material Cost for Self-Install Programs (EE&C Kits)	\$0		\$0	
5	Direct Installation Program Materials and Labor	\$0		\$11	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5) ⁽⁶⁾	\$83,166		\$318,860	
		EDC	CSP	EDC	CSP
7	Program Design	\$0		\$0	
8	Administration and Management ⁽³⁾	\$145		\$735	
9	Marketing	\$0		\$0	
10	Program Delivery ⁽⁴⁾	\$0		\$0	
11	EDC Evaluation Costs	\$0		\$0	
12	SWE Audit Costs	\$0		\$0	
13	Program Overhead Costs⁽⁵⁾ (Sum of rows 7 through 12)⁽⁶⁾	\$15,265		\$41,573	
14	Total NPV TRC Costs (Sum of rows 1 and 13)^{(5), (6)}	\$123,065		\$445,745	
15	Total NPV Lifetime Electric Energy Benefits	\$119,986		\$413,193	
16	Total NPV Lifetime Electric Capacity Benefits	\$79,767		\$269,180	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$8,741		\$29,469	
18	Total NPV Lifetime Fossil Fuel Impacts	(\$17,100)		(\$40,092)	
19	Total NPV Lifetime Water Impacts	\$13		\$37	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)⁽⁶⁾	\$191,407		\$671,787	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.56		1.51	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021.

⁽²⁾ P4TD benefits do not include carry-over energy savings from Phase III.

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as "Program Delivery" costs.

⁽⁵⁾ Portfolio-level costs are not assigned to specific programs.

⁽⁶⁾ Sum of rows may not add up to the total due to rounding.

Table 5-13 presents program financials and cost-effectiveness on a net savings basis. A detailed description of net savings research is provided in *Appendix D*, *Appendix E*, and *Appendix K*. As stated in the 2021 TRC Order, free rider incentives are not included as an additional program cost since they would have occurred even in the absence of a program.

Table 5-13. Summary of Non-Residential Program Finances – Net Verified

Row	Cost Category	PYTD (\$1,000)		P4TD (\$1,000)	
1	IMCs	\$74,571		\$334,418	
2	Rebates to Participants and Trade Allies	\$19,565		\$75,414	
3	Upstream/Midstream Incentives	\$5,069		\$9,887	
4	Material Cost for Self-Install Programs (EE&C Kits)	\$0		\$0	
5	Direct Installation Program Materials and Labor	\$0		\$11	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5)	\$49,937		\$249,106	
		EDC	CSP	EDC	CSP
7	Program Design	\$0	\$0	\$0	\$0
8	Administration and Management ⁽³⁾	\$145	\$2,151	\$735	\$8,766
9	Marketing	\$0	\$865	\$0	\$2,721
10	Program Delivery ⁽⁴⁾	\$0	\$12,103	\$0	\$29,351
11	EDC Evaluation Costs	\$0		\$0	
12	SWE Audit Costs	\$0		\$0	
13	Program Overhead Costs ⁽⁵⁾ (Sum of rows 7 through 12)	\$15,265		\$41,573	
14	Total NPV TRC Costs (Sum of rows 1 and 13) ⁽⁵⁾ ⁽⁶⁾	\$89,836		\$375,991	
15	Total NPV Lifetime Electric Energy Benefits	\$88,806		\$349,327	
16	Total NPV Lifetime Electric Capacity Benefits	\$55,853		\$225,214	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$5,869		\$24,963	
18	Total NPV Lifetime Fossil Fuel Impacts	(\$12,083)		(\$33,766)	
19	Total NPV Lifetime Water Impacts	\$11		\$28	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)	\$133,456		\$565,767	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.49		1.50	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021

⁽²⁾ P4TD benefits do not include carry-over energy savings from Phase III

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as program delivery costs.

⁽⁵⁾ Portfolio-level costs are not assigned to specific programs.

⁽⁶⁾ Sum of rows may not add up to the total due to rounding.

5.8. Status of Recommendations

In PY17, the Non-Residential Program exceeded the PY17 plans, achieving 49.04 MW/yr in system-level demand reductions (117% of goal) and 243,010 MWh/yr in verified energy savings (119% of goal). Overall, the Non-Residential Program exceeded its customer satisfaction target with 92% of survey respondents reporting they were satisfied with their program experience. Table 5-14 summarizes the key findings and conclusions from the Non-Residential Program evaluation.

Table 5-14. Non-Residential Program Findings and Conclusions

Conclusion 1: For midstream non-lighting projects, recurring discrepancies were identified in both sampled combination oven projects, which led to lower realization rates.	The ICSP calculated the sampled combination oven projects using inputs with kW units instead of Watts, as the TRM and interim measure protocol (IMP) called for (see <i>Appendix D</i>).
Conclusion 2: For downstream lighting, some reported fixture wattages differed from the listed wattages in the DLC's ENERGY STAR QPL, which led to inconsistencies in realization rate.	For the Downstream Lighting subcomponent, Cadmus adjusted 14 projects in the sample for wattages (see <i>Appendix D</i>).
Conclusion 3: For midstream lighting, the claimed facility type for the majority of sampled projects did not reflect the actual building, which led to high variability in savings.	In 17 out of 23 sampled jobs in the Midstream Lighting subcomponent, Cadmus adjusted the facility type based on an interview with the site contact (see <i>Appendix D</i>).
Conclusion 4: For Custom, savings results need to be weather-normalized irrespective of the duration of available data.	SWE requires that savings results be weather-normalized to typical weather data, even if 12 months of pre- or post-site-specific data are available (see <i>Appendix E</i>).

The impact evaluation activities in PY17 led to the following findings and recommendations from Cadmus to PPL Electric Utilities, along with a summary of how PPL Electric Utilities plans to address the recommendations in program delivery (Table 5-15).

Table 5-15. Status of Recommendations for the Non-Residential Program

Program Component	Conclusion	Recommendation	EDC Status of Recommendation
Efficient Equipment Non-Lighting	Conclusion 1: For midstream non-lighting projects, recurring discrepancies were identified in both sampled combination oven projects, which led to lower realization rates.	Ensure input units used in savings calculations match those listed in the TRM and IMP.	Implemented in Phase V
Efficient Equipment Lighting	Conclusion 2: For downstream lighting , some reported fixture wattages differed from the listed wattages in the DLC's ENERGY STAR QPL, which led to inconsistencies in realization rate.	Apply DLC's ENERGY STAR QPL-listed wattages for all fixtures in the submitted Appendix C workbook.	Implemented in Phase V
	Conclusion 3: For midstream lighting , the claimed facility type for the majority of sampled projects did not reflect the actual building, which led to high variability in savings.	Consider additional data collection to report facility types to increase the accuracy of reported savings.	Being considered

LOW-INCOME PROGRAM

The Low-Income Program offers a broad selection of no-cost energy-saving improvements and education to income-eligible customers to help reduce their electric consumption.

VERIFIED ENERGY SAVINGS

Phase IV
has saved
97,227 MWh/yr*

134%
of the compliance
target

114%
of planned

PY17 saved
14,524 MWh/yr

*Includes Phase III carryover energy savings

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
7.56 MW/yr

77%
of planned

96%
of planned

PY17 has
reductions of
1.73 MW/yr

PY17 PARTICIPATION

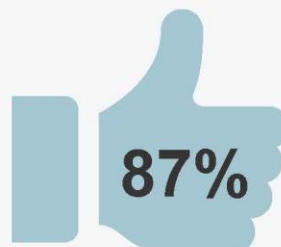


A total of **36,534**
unique households participated

- 26,309** households received welcome kits
- 4,127** households received full-cost jobs
- 3,738** households received baseload jobs
- 2,957** households received low-cost jobs
- 1,608** master metered multifamily building jobs

Sum of participation in each job type exceeds number of households because some households received more than one treatment type

PARTICIPANT SATISFACTION



87%

Satisfied with
overall program

6. Low-Income Program

The Act 129 Low-Income Program is designed to reduce electric consumption and facilitate permanent peak load reduction for income-eligible customers. PPL Electric Utilities offers services to income-qualified customers residing in single-family homes, master-metered multifamily units, individually metered multifamily units, and manufactured homes.^{23, 24}

The Low-Income Program is administered by the ICSP, CMC Energy, which is responsible for a comprehensive range of services, including outreach, customer recruitment, home energy assessments, education, and the distribution of customized kits containing energy-saving items. In addition, the ICSP operates a customer call center and supports marketing and tracking efforts for both Act 129 and the Low-Income Usage Reduction Program. The ICSP also oversees the direct installation of energy-efficient equipment in customers' homes, engaging qualified contractors to perform installations, provide related services, and replace outdated or inefficient equipment with program-approved, energy-efficient alternatives. PPL Electric Utilities administers the Low-Income Program and oversees ICSP activities, as summarized in Table 6-1.

Table 6-1. Low-Income Program Summary

Program Channel	Target Market	Eligibility Requirements	Delivery Channels	Participant Definition
Remote Energy Assessment (REA)	Income-eligible customers; household income must be at or below 150% of the Federal Poverty Guidelines	Customers in PPL Electric Utilities' territory; single-family homes, individually metered multifamily buildings, and manufactured homes; customers may choose which delivery method they prefer	Remote assessment via telephone and a customized kit of items mailed to customer	Customers who receive a remote home energy assessment
In-Home (Direct Install)		Customers in PPL Electric Utilities' territory; master-metered multifamily buildings (tenant units); receive landlord's approval	On-site energy assessment and direct installation of efficient measures	Customers who receive an on-site energy assessment
Master-Metered Multifamily (MMMF)				
Welcome Kits		Customers in PPL Electric Utilities' territory	Kit mailed to customer	Customers who receive a welcome kit

²³ Household income must be at or below 150% of the Federal Poverty Guidelines.

²⁴ Individually metered income-eligible multifamily residences are eligible for the same improvements as individually metered single-family income-eligible residences under the Low-Income Program. Individually metered manufactured homes are eligible for the same improvements as any other type of individually metered home receiving services from the Low-Income Program.

PPL Electric Utilities offers qualifying customers a range of energy-saving products and services, including lighting, weatherization, water-saving, space heating/cooling, water heating, appliances, and home health and safety.

Consistent with PY16, the ICSP provided eligible electric water-heating customers in PY17 with welcome kits containing three domestic hot water (DHW) saving products: one bathroom faucet aerator rated at 0.5 GPM, one kitchen faucet aerator rated at 1.2 GPM, and one energy-efficient showerhead rated at 1.5 GPM. Each welcome kit also included product installation instructions specifying where to install each faucet aerator and a postcard. The postcard encouraged participation in an energy assessment through the Low-Income Program and provided participants with the ICSP contact phone number and program website.

In PY17, the ICSP continued to offer on-site assessments and remote assessments via telephone. During both assessment types, technicians visited each room in the home, either in person or on the phone with the customer, and asked questions about the home's energy-consuming equipment. The technician gathered information about the home's water heater and heating fuel type, the number and wattage of light bulbs in each room, and the number of showers and sinks. The home energy technician referred to a pre-approved list of products and services, as well as criteria, to determine whether appliances and other large equipment can be replaced based on customer needs and program guidelines. Technicians also provided tips and education on how participants could save energy based on their energy needs, home specifications, and the condition of the energy equipment. For remote assessments, the ICSP mailed a comprehensive kit of energy-saving items customized to each participant's responses. If the remote energy assessment customer needed assistance, the ICSP arranged for an on-site visit. For on-site assessments, technicians installed the equipment directly.

In PY17, PPL Electric Utilities provided four types of service (also known as job types) at no cost to income-qualified customers. The program offered baseload services to customers without electric heat and without an electric water heater, low-cost services to customers without electric heat but with electrically heated water, full-cost services to customers with both electric heat and electrically heated water, and a welcome kit to any eligible customer.

6.1. Participation and Reported Savings by Customer Segment

Table 6-2 shows the participation counts, reported and verified energy and demand savings, and incentives (i.e., value of improvements provided) for the Low-Income Program. Participants are defined as unique households (identified by billing account number) that receive a welcome kit or a home assessment and program services.

Table 6-2. PY17 Low-Income Program Participation and Reported Impacts

Parameter	Residential Low-Income	Small C&I Low-Income	Total ⁽¹⁾
PY17 # Participants ⁽²⁾	36,507	27	36,534
PYRTD MWh/yr	15,489	446	15,936
PYRTD MW/yr	1.71	0.04	1.75
PYVTD MWh/yr	14,169	355	14,524
System-Level PYVTD MW/yr	1.70	0.04	1.73
PY17 Incentives (\$1,000)	\$4,126	\$318	\$4,444

⁽¹⁾ Total may not match the sum of columns due to rounding.

⁽²⁾ This count is based on PY17 unique household participants. Note that this count of participants excludes repeat customers between strata.

Table 6-3 shows the Low-Income Program's verified gross energy savings and demand reductions.

Table 6-3. Low-Income Program Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified	PY17 Verified	Phase IV Verified ⁽¹⁾
MWh/yr	9,151	12,872	14,062	15,530	14,524	97,227 ⁽²⁾
System Level MW/yr	1.02	1.53	1.53	1.73	1.73	7.56

⁽¹⁾ Phase IV verified savings may not match the sum of program years due to rounding.

⁽²⁾ Phase IV Verified Savings include 31,089 MWh/yr carryover savings from Phase III.

6.2. Gross Impact Evaluation

In PY17, for welcome kits, Cadmus reviewed a census of records. For full-cost jobs, Cadmus conducted desk reviews of 23 full-cost jobs across audit types and updated savings based on inputs from survey results and other project documentation, per the approved evaluation plan.

For low-cost and baseload jobs, Cadmus applied a historical realization rate from PY16 results to reported PY17 energy savings and demand reductions (Table 6-4). See the PY16 evaluation report for details on the PY16 evaluation approach.²⁵

²⁵ PPL Electric Utilities. September 30, 2025. *Phase IV of Act 129 Program Year 16 Annual Report (June 1, 2024–May 31, 2025)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

Table 6-4. Low-Income Program Historical Realization Rates⁽¹⁾

Savings	REA Baseload	REA Low-Cost	In-Home Assessment Baseload	In-Home Assessment Low-Cost	In-Home Assessment Master-Metered Multifamily
Energy Savings (MWh/yr)	88%	102%	86%	104%	80%
Demand Reductions (MW/yr)	76%	106%	84%	107%	86%

⁽¹⁾ Cadmus applied a historical realization rate from PY16 results to reported PY17 energy savings and demand reductions.

In PY17, the Low-Income Program reported energy savings of 15,936 MWh/yr and achieved a program energy realization rate of 91%, weighted by stratum, as shown in Table 6-5. The program reported demand reductions of 1.75 MW/yr and achieved a program demand realization rate of 91%, as shown in Table 6-6. Both tables are shown by stratum (job type).

Table 6-5. PY17 Low-Income Program Gross Impact Results for Energy

Stratum ⁽¹⁾	PYRTD MWh/yr	Energy Realization Rate ⁽²⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr) ⁽³⁾
Remote Energy Assessment					
REA Baseload	387	88%	0.00	6.8%	340
REA Low-Cost	1,000	102%	0.30	13.3%	1,016
REA Full-Cost	12	127%	0.58	18.0%	15
REA Subtotal⁽⁴⁾	1,399	98%	0.39	9.4%	1,371
On-Home Assessment					
In-Home Assessment Baseload	2,113	86%	0.14	7.7%	1,822
In-Home Assessment Low-Cost	2,512	104%	0.23	12.1%	2,605
In-Home Assessment Full-Cost	3,946	127%	0.58	18.0%	5,005
In-Home Assessment Master-Metered Multifamily	446	80%	0.13	6.8%	355
In-Home Assessment Subtotal⁽⁴⁾	9,017	109%	0.44	9.6%	9,788
Welcome Kits					
Welcome Kit	5,520	61%	N/A	N/A	3,365
Welcome Kits Subtotal⁽⁴⁾	5,520	61%	N/A	N/A	3,365
Program Total⁽⁴⁾	15,936	91%	0.35	6.4%	14,524

⁽¹⁾ In PY16, Cadmus aggregated jobs by job type and delivery type. PY16 realization rates are reflective of this.

⁽²⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Total may not match the sum of rows due to rounding.

Table 6-6. PY17 Low-Income Program Gross Impact Results for Demand

Stratum ⁽¹⁾	PYRTD MW/yr	Demand Realization Rate ⁽²⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr) ⁽³⁾	System-Level PYVTD (MW/yr) ⁽³⁾
Remote Energy Assessment						
REA Baseload	0.04	76%	0.43	18.9%	0.03	0.04
REA Low-Cost	0.10	106%	0.27	12.2%	0.11	0.12
REA Full-Cost	0.001	126%	0.54	16.7%	0.001	0.002
REA Subtotal⁽⁴⁾	0.15	97%	0.41	9.7%	0.14	0.16
On-Site Assessment						
In-Home Assessment Baseload	0.28	84%	0.14	7.6%	0.24	0.26
In-Home Assessment Low-Cost	0.29	107%	0.29	15.3%	0.31	0.33
In-Home Assessment Full-Cost	0.41	126%	0.54	16.7%	0.52	0.56
In-Home Assessment Master-Metered Multifamily	0.04	86%	0.19	10.1%	0.04	0.04
On-Site Assessment Subtotal⁽⁴⁾	1.02	107%	0.40	8.8%	1.10	1.19
Welcome Kits						
Welcome Kit	0.58	61%	N/A	N/A	0.35	0.39
Welcome Kits Subtotal⁽⁴⁾	0.58	61%	N/A	N/A	0.35	0.39
Program Total⁽⁴⁾	1.75	91%	0.34	6.0%	1.59	1.73

⁽¹⁾ In PY16, Cadmus aggregated jobs by job type and delivery type. PY16 realization rates are reflective of this.

⁽²⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings. Realization rates are applied to verified demand reductions before distribution losses are applied.

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Total may not match the sum of rows due to rounding.

The following factor led to variation between reported and verified savings and to the observed realization rates for the full cost stratum:

Home Occupancy Assumptions for Water Equipment. The ICSP assumed the number of home occupants based on home type per the Pennsylvania Technical Reference Manual (PA TRM). As in previous analyses, Cadmus used the number of occupants verified by the ICSP during the home assessment for water-saving equipment, while the ICSP assumed the quantity of home occupants based on home type per the PA TRM. This adjustment is made to bathroom and kitchen low-flow aerators, low-flow showerheads, and thermostatic shower restriction valves. In most cases, the number of occupants observed during the home assessment was greater than the TRM assumption, leading to higher *ex post* savings and increased energy and demand realization rates for these measures. All domestic hot water measures (aerators, showerheads, and thermostatic shower restriction valves) in the sample account for 37% of total reported energy savings, highlighting the impact on realization rates.

CADMUS

The following factors led to variation between reported and verified savings and to the observed realization rates for the welcome kit stratum. Welcome kits account for about 35% of total reported energy savings in PY17 and have a large impact on the program's overall performance.

- **Electric Water Heat Assumption**
 - The PY17 participant survey results showed that 68% of homes that received a welcome kit had electric water heat; therefore, Cadmus applied this value in its analysis in place of the 100% assumption applied by the ICSP.
 - Cadmus used a weighted average to calculate the recovery efficiency of the water heater based on data from the 2018 SWE baseline study, whereas the ICSP used the standard electric water heater default TRM value of 0.98 for all equipment.
- **Multiple Welcome Kit Delivery.** The ICSP provided welcome kits to 59 duplicate customers, with each customer receiving two kits. The ICSP previously specified that customers should receive one welcome kit. As such, Cadmus did not include savings for the duplicate kits in the verified savings.
- **Housing Type Assumption.** While this did not affect realization rates, the ICSP reported welcome kit savings separately for single-family and multifamily households in PY17, resulting in different savings values for each household type. Cadmus compared a sample of these deliveries to PY17 participant survey data and confirmed that the ICSP's household classification (i.e., where the kit was delivered) was generally accurate. Cadmus used single-family and multifamily inputs where relevant.

For PY16 realization rates and the key factors contributing to differences between verified and reported savings, please refer to the PY16 annual report.

6.3. Net Impact Evaluation

The Low-Income Program is offered to income-eligible customers at no cost. No free riders are anticipated, as income-constrained customers are not likely to purchase energy-efficient products on their own. An NTG ratio of 1.0 is appropriate for this program. Therefore, Cadmus did not estimate net savings.

6.4. Verified Savings Estimates

As shown in Table 6-7, Cadmus determined the realization rates and NTG ratios and applied these values to the reported energy savings and demand reduction estimates to calculate the verified savings estimates for the PY17 Low-Income Program. Cadmus added these totals to the verified savings achieved in previous program years to calculate the P4TD program impacts.

Table 6-7. PY17 and P4TD Savings Summary for the Low-Income Program

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	15,936	1.75
PYVTD Gross	14,524	1.73 ⁽¹⁾
PYVTD Net	14,524	1.73 ⁽¹⁾
RTD	69,776	7.49
VTD Gross	97,227 ⁽²⁾	7.56 ⁽¹⁾
VTD Net	66,138 ⁽³⁾	7.56 ⁽¹⁾

⁽¹⁾ Verified demand reductions include line-loss adjustments.

⁽²⁾ Includes Phase III carryover of 31,089 MWh/yr.

⁽³⁾ VTD Net does not include Phase III carryover.

6.5. Process Evaluation

The approved PY17 evaluation plan did not include a participant survey, but PPL Electric Utilities added one to the plan to collect customer feedback and assess participants' experiences with the Low-Income Program. Throughout this section, the program is also referred to by its customer-facing name, WRAP, as it appears in several survey questions.

Methodology

Table 6-8 lists the process evaluation sampling strategy. For the survey sample frame, Cadmus removed duplicate records and customers who had requested no contact in a previous survey. See [Appendix L](#) for details about Cadmus' approach to reducing survey bias and contact instructions.

Sample sizes noted in this report may vary by survey question because respondents could skip questions they chose not to answer; therefore, not all respondents answered every question. Cadmus included all survey respondents who answered at least one question, even if they did not complete the survey.

Table 6-8. Low-Income Program Process Evaluation Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size ⁽¹⁾	Sample Frame ⁽²⁾	Assumed Cv in Sample Design	Target Sample Size	Achieved Sample Size ⁽³⁾	Percent Contacted ⁽⁴⁾
Full Cost Jobs	Participants who received full-cost jobs	Online survey	3,856	2,816	0.50	68	144	100%
Low-Cost and Baseload Jobs	Participants who received low-cost and baseload jobs	Online survey	4,722	3,591	0.50	68	121	100%
Welcome Kits	Participants who received a welcome kit	Online survey	25,020	15,329	0.50	68	221	32%
Program Total			33,598	21,736	N/A	204	486	100%

⁽¹⁾ This represents the number of participants at the time of the evaluation survey. Process population size may differ from impact numbers, which include the final count of participants for the program year.

⁽²⁾ The sample frame is a list of participants with contact information who have an opportunity to complete the survey and who were sent an email to complete the survey. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the surveys. After selecting all unique records, Cadmus removed any records from the population if the customer had participated in a survey in the last three months, had been selected for another program survey, did not have valid contact information (email), or had previously opted out of the online survey.

⁽³⁾ This represents the number of respondents who completed the survey. The analysis used all survey responses, regardless of whether every question was answered.

⁽⁴⁾ Percent contacted means the percentage of the sample frame contacted to complete surveys or interviews, even if the record was invalid.

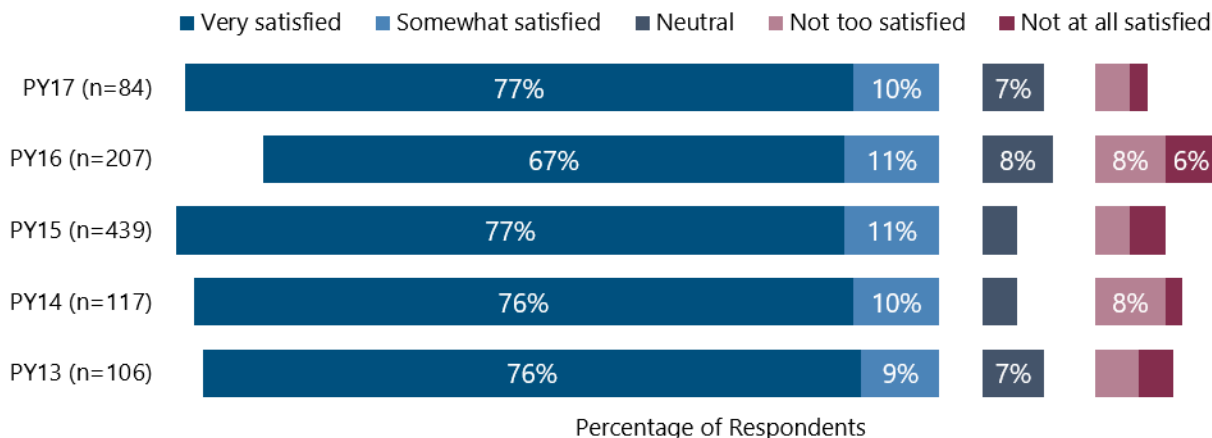
6.5.1. Program Experience

This section presents evaluated findings on program satisfaction, energy-saving behaviors, and program experience.

Overall Program Satisfaction

Overall, 87% of remote and on-site assessment survey respondents (n=84) were *very* or *somewhat satisfied* with the program, exceeding the goal of 85% satisfaction. Figure 6-1 shows that program satisfaction in PY17 was significantly different from PY16 (87% vs. 78%, respectively; $p < 0.10$).

Figure 6-1. Phase IV Overall Satisfaction with Low-Income Program by Year



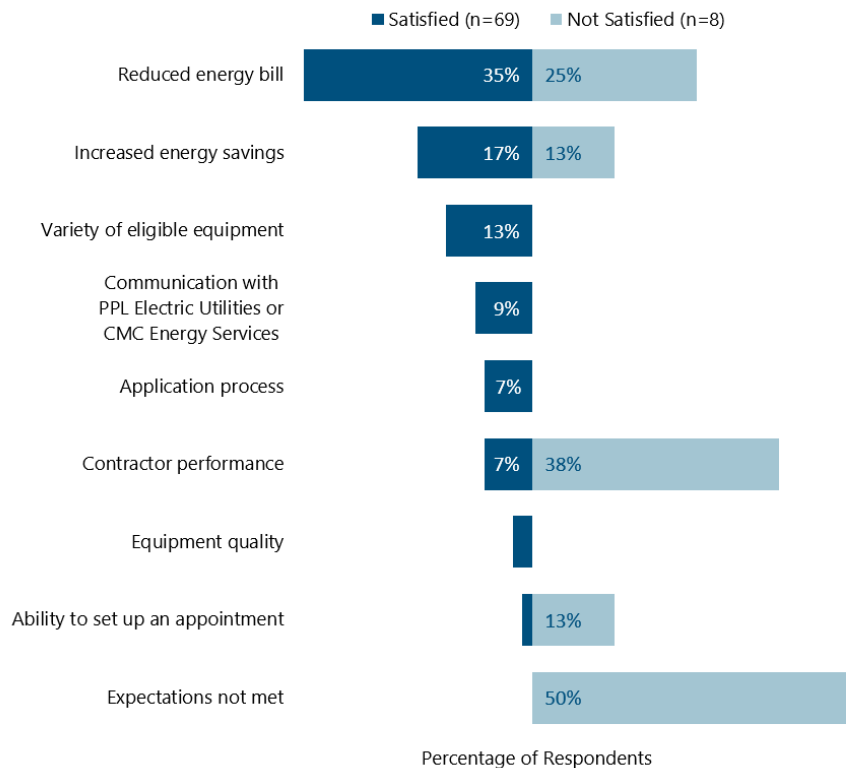
Source: Participant survey, “Now, thinking about your overall experience with the WRAP program, how would you rate your satisfaction?” Totals may not sum due to rounding. Sample sizes reflect partially completed surveys. Percentages smaller than 5% are not labeled in the chart.

Drivers of Program Satisfaction

To better understand what drives program satisfaction, the survey asked participants what factor most affected their program satisfaction rating. Figure 6-2 shows the most common reasons REA and on-site respondents were satisfied or dissatisfied with the program. Similar to PY15 and PY16, the most common driver for respondents reporting they were *very* or *somewhat satisfied* (n=69) was the reduced energy bill (35%).

Respondents who were *neither satisfied nor dissatisfied*, *not too satisfied*, or *not at all satisfied* most frequently cited “other” as the reason for their rating (50%, n=8). Cadmus reviewed open-ended responses and classified these responses as “expectations not met.” For example, two respondents expected LED light bulbs and smart power strips but did not receive them. Additionally, one respondent commented that they did not observe any changes because not much was done through the program, and another respondent said the program did not help with their energy costs.

Figure 6-2. PY17 REA and On-Site Drivers of Program Satisfaction



Source: Participant survey, "What factor(s) most affected the overall experience rating you gave?"
Multiple responses allowed. (n=77)

Opinion of PPL Electric Utilities

Of 75 REA and on-site survey respondents who answered a question about how program participation impacted their opinion of PPL Electric Utilities, over half (69%) said their opinion of PPL Electric Utilities had improved after participating in the Low-Income Program, 21% said their opinion had not changed, and 9% said their opinion decreased.

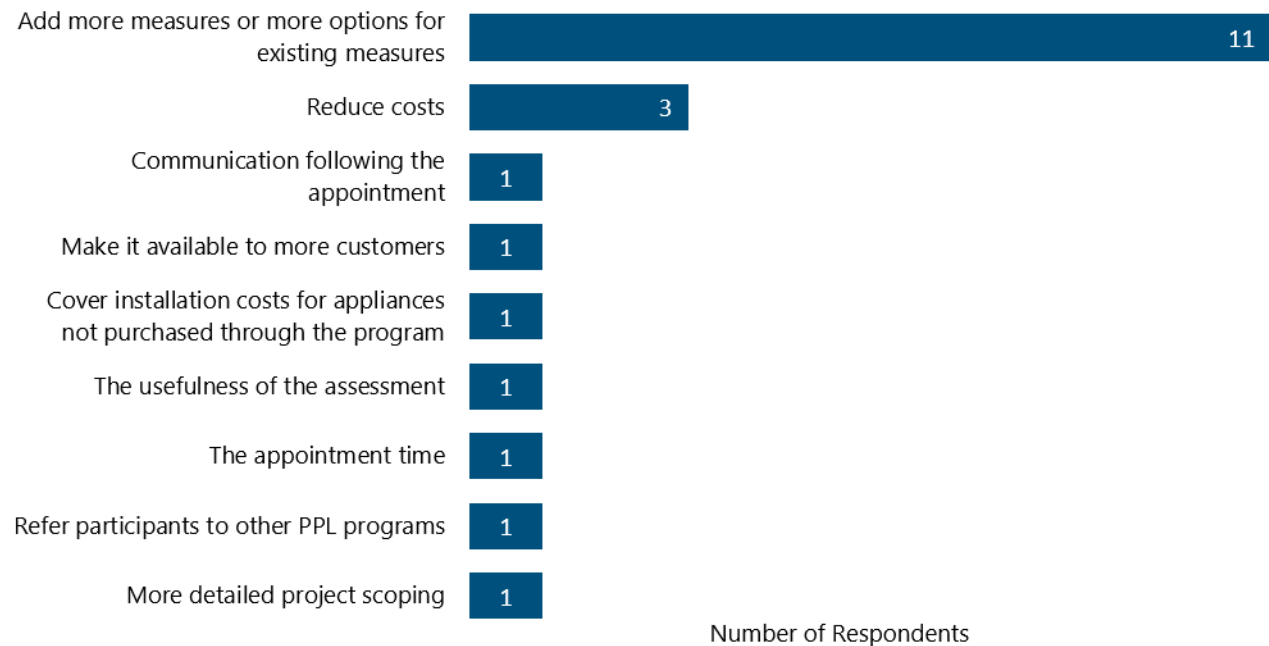
Of all REA and on-site participants who reported that their opinion of PPL Electric Utilities decreased following program participation, two provided a reason for this change. The respondents reported they were unhappy that their monthly energy costs had not decreased after installing energy-saving equipment.

Improvement Suggestions

When asked for one thing PPL Electric Utilities could change to improve the program, 21 respondents said that there was nothing PPL Electric Utilities could improve. Nineteen respondents offered suggestions (Table 6-3). Of this subset, 52% (n=21) suggested adding more measures to the program or more options for existing measures, such as seasonal weather stripping, an online marketplace for appliances, and a wider variety of energy-efficient lighting options. Fourteen percent of these respondents said the program needed to do more to reduce energy costs. Other suggestions included improving the usefulness of the

assessment, clarifying the appointment time, improving follow-up communication after the assessment, referring participants to other PPL Electric Utilities programs, making the program available to more customers, and covering the installation costs for appliances.

Figure 6-3. Suggestions for Improving the Low-Income Program



Source: Participating customer survey, "What is the one thing PPL Electric Utilities could change about the program to improve it? Please describe." (n=21; multiple responses allowed)

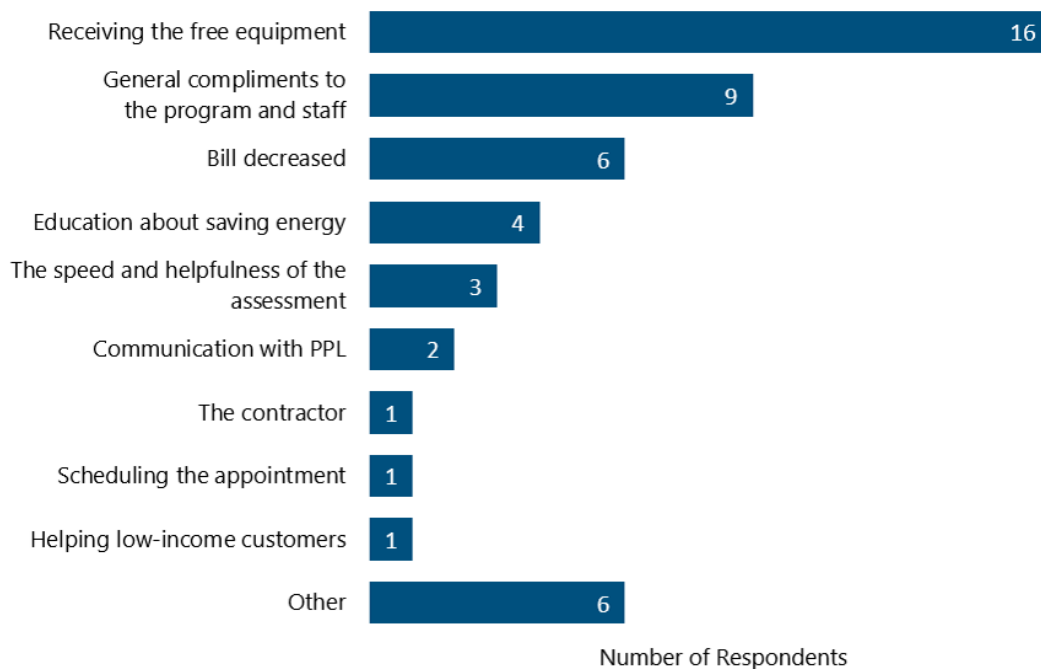
Program Successes

When asked what worked particularly well with the program, 40 respondents provided answers. As shown in Figure 6-4, 16 respondents were satisfied with the free equipment they received through the program, nine respondents provided general positive compliments to the program and its staff, and six said their bills decreased. Four respondents appreciated receiving education about how to save energy, and three said the speed and helpfulness of the assessment, with one respondent commenting, "The whole process was great and easy to work with. It had flexibility that's crucial in this day and age. I was able to complete everything over the phone, get the recommendations, and have everything delivered quickly."

"[PPL] employees along with the program is what makes it all work."

-survey respondent

Figure 6-4. Low-Income Program Successes



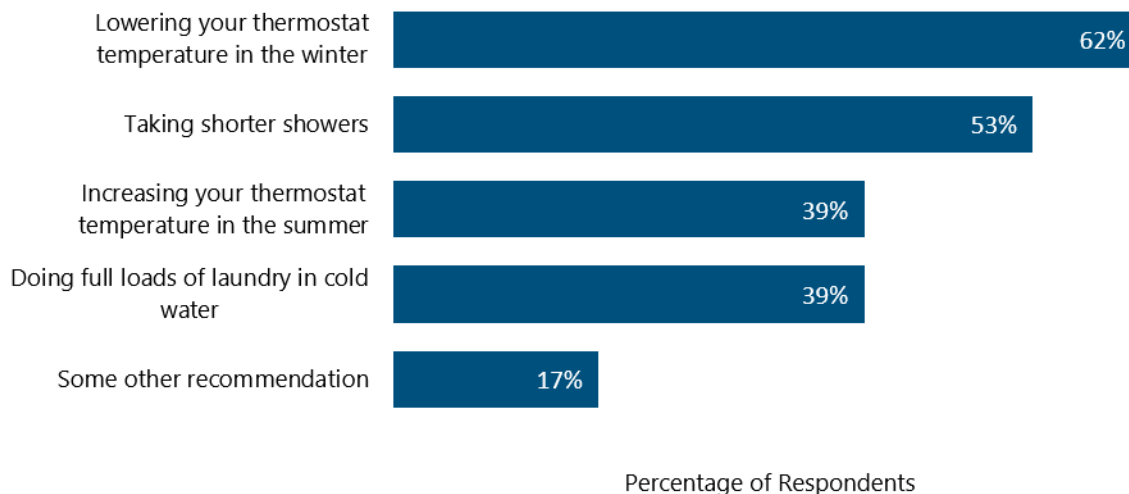
Source: Participating customer survey, "C9. What do you think worked particularly well with the WRAP program? Please be as detailed as possible." (n=40; multiple responses allowed)

6.5.2. Energy-Saving Behaviors

The PY17 survey included a set of questions to better understand the types of energy-saving behavior in which on-site participants engaged. Of the 114 on-site respondents who answered these questions, 90% said their energy advisor provided recommendations on how to save electricity and reduce energy usage.²⁶ Of those who provided information on the recommendations, most said they received a recommendation to lower thermostats in the winter (62%) and to take shorter showers (53%, n=89). Figure 6-5 shows a breakdown of the responses.

²⁶ Cadmus limited participation in this set of questions to on-site participants.
5 Non-Residential Program

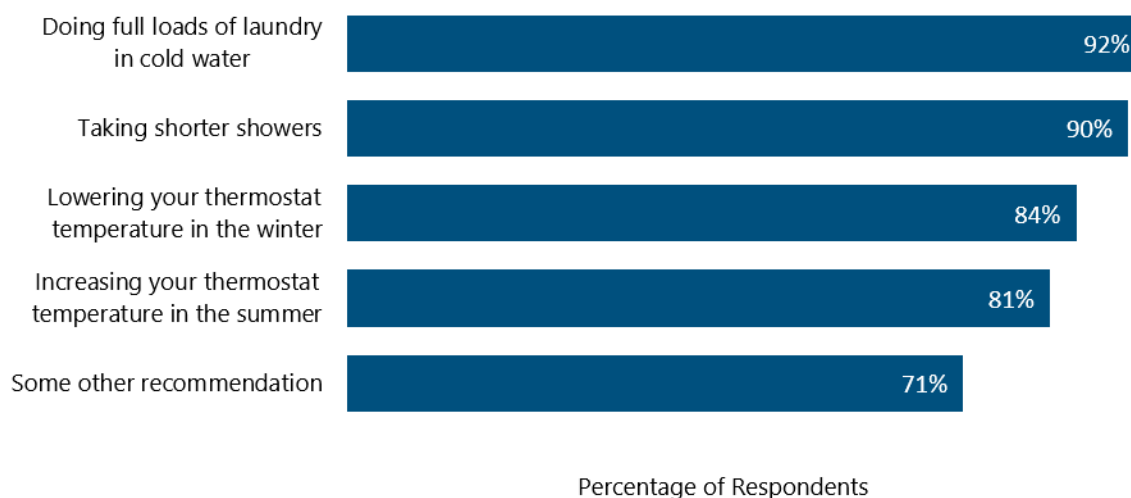
Figure 6-5. PY17 Participant Recall of Receiving Energy Advisor Recommendations



Source: Participant survey, "Which of the following recommendations did the energy advisor provide you during the home energy assessment? Select all that apply."
 Sample sizes reflect partially completed surveys. (n=89)

Among the recommendations provided, on-site respondents most frequently followed the suggestion to do full loads of laundry in cold water (Figure 6-6) and least frequently followed the recommendation to increase their thermostat temperature in the summer.

Figure 6-6. PY17 Adoption of Energy Advisor Recommendations

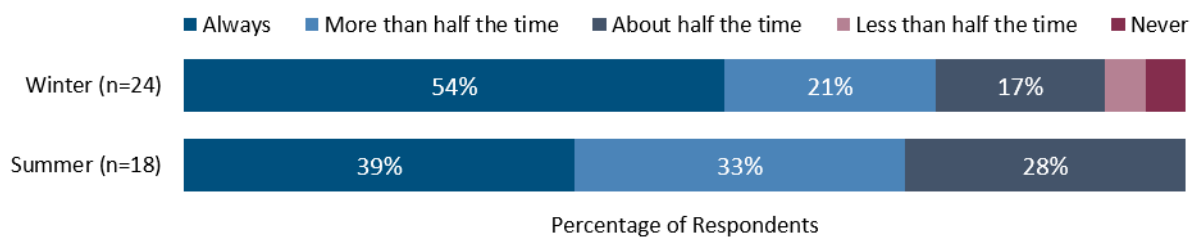


Source: Participant survey, "Which of the following recommendations did you follow? (Select all that apply)" Sample sizes reflect partially completed surveys. (n=109)

Thermostat Settings

Among those who reported following thermostat setback advice, 75% reported following the energy advisor's advice *always* or *more than half the time* during the winter (n=24). Seventy-two percent of respondents reported that they followed the energy advisor's recommendations *always* or *more than half the time* during the summer (n=18). (Figure 6-7).

Figure 6-7. PY17 How Often Respondents Followed Recommended Manual Thermostat Settings



Source: Participant survey, "About how often throughout the winter have you set your thermostat to the decreased temperature recommendation after the energy advisor provided energy-saving recommendations?"; "About how often throughout the summer have you set your thermostat to the increased temperature recommendation after the energy advisor provided energy-saving recommendations?" Sample sizes reflect partially completed surveys.

Most respondents (92%) who reported following energy advisor recommendations to adjust the thermostat in summer or winter had a manual thermostat, and 6% reported having a programmable thermostat (n=77).

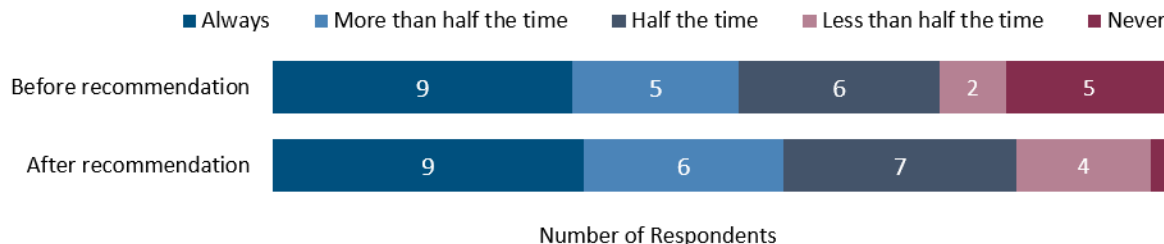
Laundry Practices

Of those who followed recommendations to do full loads of laundry in cold water, most (70%) reported washing laundry at home (n=20). The rest said they do their laundry at an on-site (20%) or off-site laundry facility (10%).

Showering Practices

Of those who reported following advice to take shorter showers, 14 said they took shorter showers always or more than half the time before the recommendation, while 15 said this after receiving the recommendation (n=27; Figure 6-8).

Figure 6-8. PY17 Energy-Saving Showering Practices Before and After Receiving Recommendations



Source: Participant survey, "Please indicate about how often you took showers that were five minutes or less before and after the energy advisor provided energy-saving recommendations." Totals may not sum due to rounding. Sample sizes reflect partially completed surveys (n=27).

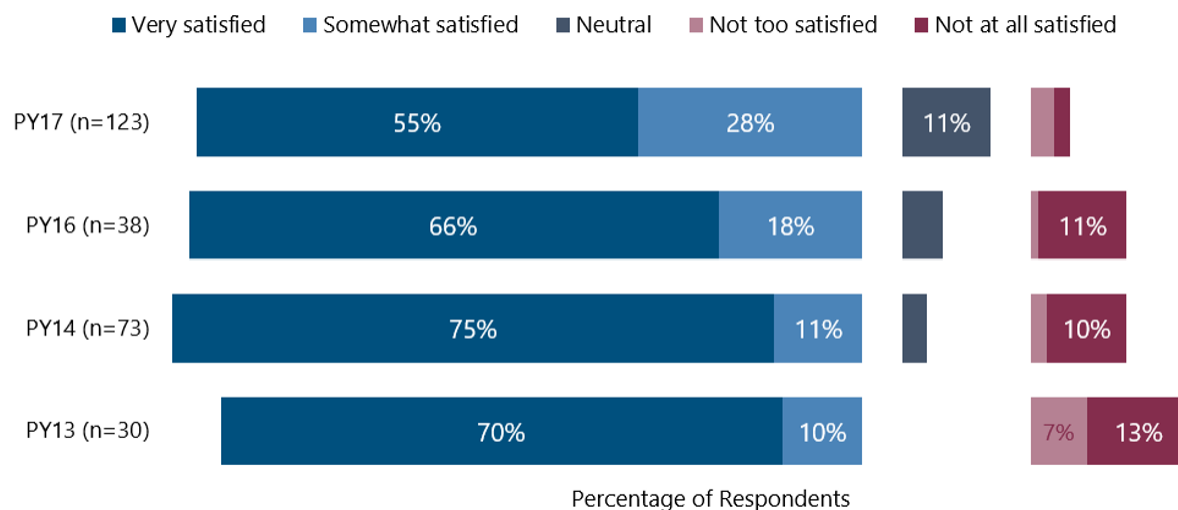
6.5.3. Welcome Kits

Survey respondents who received welcome kits rated satisfaction with the kits, provided reasons for their ratings, and rated the influence of the kits on their opinion of PPL Electric Utilities.

Satisfaction with Welcome Kits

As shown in Figure 6-9, most respondents were satisfied with the kit, with 83% overall satisfaction (as measured by responses of *very* or *somewhat satisfied*; n=123). These results are similar to PY13, PY14, and PY16. Cadmus did not survey welcome kit respondents in PY15.

Figure 6-9. Phase IV Overall Satisfaction with Welcome Kits

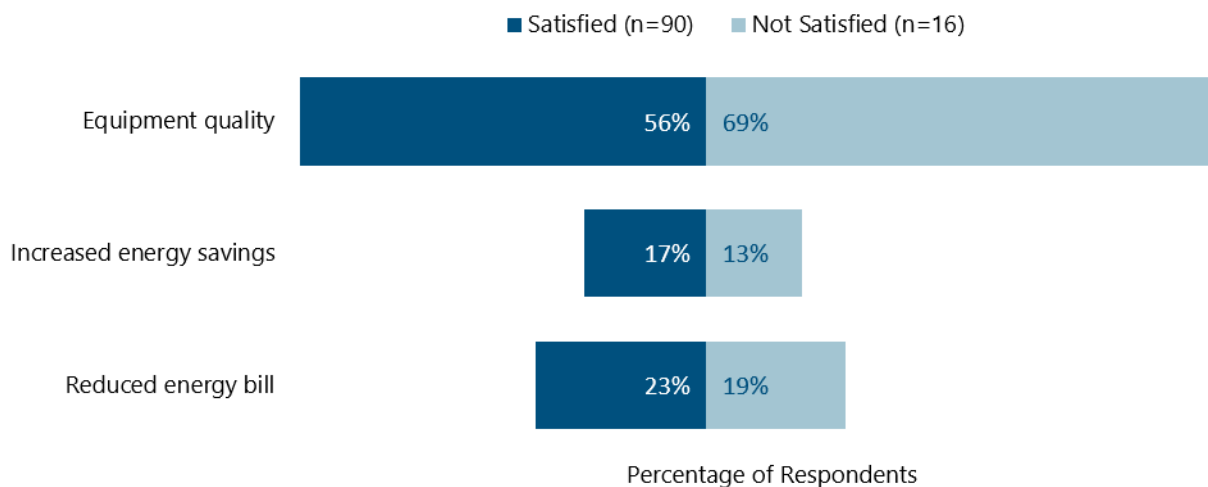


Source: Participant survey, "Now, thinking about your overall experience with the welcome kit, how would you rate your satisfaction?" Cadmus did not conduct participant research in PY15. Percentages smaller than 5% are not labeled in the chart.

Drivers of Satisfaction with Welcome Kits

To better understand what drives program satisfaction, the survey asked participants what factor most affected their program satisfaction rating. Figure 6-10 shows the most common reasons respondents were satisfied or dissatisfied with the welcome kit. The most common driver for both satisfied and dissatisfied respondents was the quality of equipment.

Figure 6-10. PY17 Welcome Kit Drivers of Program Satisfaction



Source: Participant survey, "What factor(s) most affected the overall experience rating you gave?"
Multiple responses allowed. (n=106)

Opinion of PPL Electric Utilities

Of the 116 welcome kit respondents who answered this question, around half (49%) said their opinion of PPL Electric Utilities had improved after participating in the Low-Income Program, 46% said their opinion had not changed, and 5% said their opinion had decreased.

None of the welcome kit participants who reported that their opinion of PPL Electric Utilities decreased following the program provided an explanation.

6.6. Program Finances and Cost-Effectiveness Reporting

Table 6-9 provides a detailed breakdown of program finances and cost-effectiveness. Cadmus calculated TRC benefits using gross verified impacts. PY17 NPV costs and benefits are expressed in 2025 dollars. NPV costs and benefits for P4TD financials are expressed in 2021 dollars. Net verified savings are equal to gross verified savings because the program is assumed to have an NTG ratio of 1.0.

Table 6-9. Summary of Low-Income Program Finances – Gross and Net Verified

Row	Cost Category	PYTD (\$1,000)		P4TD (\$1,000) ⁽²⁾	
1	IMCs	\$4,444		\$18,500	
2	Rebates to Participants and Trade Allies	\$37		\$662	
3	Upstream/Midstream Incentives	\$0		\$0	
4	Material Cost for Self-Install Programs (EE&C Kits)	\$461		\$4,212	
5	Direct Installation Program Materials and Labor	\$3,945		\$13,626	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5)⁽⁶⁾	\$0		\$0	
		EDC	CSP	EDC	CSP
7	Program Design	\$0	\$0	\$0	\$0
8	Administration and Management ⁽³⁾	\$156	\$553	\$826	\$3,013
9	Marketing	\$0	\$371	\$0	\$1,115
10	Program Delivery ⁽⁴⁾	\$0	\$2,103	\$0	\$10,111
11	EDC Evaluation Costs	\$0		\$0	
12	SWE Audit Costs	\$0		\$0	
13	Program Overhead Costs ⁽⁵⁾ (Sum of rows 7 through 12)⁽⁶⁾	\$3,183		\$15,064	
14	Total NPV TRC Costs (Sum of rows 1 and 13)^{(5), (6)}	\$7,626		\$33,565	
15	Total NPV Lifetime Electric Energy Benefits	\$3,253		\$12,648	
16	Total NPV Lifetime Electric Capacity Benefits	\$1,751		\$6,792	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$0		\$64	
18	Total NPV Lifetime Fossil Fuel Impacts	(\$43)		(\$196)	
19	Total NPV Lifetime Water Impacts	\$7,910		\$30,725	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)⁽⁶⁾	\$12,872		\$50,033	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.69		1.49	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021.

⁽²⁾ P4TD benefits do not include carryover energy savings from Phase III.

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as program delivery costs.

⁽⁵⁾ Portfolio-level costs are not assigned to specific programs.

⁽⁶⁾ The sum of rows may not add up to the total due to rounding.

6.7. Recommendations

The Low-Income Program achieved 9,788 MWh/yr in verified savings from on-site assessments, 1,371 MWh/yr from REAs, and 3,365 MWh/yr from the welcome kits.

Overall, the PY17 process evaluation found that the Low-Income Program continues to provide a positive customer experience and deliver meaningful benefits to participating households. Satisfaction among respondents who received remote or in-home assessments (87%, n=84) exceeded the program's satisfaction goal (85%), demonstrating the program's continued effectiveness in serving income-eligible customers. Survey respondents consistently reported that lower energy bills and the opportunity to receive energy-saving equipment were the primary reasons for their positive program experiences. Table 6-10 summarizes the key findings and conclusions from the Low-Income Program evaluation.

Table 6-10. Low-Income Program Findings and Conclusions

Conclusion	Key Supporting Findings
Conclusion 1: Unmet expectations about equipment eligibility and availability reduced satisfaction for some participants.	- Four of eight respondents who gave low satisfaction scores most frequently cited expectations not being met, including not receiving equipment they expected, such as LED light bulbs or smart power strips. (<i>Section 6.5.1. Program Experience</i>) - Eleven respondents (52%) identified adding more measures or additional options for existing eligible equipment as a suggestion for improving the program. (<i>Section 6.5.1. Program Experience</i>)
Conclusion 2: DHW welcome kits are not consistently provided to homes with electrically heated DHW systems.	Of the welcome kit customers surveyed, 68% reported having electrically heated DHW, which negatively impacted realization rates. (<i>Section 6.2. Gross Impact Evaluation</i>)

Cadmus' impact and process evaluation activities in PY17 led to the conclusions and recommendations shown in Table 6-11. The table also includes a summary of how PPL Electric Utilities plans to address the recommendations in program delivery.

Table 6-11. Status of Recommendations for the Low-Income Program

Conclusion	Recommendation	EDC Status of Recommendation
Conclusion 1: Unmet expectations about equipment eligibility and availability reduced satisfaction for some participants.	• Improve expectation-setting during assessments by clearly explaining which measures are available, what eligibility criteria apply, and what factors determine whether equipment will be installed. • Add or reinforce an assessment checklist documenting measures discussed, recommended, approved, declined, or deemed ineligible, and use it to guide follow-up communication with customers.	Implemented in Phase V.
Conclusion 2: DHW welcome kits are not consistently provided to homes with electrically heated DHW systems.	• Refine methods by which homes with electric water heat are identified for kit delivery. Consider reviewing the data source and algorithm design to detect electric water heat.	Not applicable with the change in kit design for Phase V.

RESIDENTIAL PROGRAM

The Residential Program offers financial incentives to recycle inefficient appliances, purchase rebated and discounted equipment, build energy-efficient new homes, educate students about energy efficiency, and encourages customers to save energy by sending home energy reports.

VERIFIED ENERGY SAVINGS

Phase IV
has saved
261,717 MWh/yr

146%
of planned

227%
of planned

PY17 saved
79,241 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
38.56 MW/yr

114%
of planned

216%
of planned

PY17 has
reductions of
12.99 MW/yr

PY17 PARTICIPATION

A total of **536,746** rebates or discounts



426,905 Home Energy Reports



63,310 Energy Efficient Homes*



26,435 Appliance Recycling



20,096 Student Energy
Efficient Education

*Includes number of instant discount purchases

PARTICIPANT SATISFACTION



90%

Satisfied with
overall program

97%

satisfied with Appliance Recycling

88%

satisfied with Energy Efficient Homes

84%

satisfied with Student Energy
Efficient Education

7. Residential Program

The Residential Program is a comprehensive offering comprising new construction, retrofit improvements, appliance recycling, home energy reports, and kit delivery streams for PPL Electric Utilities' residential customers. The program ICSP, CLEAResult, manages program operations and oversees rebate and incentive delivery, with assistance from several subcontractors for specific markets and delivery mechanisms. The evaluation methodology and findings for each Residential Program component are described in separate appendices.

In PY17, the program has four major components:

- **Appliance Recycling**, which offers an incentive to customers who turn in eligible, working appliances and provides free pick-up and environmentally responsible recycling services. Eligible products include freezers, refrigerators, room air conditioners, and dehumidifiers. Participation is counted as the number of appliances recycled.
- **Energy Efficient Homes**, which offers incentives to home builders to construct program-qualifying homes more efficient than code, downstream incentives for high-efficiency products and equipment, instant discounts for qualifying energy-efficient products at retailers, discounted products via an Online Marketplace, and home energy audits, energy kits, and downstream rebates for weatherization solutions. Additionally, this component offers midstream incentives through HVAC and refrigeration distributors, three pilot programs, the Deep Energy Retrofits pilot, the High-Performance Homes pilot, and, starting in PY17, the EV Charging pilot. Participation is counted as the number of rebated projects or homes.
- **Home Energy Reports (HER)**, a behavioral energy efficiency program component that encourages customers to reduce energy use through personalized insights and comparisons with similar households. In PY17, the component included two subcomponents: (1) the Home Energy Reports subcomponent, which delivered paper and digital reports to residential customers. Participation is defined as the number of homes randomly assigned to the treatment group that receives reports; and (2) the Energy Analyzer subcomponent, a free online tool that helps customers understand their energy consumption, compare usage, and identify opportunities to save energy and reduce bills. Participation is defined as the number of customers who first accessed the Energy Analyzer tool by clicking the program link.
- **Student Energy Efficient Education (SEEE)**, which offers free kits with energy-saving products and energy education for students and teachers in grade schools and high schools in PPL Electric Utilities' territory. Participation is counted by the number of kits delivered.

7.1. Participation and Reported Savings by Customer Segment

Table 7-1 presents the participation counts, reported energy and demand savings, and incentive payments for the Residential Program in PY17 by customer segment.

Table 7-1. PY17 Residential Participation and Reported Impacts⁽¹⁾

Parameter	Residential (Non-LI)	Small C&I (Non-GNE)	GNE	Total ⁽³⁾
PY17 # Participants	534,668	1,701	377	536,746
PYRTD MWh/yr	75,349	1,005	179	76,532
PYRTD MW/yr	11.43	0.26	0.07	11.75
PYVTD MWh/yr	78,088	973	181	79,241
System-Level PYVTD MW/yr	12.64	0.27	0.07	12.99
PY17 Incentives (\$1,000)	\$6,986	\$73	\$9	\$7,068

Note: This table does not include results from the Low-Income Program.

⁽¹⁾ The totals in this table do not include PY15/PY16 unverified savings verified in PY17.

⁽²⁾ This table does not include participants in the Energy Analyzer subcomponent of the Home Energy Reports component because PPL Electric Utilities did not claim savings for this subcomponent, and the evaluation did not find savings for this subcomponent.

⁽³⁾ Total may not sum due to rounding.

Table 7-2 shows the Residential Program's verified gross energy savings and demand reductions.

Table 7-2. Residential Program Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified ⁽¹⁾	PY16 Verified ⁽²⁾	PY17 Verified	Phase IV Verified ⁽³⁾
MWh/yr	34,603	43,595	48,861	55,416	79,241	261,717
System-Level MW/yr	4.92	6.07	6.37	8.21	12.99	38.56

⁽¹⁾ Includes savings for all program components left unverified in PY15 and verified in PY16 or PY17.

⁽²⁾ Includes savings for all program components left unverified in PY16 and verified in PY17.

⁽³⁾ Phase IV verified savings may not match the sum of program years due to rounding.

7.2. Gross Impact Evaluation

Cadmus conducted a gross impact evaluation for all Residential Program components in PY17 using a basic level of rigor, with the exception of the Deep Energy Retrofits Pilot, EV Charging Pilot, and the HERs component, which were evaluated with an enhanced level of rigor. Evaluation methods and sampling approaches differed by component and subcomponent to reflect the unique design, delivery, and historical performance. For Appliance Recycling, Cadmus applied historical realization rates from the PY15 evaluation to refrigerators and freezers, presented in the PY15 annual report. For Energy Efficient Homes, Cadmus applied historical realization rates to Audit and Weatherization, Downstream, and Midstream Equipment subcomponents, completed desk reviews of project documentation, and conducted participant surveys to gather evaluation inputs for the Online Marketplace and Instant Discount subcomponents of the Energy Efficiency Homes component. For the New Homes subcomponent, Cadmus completed desk reviews of Ekotrope model outputs for a sample of projects and applied the PY16

historical realization rate to REM/Rate model outputs. For the HERs component, the team conducted a billing analysis.

Cadmus verified savings for the Deep Energy Retrofits Pilot that remained unverified from PY15 and PY16, as well as savings for the New Homes subcomponent that remained unverified in PY16.

Gross savings verification methodology details, sampling approach, and detailed findings are discussed in the individual appendices of this report (*Appendix G, Appendix H, Appendix J and Appendix N*).

The Residential Program, excluding Low-Income, overall achieved a 104% realization rate for energy (Table 7-3) and a 102% realization rate for demand (Table 7-4).

Table 7-3. PY17 Residential Program Gross Impact Results for Energy

Component	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv	Relative Precision at 90% C.L. ⁽²⁾	PYVTD (MWh/yr)
Appliance Recycling	13,686	99%	5.73	8.2%	13,523
Energy Efficient Homes	30,436	105%	4.74	6.4%	32,094
Home Energy Reports	27,290	105%	<0.01	18.4%	28,695
Student Energy Efficient Education	5,121	96%	0.96	1.4%	4,929
Residential Subtotal⁽³⁾	76,532	104%	2.15	3.5%	79,241
Low-Income (Residential) ⁽⁴⁾	15,936	91%	4.47	6.4%	14,524
Program Total⁽³⁾	92,468	101%	1.95	3.2%	93,765

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Relative precision in this table is reported at the 90% confidence level and will not match tables in the appendices, where relative precision is reported at the 85% confidence level.

⁽³⁾ Totals may not sum due to rounding and may not match other tables or figures due to rounding.

⁽⁴⁾ Low-Income is shown as a subsector of residential in this table per sampling requirements in the Evaluation Framework.

Table 7-4. PY17 Residential Program Gross Impact Results for Demand

Component	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv	Relative Precision at 90% C.L. ⁽²⁾	PYVTD (MW/yr)	System-Level PYVTD (MW/yr)
Appliance Recycling	5.10	99%	2.47	3.6%	5.07	5.51
Energy Efficient Homes	3.03	124%	4.44	7.1%	3.74	4.07
Home Energy Reports	3.11	84%	<0.00	34.5%	2.62	2.85
Student Energy Efficient Education	0.51	98%	0.93	1.3%	0.50	0.55
Residential Subtotal⁽³⁾	11.75	102%	1.74	2.9%	11.94	12.99
Low-Income (Residential) ⁽⁴⁾	1.75	91%	4.17	6.0%	1.59	1.73
Program Total⁽³⁾	13.50	100%	1.61	2.7%	13.54	14.72

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Relative precision in this table is reported at the 90% confidence level and will not match tables in the appendices, where relative precision is reported at the 85% confidence level.

⁽³⁾ Totals may not sum due to rounding and may not match other tables or figures due to rounding.

⁽⁴⁾ Low-Income is shown as a subsector of residential in this table per sampling requirements in the Evaluation Framework.

The following factors led to variation between the reported and verified savings and to the observed realization rates for the subcomponents or components verified in PY17. Additional details can be found in *Appendix G*, *Appendix I*, *Appendix J*, and *Appendix N*.

- The **Appliance Recycling component** had an energy realization rate of 99% and a demand reduction realization rate of 99%. Cadmus applied a historical realization rate in PY17 derived from the PY15 evaluation. The ICSP had updated per-unit reported savings for the majority of records in PY17 to match the PY15 evaluation. For these records, Cadmus passed through the reported savings, resulting in 100% realization rates, since applying a correction to the realization rate would be redundant. However, a small portion of records reported per-unit savings that had not been updated, and Cadmus adjusted the verified savings using historical realization rates.
- The **Energy Efficient Homes component** had an overall energy realization rate of 105% and an overall demand realization rate of 124% due to the reasons listed for each subcomponent below:
 - The **Online Marketplace subcomponent** of Energy Efficient Homes had energy realization rates of 85% for kits, 108% weatherization measures, and 167% for all other measures, and demand realization rates of 83% for kits, 110% weatherization measures, and 131% for all other measures. The majority of variations were due to in-service rate (ISR) updates from the PY17 participant survey, which were higher in PY17 for standalone measures and lower for kit measures. For other measures, Cadmus calculated the evaluated savings using TRM default assumptions for heating and cooling system types, while *ex ante* savings calculations used heating and cooling saturation percentages from the PY15 evaluation report.
 - The **Instant Discount subcomponent** had an energy realization rate of 114% and a demand reduction realization rate of 110%. These realization rates were largely driven by increased ISRs in PY17, as determined through the Online Marketplace participant surveys.

- The **Deep Energy Retrofits Pilot** had an energy realization rate of 45% and a demand reduction realization rate of 73% because savings for ductless heat pumps were overstated in one of the three projects.
- The **EV Charging Pilot** had an energy realization rate of 78% and a demand reduction realization rate of 85% because metered charging behavior differed from the expected behavior, and many participants in the Tesla stratum could not be verified as having ENERGY STAR Level 2 chargers.
- For the **New Homes subcomponent** of Energy Efficient Homes, the evaluation produced a 100% realization rate for annual electric energy savings and a 167% realization rate for peak demand savings. The realized energy savings closely matched reported savings, while the hourly Ekotrope analysis identified greater coincident summer peak demand reductions than reflected in the reported demand savings. The difference between the energy and demand realization rates suggests that the methodology used to estimate claimed demand savings may have understated coincident peak demand reductions.
- The **Student Energy Efficient Education component** had an energy realization rate of 96% and a demand reduction realization rate of 98%, largely because of decreases in installation rates of smart strips and night lights among the Bright Kids and Take Action cohorts.
- The **Home Energy Reports component** had an energy realization rate of 105% and a demand reduction realization rate of 84%. The energy realization rate above 100% may reflect reported savings, which excluded a portion of treatment customers. The demand reduction realization rate primarily reflects methodological differences. Cadmus estimated demand reduction directly from AMI data, while the reported demand reduction relied on a factor derived from historical data.

7.3. Net Impact Evaluation

The methods used to determine net savings for the downstream, upstream, and midstream channels are provided in the Evaluation Framework,²⁷ which discusses common methods used to determine free ridership and spillover. Cadmus used the methods listed in Table 7-5.

²⁷ Pennsylvania Public Utility Commission. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

Table 7-5. PY17 Net Impact Evaluation Methodology

Component/Subcomponent	NTG Notes
Appliance Recycling	Applied historical NTG ratio from PY15 to PY17 verified savings
Energy Efficient Homes Downstream Equipment	Applied historical NTG ratios from PY16 to PY17 verified savings
Energy Efficient Homes Midstream Equipment	Applied historical NTG ratios from PY16 to PY17 verified savings
Energy Efficient Homes Online Marketplace	Applied historical NTG ratios from PY15 to PY17 verified savings
Energy Efficient Homes Instant Discount	Applied historical NTG ratios from PY15 and PY16 to PY17 verified savings
Energy Efficient Homes Audit and Weatherization	Applied historical NTG ratio from PY14 to PY17 verified savings
Energy Efficient Homes New Homes	Applied historical NTG ratio from PY13 to PY17 verified savings
Energy Efficient Homes EV Charging Pilot	Administered online self-report surveys in PY17 to assess free ridership and spillover
Home Energy Report	Used a deemed NTG ratio of 1.00 to calculate net savings, per the evaluation plan
Student Energy Efficient Education	

Additional information about the NTG methodology used for the EV Charging Pilot stratum in the Energy Efficient Homes component is provided in *Appendix I* and *Appendix K*.

Findings from net savings research are not used to adjust compliance savings in Pennsylvania. Instead, this research provides directional information for program planning purposes. Table 7-6 presents NTG ratios for the components of the Residential Program in PY17.

Table 7-6. PY17 Residential Program Net Impact Evaluation Results

Component	PYVTD (kWh/yr)	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (at 85% CL)
Appliance Recycling	13,523,361	50%	0%	0.50	5%
Energy Efficient Homes	32,093,808	44.23%	0.44%	0.56	8%
Home Energy Reports	28,694,720	N/A	N/A	1.00	N/A
Student Energy Efficient Education	4,929,243	N/A	N/A	1.00	N/A
Program Total	79,241,132⁽¹⁾	N/A	N/A	0.74⁽²⁾	3%

⁽¹⁾ May not sum due to rounding.

⁽²⁾ Weighted by PY16 verified gross energy savings.

The PY17 Residential Program total NTG ratio of 0.74 is heavily weighted toward the Energy Efficient Homes and HERs component NTG ratios, as these components represented 77% of the Residential Program verified gross population energy savings.

7.4. Verified Savings Estimates

As shown in Table 7-7, Cadmus applied the realization rates and NTG ratios to the reported energy and demand savings estimates to calculate the verified savings estimates for the Residential Program in PY17.

These totals are added to the verified savings achieved in previous program years to calculate the P4TD program impacts.

Table 7-7. PY17 and P4TD Savings Summary for the Residential Program

Savings Type	Energy (MWh/yr) ⁽¹⁾	Demand (MW/yr) ⁽¹⁾
PYRTD	76,532 ⁽²⁾	11.75 ⁽²⁾
PYVTD Gross	79,241 ⁽²⁾	12.99 ^{(2),(3)}
PYVTD Net	58,427 ⁽²⁾	8.64 ^{(2),(3)}
RTD	270,889 ⁽⁴⁾	36.54 ⁽⁴⁾
VTD Gross	261,717 ⁽⁴⁾	38.56 ^{(3),(4)}
VTD Net	179,108 ⁽⁴⁾	24.97 ^{(3),(4)}

⁽¹⁾ Does not include the Low-Income Program.

⁽²⁾ Does not include unverified savings from PY15 or PY16, verified in PY17.

⁽³⁾ Verified peak demand reductions include application of distribution losses.

⁽⁴⁾ Includes unverified PY15 and PY16 savings from previous years.

The VTD savings contribution in the final PY15 and PY16 annual reports changed for the following reasons:

- **Energy Savings**

- *Energy Efficient Homes Deep Energy Retrofit (PY15):* 17 MWh/yr savings were reported but not verified in the PY15 final annual report. Those savings have since been verified with an energy realization rate of 45% and an NTG ratio of 1.00, which yields an additional 8 MWh/yr of gross verified energy savings and an additional 8 MWh/yr of net verified energy savings. These savings are attributed to the Residential customer sector.
- *Energy Efficient Homes Deep Energy Retrofit (PY16):* 7 MWh/yr savings were reported but not verified in the PY16 final annual report. Those savings have since been verified with an energy realization rate of 45% and an NTG ratio of 1.00, which yields an additional 3 MWh/yr of gross verified energy savings and an additional 3 MWh/yr of net verified energy savings. These savings are attributed to the Residential customer sector. Due to an evaluation clerical error in PY16, a portion of these savings was already reported as verified, so the PY16 totals and Phase IV incremental difference is 1 MWh/yr of gross and net reported savings.
- *Energy Efficient Homes New Homes:* 6,140 MWh/yr savings were reported but not verified in the PY16 final annual report. Those savings have since been verified with an energy realization rate of 100.1% and an NTG ratio of 0.64, which yields an additional 6,148 MWh/yr of gross verified energy savings and an additional 3,935 MWh/yr of net verified energy savings. These savings were attributed to the Residential customer sector.
- *Energy Efficient Homes Downstream Equipment:* SWE audit activities recommended an increase of PY16 gross verified energy savings of 193 MWh/yr, and net verified energy savings of 100 MWh/yr.

- **Demand Reductions**

- *Energy Efficient Homes Deep Energy Retrofit (PY15):* 0.0004 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a demand realization rate of 73% and an NTG ratio of 1.00, which yields an additional 0.0004 MW/yr of gross and net verified demand reductions (system level). These demand reductions are attributed to the Residential customer sector.
- *Energy Efficient Homes Deep Energy Retrofit (PY16):* 0.0004 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a demand realization rate of 73% and an NTG ratio of 1.00, which yields an additional 0.00026 MW/yr of gross and net verified demand reductions (system-level). These demand reductions are attributed to the Residential customer sector. Due to an evaluation clerical error in PY16, a portion of these savings was already reported as verified, so the PY16 totals and Phase IV incremental difference are 0.00021 MW/yr of gross and net reported savings.
- *Energy Efficient Homes New Homes:* 1.34 MW/yr demand reductions were reported but not verified in the PY16 final annual report. These demand reductions have since been verified with a demand realization rate of 147% and an NTG ratio of 0.64, which yields an additional 2.13 MW/yr of gross verified system-level demand reductions and an additional 1.36 MW/yr of net verified system-level demand reductions. These savings were attributed to the Residential customer sector.
- *Energy Efficient Homes Downstream Equipment:* SWE audit activities recommended an increase of PY16 gross verified demand reductions of 0.17 MW/yr (system-level) and an increase of net verified demand reductions of 0.09 MW/yr (system-level).

7.5. Process Evaluation

This section provides high-level results and findings from the process evaluation of the Residential Program. Methodology and additional details are discussed in the individual appendices of this report.

Cadmus conducted a process evaluation in PY17 to gather updates from program administration staff and ICSPs, assess participant experience, and make recommendations for program modification and improvement.

The evaluation activities are summarized in Table 7-8. Modifications to Cadmus' evaluation plans are noted in the individual program component appendices of this report.

Table 7-8. PY17 Residential Program Evaluation Activities

Activity	Audience	Methodology
Appliance Recycling⁽²⁾		
Surveys	Participants (n=93) ⁽¹⁾	Online
Energy Efficient Homes		
In-depth interview	EV Charging Pilot administration staff (n=3)	Telephone
In-depth interview	EV Charging Pilot participating original equipment manufacturers (OEMs) (n=2)	Telephone
Online survey	EV Charging Pilot participants (n=137) ⁽¹⁾	Online
Online survey	Downstream equipment participants (n=73) ⁽¹⁾	Online
Online survey	Audit and Weatherization participants (n=77) ⁽¹⁾	Online
Online survey	Online Marketplace participants (n=74) ⁽¹⁾	Online
Home Energy Report		
In-depth Interviews	Administration staff (n=2)	Telephone
Surveys	Home energy reports participants (n=213) ⁽¹⁾	Online
	Energy Analyzer participants (n=425) ⁽¹⁾	Online
	Home energy reports and Energy Analyzer participants (n=6) ⁽¹⁾	Online
Student Energy Efficient Education		
In-depth Interviews	Administration staff (n=2)	Telephone
Surveys	Participant students and teachers (n=14,590) ⁽¹⁾	Paper and Online

⁽¹⁾ Represents completed surveys. Survey and interview respondents could skip questions, and not all answered each question, so the number of responses may differ from what is reported here and what was reported in the overall component or program satisfaction.

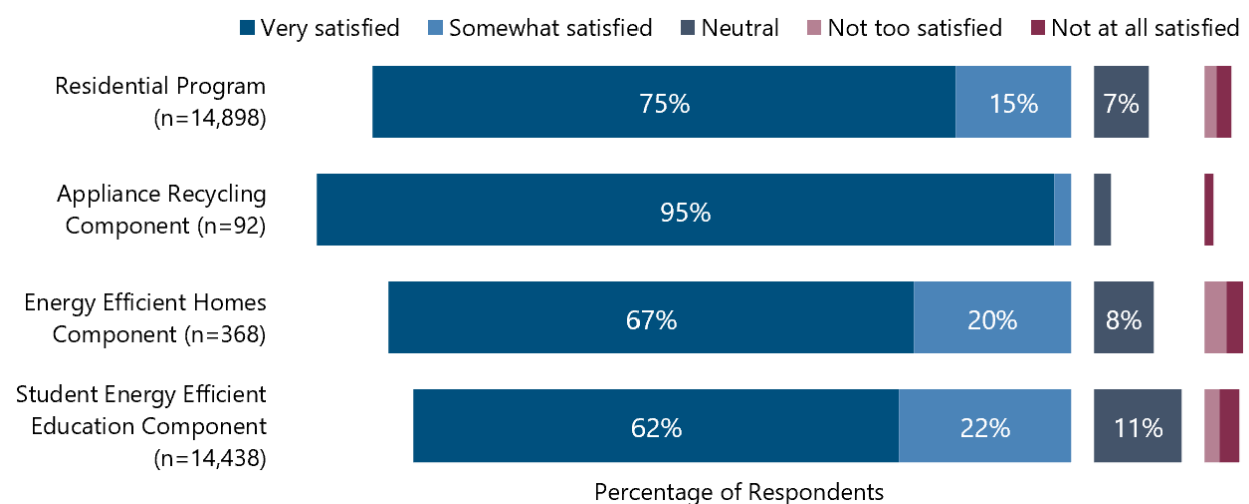
The Cadmus team conducted in-depth phone interviews starting in February and ending in June 2026, and the online participant surveys between March and June 2026.

7.5.1. Process Evaluation Key Findings

For Phase IV, PPL Electric Utilities established a Residential Program goal to achieve 85% or greater of *very satisfied* and *somewhat satisfied* customers,²⁸ which it met with 90% of opt-in participants reporting they were satisfied (Figure 7-1).²⁹ Eighty-eight percent of customers were satisfied with the Energy Efficient Homes component (n=368), 84% of student and teacher respondents were satisfied with the Student Energy Efficient Education component (n=14,438), and 97% of customers were satisfied with the Appliance Recycling component (n=92). The sum of *very* and *somewhat satisfied* does not always match the overall percentage due to rounding.

Compared with PY16, participant satisfaction with the Energy Efficient Homes component decreased from 90% to 88% in PY17, and satisfaction with the Student Energy Efficient Education component decreased from 85% to 84% in PY17.

Figure 7-1. PY17 Residential Program Overall Satisfaction



Source: PY17 Participant surveys question, "Thinking about your overall experience with the PPL Electric Utilities [PROGRAM] rebate program, how would you rate your overall satisfaction?" PY17 SEEE Student Home Energy Worksheet question, "Please rate your overall satisfaction with the Think! Energy program." PY17 SEEE Teacher Evaluation Form question, "Please share your impression of Think! Energy – Overall Experience." The sum of *very* and *somewhat satisfied* do not always sum to the reported value due to rounding. Percentages may not total 100% or match other sections of the report due to rounding.

Table 7-9 shows key findings from individual process evaluations for components in the Residential Program. Additional details are in the program component appendices.

²⁸ The customer satisfaction goal is stipulated in PPL Electric Utilities' EE&C Plan (Docket No. M-2020-3020824) filed with the PA PUC, March 27, 2025.

²⁹ Findings from the Home Energy Reports participant survey are excluded from this chart as this represents satisfaction among participants who opted in to a Residential Energy Efficiency Program component.

Table 7-9. Residential Program Key Process Evaluation Findings

Program Component	Finding
Appliance Recycling	- Appliance Recycling remains the Residential Program component with the highest levels of participant satisfaction, with 97% of respondents reporting they were either <i>very satisfied</i> or <i>somewhat satisfied</i> (n=92). (See <i>Appendix G.3.1. Component Experience</i>). - Participants reported highest satisfaction with the pick-up (60%; n=86) and contractor professionalism (53%; n=86). (See <i>Appendix G</i>).
Energy Efficient Homes (Downstream Equipment, Audit and Weatherization, and Online Marketplace)	- Downstream Equipment, Audit and Weatherization, and Online Marketplace participants were satisfied with their experience; 87% of participants were <i>very satisfied</i> or <i>somewhat satisfied</i> (n=247). Satisfaction levels were consistent between PY16 and PY17. (See <i>Appendix I</i>). - Downstream Equipment respondents' satisfaction was particularly driven by the application process (59%) and increased energy savings (49%). Audit and Weatherization respondents' satisfaction was particularly driven by increased energy savings (46%), reduced energy bills (40%), and the application process (32%). The quality of equipment in the Online Marketplace subcomponent contributed to both high satisfaction with the subcomponent (59%, n=68) and low satisfaction (43%, n=14). (See <i>Appendix I</i>).
EV Charging Pilot	- Participants were satisfied with their experience; 85% of participants in the online marketplace were <i>very satisfied</i> or <i>somewhat satisfied</i> (n=47), and 92% of participants in the downstream rebate were <i>very satisfied</i> or <i>somewhat satisfied</i> (n=74). (See <i>Appendix I</i>). - Data sharing requirements vary by OEM; this, and customer hesitancy to share data, may result in data sharing challenges. Interviews and survey results suggest that program staff management and increased communication with customers on the use of customer data are likely to help mitigate challenges. (See <i>Appendix I</i>). - Participants shared information on their charging behavior. Participants who reported having typical charge times (n=78) most frequently reported charging in the evening. A fifth of participants also reported using their charger to charge a second vehicle. Ninety-one percent of participants reported not regularly charging their vehicle at other chargers (n=121). The average amount of time that participants reported leaving their vehicle plugged in daily was 7.5 hours (n=69). (See <i>Appendix I</i>). - Most participants said they would participate in a time-of-use (TOU) rate if one were offered (73%, n=123); similarly, most participants (73%, n=123) said they would consider participating in the Managed Charging Program, and that the most influential factor in their determining participation would be the ability to reduce their utility bill through optimization of charging times (See <i>Appendix I</i>).
SEEE	Satisfaction with the SEEE program component overall remained high in PY17 across both students and teachers, with a satisfaction level of 84% (n=14,438). (See <i>Appendix J</i>).

Program Component	Finding
	Teachers were slightly more satisfied with the presentations in PY17 compared to PY16 or PY15 (95%, 93%, and 87%; respectively.) (See <i>Appendix J</i>).
Home Energy Reports	- A greater proportion of customers who accessed the Energy Analyzer tool (n=460) said they began engaging in multiple energy-saving behaviors and home improvements after they accessed the tool than the proportion of customers who engaged in similar behaviors after receiving their first home energy report (n=217). For instance, among those who accessed the tool, 39% said they started unplugging unused appliances after accessing the tool, compared to only 12% of customers who started doing so after they received their first home energy report. - Energy Analyzer users (n=432) said that the tool was <i>extremely important</i> (18%) or <i>important</i> (48%) in helping them engage in energy-saving actions or home improvements, compared to home energy report recipients (n=199), with 7% and 31% saying the reports were <i>extremely important</i> or <i>important</i>, respectively. - Energy Analyzer users (n=42) said the tool was either <i>very important</i> (52%) or <i>important</i> (33%) in increasing their awareness of PPL Electric Utilities programs; Users also said the tool was at least <i>somewhat helpful</i> (89%; n=452) and easy to use (48% saying it was <i>very easy</i>, n=437). - Customers who accessed the Energy Analyzer were generally satisfied with the tool, with 44% <i>very satisfied</i> and 35% <i>somewhat satisfied</i> (n=422), whereas only 24% of home energy report recipients were <i>very satisfied</i> (n=213 (See <i>Appendix N</i> for further details.)

7.6. Program Finances and Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 7-10. Cadmus calculated the TRC benefits using gross verified impacts. PY17 NPV costs and benefits are expressed in 2025 dollars. NPV costs and benefits for P4TD financials are expressed in 2021 dollars.

Table 7-10. Summary of Residential Program Finances – Gross Verified

Row	Cost Category ⁽¹⁾	PYTD (\$1,000)		P4TD (\$1,000)	
1	IMCs	\$31,090		\$94,461	
2	Rebates to Participants and Trade Allies	\$5,826		\$20,678	
3	Upstream/Midstream Incentives	\$607		\$5,999	
4	Material Cost for Self-Install Program Components (EE&C Kits)	\$635		\$2,851	
5	Direct Installation Materials and Labor	\$0		\$0	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5) ⁽⁶⁾	\$24,022		\$64,933	
		EDC	CSP	EDC	CSP
7	Program Design	\$0	\$0	\$0	\$0
8	Administration and Management	\$101	\$2,797	\$684	\$4,697
9	Marketing	\$0	\$794	\$0	\$4,535
10	Program Delivery	\$0	\$5,442	\$0	\$16,681
11	EDC Evaluation Costs	\$0		\$0	
12	SWE Audit Costs	\$0		\$0	
13	Program Overhead Costs (Sum of rows 7 through 12)⁽⁶⁾	\$9,134		\$26,597	
14	Total NPV TRC Costs (Sum of rows 1 and 13)^{(5),(6),(7)}	\$40,223		\$122,574	
15	Total NPV Lifetime Electric Energy Benefits	\$19,393		\$64,598	
16	Total NPV Lifetime Electric Capacity Benefits	\$13,799		\$42,395	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$0		\$0	
18	Total NPV Lifetime Fossil Fuel Impacts	\$9,620		\$47,836	
19	Total NPV Lifetime Water Impacts	\$4,478		\$15,580	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)⁽⁶⁾	\$47,290		\$170,409	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.18		1.39	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021.

⁽²⁾ P4TD benefits do not include carry-over energy savings from Phase III.

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as "Program Delivery" costs.

⁽⁵⁾ Portfolio-level costs are not assigned to specific programs.

⁽⁶⁾ Sum of rows may not add up to the total due to rounding.

⁽⁷⁾ Row 14 (portfolio-level TRC costs) includes excess incentives from the Residential Efficient Lighting program component; \$1,516,214 in P4TD. Per Phase IV TRC Order, excess incentives are to be treated as a TRC cost, so the sum of rows 1 and 13 does not add up to row 14.

Table 7-11 presents program financials and cost-effectiveness on a net savings basis. As stated in the 2021 TRC Order, free rider incentives are not included as an additional program cost, as these would have occurred even in the absence of the program.

Table 7-11. Summary of Residential Program Finances – Net Verified

Row	Cost Category ⁽¹⁾	PYTD (\$1,000)		P4TD ⁽²⁾ (\$1,000)	
1	IMCs	\$17,690		\$76,641	
2	Rebates to Participants and Trade Allies	\$5,826		\$20,678	
3	Upstream/Midstream Incentives	\$607		\$5,999	
4	Material Cost for Self-Install Program Components (EE&C Kits)	\$635		\$2,851	
5	Direct Installation Materials and Labor	\$0		\$0	
6	Participant Costs (Row 1 minus the sum of Rows 2 through 5) ⁽⁶⁾	\$10,622		\$47,113	
		EDC	CSP	EDC	CSP
7	Program Design	\$0	\$0	\$0	\$0
8	Administration and Management	\$101	\$2,797	\$684	\$4,697
9	Marketing	\$0	\$794	\$0	\$4,535
10	Program Delivery	\$0	\$5,442	\$0	\$16,681
11	EDC Evaluation Costs	\$0		\$0	
12	SWE Audit Costs	\$0		\$0	
13	Program Overhead Costs (Sum of rows 7 through 12)⁽⁶⁾	\$9,134		\$26,597	
14	Total NPV TRC Costs (Sum of rows 1 and 13)^{(5),(6),(7)}	\$26,824		\$104,754	
15	Total NPV Lifetime Electric Energy Benefits	\$12,572		\$53,658	
16	Total NPV Lifetime Electric Capacity Benefits	\$8,889		\$34,884	
17	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	\$0		\$0	
18	Total NPV Lifetime Fossil Fuel Impacts	\$5,941		\$41,576	
19	Total NPV Lifetime Water Impacts	\$4,129		\$15,264	
20	Total NPV TRC Benefits (Sum of rows 15 through 19)⁽⁶⁾	\$31,532		\$145,381	
21	TRC Benefit-Cost Ratio (Row 20 divided by Row 14)	1.18		1.39	

⁽¹⁾ Rows 1-13 are presented in nominal dollars (PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025); P4TD = \$2021

⁽²⁾ P4TD benefits do not include carry-over energy savings from Phase III

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

⁽⁴⁾ Includes CSP rebate processing, direct program management, customer support, technical assistance to customers, site visits, legal, and QA/QC documentation. These costs cannot be quantified separately and are included as "Program Delivery" costs.

⁽⁵⁾ Portfolio-level costs are not assigned to specific programs.

⁽⁶⁾ Sum of rows may not add up to the total due to rounding.

⁽⁷⁾ Row 14 (portfolio-level TRC costs) includes excess incentives from the Residential Efficient Lighting program component; \$1,516,214 in P4TD. Per Phase IV TRC Order, excess incentives are to be treated as a TRC cost, so the sum of rows 1 and 13 does not add up to row 14.

7.7. Status of Recommendations

Overall, the Residential Program exceeded the PY17 planned energy savings and demand reductions by approximately 127% and 116%, respectively. Additionally, the Residential Program met its customer satisfaction target with 90% of opt-in participants reporting they were satisfied. Table 7-12 summarizes the key findings and conclusions from the Residential Program evaluation.

Table 7-12. Residential Program Findings and Conclusions

Conclusion 1: Appliance recycling Documentation practices are not consistently applied across all participation channels.	- Six of the 40 total records sampled for the quarterly data request were missing appliance photos. These sampled appliances were picked up during drop-off events. (See <i>Appendix G</i>) - Cadmus is coordinating additional verification activities with PPL Electric Utilities and the ICSP for drop-off events in PY18. (See <i>Appendix G</i>)
Conclusion 2: Energy Efficient Homes EV Charging Pilot Contradictory or incomplete data on participant EV charging hardware resulted in reduced verified savings.	- For verified ENERGY STAR Level 2 chargers, annual energy and demand savings closely matched reported savings despite deviations from expected charging behavior by participants. The stratum wide energy and demand savings realization rate was significantly below 100% due to participants associated with Tesla hardware that could not be verified as ENERGY STAR Level 2 chargers. (See <i>Appendix I</i>) - Successful sharing of data is complicated by sharing requirements that vary by OEM, and hesitancy on the part of some customers to provide data. (See <i>Appendix I.1</i>)
Conclusion 3: Energy Efficient Homes EV Charging Pilot EV Charging Pilot customers are interested in managed charging and TOU programming.	- The majority of EV Charging Pilot participants expressed interest in participation in managed charging (73%) and TOU programming (73%). (See <i>Appendix I</i>) - Survey results also indicate that EV Charging Pilot participants are most frequently charging in the evening, and most frequently charging their vehicles at their home charger (versus other charger locations). (See <i>Appendix I</i>)
Conclusion 4: Energy Efficient Homes/ New Homes Project-specific hourly analysis of Ekotrope modeled homes produced higher peak demand savings than the approach used to develop reported demand savings.	- The evaluation produced a 167% peak demand realization rate, indicating that reported demand savings understated coincident summer peak demand reductions. (See <i>Appendix I</i>) - Hourly Ekotrope model outputs enabled direct calculation of TRM-defined peak demand savings using project-specific hourly performance data. (See <i>Appendix I</i>) - The hourly analysis consistently identified greater coincident summer peak reductions than reflected in the reported demand savings. (See <i>Appendix I</i>)

Conclusion 5 (Energy Analyzer/HER): While participants were satisfied with the Energy Analyzer and it appeared to increase customer awareness and engagement, it did not produce measurable energy savings.

- Survey respondents said that the Energy Analyzer tool was either *very important* (52%) or *important* (33%) in increasing their awareness of PPL Electric Utilities programs (n=42; see *Appendix N.4*).
- Respondents who accessed the tool said they were *extremely knowledgeable* (12%) or *very knowledgeable* (38%) of energy saving behaviors (n=472; see figure 15), with 20% saying that the tool was *very important* and 48% saying it was *important* for increasing their energy saving knowledge (n=436; see *Appendix N.4*).
- 44% of respondents were very satisfied, and 35% were somewhat satisfied with the Energy tool (n=422; see *Appendix N.4*).
- For those who were less than very satisfied (n=226; see figure 28), the most frequently cited suggestions for improvements were more personalized recommendations (43%), clearer explanations of bill impacts (39%), and more accurate savings estimates (38%).
- Conversely, only 24% of surveyed Home Energy Reports recipients were *very satisfied* with the reports (n=213; see *Appendix N.4*).
- While the annual impact analysis found no evidence of measurable savings attributable to the Energy Analyzer component, Energy Analyzer participants engaged in cross-program participation 2.46% more often than control customers. However, this uplift is lower than the 3.5% participation uplift observed for HERs treatment customers. Also, increased participation does not necessarily result in increased savings. Program savings depend not only on the number of participants but also on the types of measures installed and the magnitude of savings achieved per participant. As a result, higher cross-program participation among Energy Analyzer users does not guarantee measurable portfolio-level savings uplift (see *Appendix N.4*.)

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The impact and process evaluation activities in PY17 led to the following findings and recommendations from Cadmus to PPL Electric Utilities, along with a summary of how PPL Electric Utilities plans to address the recommendations in program delivery (Table 7-13).

Table 7-13. Status of Recommendations for the Residential Program

Program Component	Conclusion	Recommendation	EDC Status of Recommendation
Appliance Recycling	Conclusion 1: Documentation practices are not consistently applied across all participation channels.	Review and as needed, enhance procedures to support consistent documentation requirements, including appliance photos, across all participation channels.	Implemented in Phase V.
Energy Efficient Homes (EV Charging Pilot)	Conclusion 2: Contradictory or incomplete data on participant EV charging hardware resulted in reduced verified savings.	For all EV Charging projects, document the make, model, and associated ENERGY STAR ID of the charger.	No applicable for Phase V Direct Load Shifting programs.
Energy Efficient Homes (EV Charging Pilot)	Conclusion 3: EV Charging Pilot customers are interested in managed charging and TOU programming.	Consider the development and promotion of a managed charging and/or TOU program.	Implemented in Phase V.
Energy Efficient Home (New Construction)	Conclusion 4: Project-specific hourly analysis of Ekotrope modeled homes produced higher peak demand savings than the approach used to develop reported demand savings.	For Ekotrope-modeled homes, consider incorporating project-specific hourly analysis into peak demand reduction calculations for reported savings.	Being considered.
Home Energy Reports/Energy Analyzer	Conclusion 5: While participants were satisfied with the Energy Analyzer and it appeared to increase customer awareness and engagement, it did not produce measurable energy savings.	Review whether cross-program awareness, engagement, and program satisfaction outcomes achieved through the Energy Analyzer align with program goals, given the absence of measurable savings.	Being considered.
		Consider periodic promotional and outreach campaigns throughout the program year to encourage continued customer participation in the Energy Analyzer. Sustaining treatment adoption beyond the initial launch period may improve program reach and increase the potential for more cross-program participation.	Implemented in Phase V.

Appendix A. Site Inspection Summary

Table A-1 summarizes the program components and subcomponents that received verification site visits by Cadmus or the ICSP (listed in the Inspection Firm column), including the number of inspections, as well as discrepancies and their resolution.

Table A-1. PY17 Site Visit Summary

Program Component	Inspection Firm	Inspections Conducted		Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
		In-Person	Virtual		
Custom Ag	CLEAResult (the ICSP)	3	0	3	• Submitter's estimate of original savings was not accurate • Actual metered data used in place of estimates • Project not modeled accurately compared to the installed condition • Project scope deviated from the original submission
Custom CHP		5	0	5	
Custom Compressed Air		25	0	25	
Custom HVAC		9	0	9	
Custom Lighting		4	0	4	
Custom Motors		2	0	2	
Custom Other		7	0	7	
Custom Process Improvement		4	0	4	
Custom Refrigeration		2	0	2	
Custom Solar		16	0	16	
Custom	Warren Energy Engineering (on behalf of Cadmus)	23	0	0	• All visits were performed for projects in the CHP and large strata. Therefore, visits were performed during real-time evaluation, and discrepancies were not expected. All equipment and quantities matched reported values.
Efficient Equipment Direct Discount Lighting	CLEAResult (the ICSP)	140	0	18	• Scope of work changes
					• Incorrect fixture codes used
					• Wrong number of lights submitted on application
					• Wrong HOU given on Appendix C form vs. what was found from customer interviews on site
					• Wrong number of bulbs in the fixtures submitted
					• Building type change
					• Incorrect wattage selected for baseline fixtures

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Program Component	Inspection Firm	Inspections Conducted		Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
		In-Person	Virtual		
Direct Discount Refrigeration	CLEAResult (ICSP)	6	0	0	No discrepancies found
Direct Discount HVAC Tune-up		10	0	0	
Direct Discount Compressed Air	CLEAResult (ICSP)	3	0	1	Unit equipment size corrected
Efficient Equipment Downstream Lighting	CLEAResult (the ICSP)	21	0	3	- Scope of work changes - Incorrect fixture codes used - Wrong number of lights submitted on application - Wrong HOU given on Appendix C form vs. what was found from customer interviews on site - Wrong number of bulbs in the fixtures submitted - Building type change - Incorrect wattage selected for baseline fixtures
Efficient Equipment Lighting	Cadmus	1	0	0	Changed wattages to DLC values from spec sheet values, made corrections to meter data analysis.
Equipment (non-lighting)	DNV (on behalf of Cadmus)		2	1	1 fan size discrepancy
Efficient Equipment Other	CLEAResult (the ICSP)	2	0	0	No discrepancies found
Efficient Equipment Compressed Air		1	0	0	
Efficient Equipment HVAC		1	0	0	
New Homes	PSD (the ICSP's subcontractor)	77	0	63	- Appliances (35) – Appliance discrepancies were most often caused by misreported equipment efficiency ratings or failing to use defaults if not installed. - Windows (34) – Window discrepancies are most often caused by misreported window area or the orientation of the windows. - Orientation (28) – Orientation discrepancies are caused by misreported building orientation. - Hatches (19) – Hatch discrepancies were most often caused by misreported R-values or exclusion from the model.

Program Component	Inspection Firm	Inspections Conducted		Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
		In-Person	Virtual		
					Duct Leakage (8) – Duct Leakage discrepancies were most often caused by misreported CFM @ 25Pa.
Energy Efficient Homes Air Sealing	CLEAResult (the ICSP)	0	1	0	No discrepancies found.
Energy Efficient Homes Air Source Heat Pump	CLEAResult (the ICSP)	3	62	0	No discrepancies found.
Energy Efficient Homes Attic Insulation (R0 to R49)	CLEAResult (the ICSP)	4	65	9	Discrepancies most often were a result of the projects not meeting program requirements. Not meeting HVAC requirements, location, or under r-49
Energy Efficient Homes Central AC	CLEAResult (the ICSP)	5	30	0	No discrepancies found.
Energy Efficient Homes Central Heat Fuel Switch	CLEAResult (the ICSP)	0	3	0	No discrepancies found.
Energy Efficient Homes Ductless Heat Pump	CLEAResult (the ICSP)	4	312	1	Failed due to no response.
Energy Efficient Homes Smart Thermostat	CLEAResult (the ICSP)	0	7	0	No discrepancies found.
Energy Efficient Homes Wall Insulation	CLEAResult (the ICSP)	1	26	4	Failed due to not meeting HVAC requirements or the incorrect type of insulation.
Low-Income (Baseload)	CMC (the ICSP)	7	332 interim surveys and 275 quality confirmation surveys sent	65	35 customers said they had not installed all their LEDS, and 24 were not able to resolve the issue over the phone
					15 customers responded that they had not installed all their tier I smart strips, and seven were not able to resolve the issue over the phone
Low-income (Low-Cost)	CMC (the ICSP)	13	771 interim surveys and 635 quality confirmation surveys	150	83 customers said they had not installed all their LEDs, and 42 were not able to resolve the issue over the phone
					127 customers said they could not install their showerheads, and 32 were not able to resolve the issue over the phone
					83 customers said they were not able to install all their aerators, and 75 were not able to solve the issue over the phone
					43 customers said they could not install all their tier I smart strips, and 15 were not able to resolve the issue over the phone

Appendix B. PY17 and P4TD Summary by Customer Segment and Low-Income Carveout

Table B-1 summarizes the Low-Income Program, initiatives, and customer segments that contributed to the low-income carveout in PY17 and P4TD.

Table B-1. Summary of Low-Income Carveout Energy Savings (MWh/Year)

Program	Customer Segment	PYVTD Gross (MWh/yr)	VTD Gross (MWh/yr)
Low-Income	Low-Income	14,169	64,701
	Small C&I	355	1,379
	GNE	-	59
Subtotal		14,524	66,138
Phase III Carryover		-	31,089
Total		14,524	97,227

Appendix C. Summary of Program-Level Impacts, Cost Effectiveness, and High-Impact Measure NTG

C.1. Program- and Initiative-Level Impacts Summary

Table C-1 summarizes the energy impacts by program and initiative in Phase IV.

Table C-1. Incremental Annual Energy Savings by Program and Initiative (MWh/Year)

Program/Initiative	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr) ⁽¹⁾	PYVTD Net (MWh/yr) ⁽¹⁾	RTD (MWh/yr)	VTD Gross (MWh/yr) ⁽²⁾	VTD Net (MWh/yr) ^{(2), (3)}
Non-Residential						
Custom	134,796	128,202	92,306	529,987	506,843	351,438
Efficient Equipment	92,857	114,807	76,671	453,338	485,096	321,343
Subtotal⁽⁴⁾	227,653	243,010	168,977	983,326	991,939	672,781
Low-Income						
Subtotal⁽⁴⁾	15,936	14,524	14,524	69,776	97,227⁽⁵⁾	66,138⁽⁶⁾
Residential						
Appliance Recycling	13,686	13,523	6,762	51,152	49,521	25,749
Efficient Lighting	-	-	-	8,763	8,969	9,597
Energy Efficient Homes	30,436	32,094	18,041	150,401	141,825	82,361
Home Energy Report	27,290	28,695	28,695	33,504	36,257	36,257
Student Energy Efficient Education	5,121	4,929	4,929	27,069	25,145	25,145
Subtotal⁽⁴⁾	76,532	79,241	58,427	270,889	261,717	179,108
Portfolio Total⁽⁴⁾	320,121	336,775	241,928	1,323,991	1,319,793⁽⁶⁾	918,027
Carryover	-	-	-	-	306,275	-
Portfolio Total with Carryover⁽⁴⁾	320,121	336,775	241,928	1,323,991	1,626,068	918,027

⁽¹⁾ Does not include PY15 or PY16 savings verified in PY17.

⁽²⁾ Includes PY15 and PY16 unverified savings, verified in PY17.

⁽³⁾ VTD Net does not include carryover savings.

⁽⁴⁾ Subtotals and totals may not match the sums of rows due to rounding and may not match figures or tables in other sections of the report due to rounding.

⁽⁵⁾ Includes 31,089 MWh/yr of carryover attributed to the Low-Income Program.

⁽⁶⁾ Excludes carryover attributed to the Low-Income Program.

Table C-2 summarizes peak demand impacts by energy efficiency program and initiative through the current reporting period.

Table C-2. Peak Demand Savings by Energy Efficiency Program and Initiative (MW/Year)

Program/Initiative	PYRTD (MW/yr)	System-Level PYVTD Gross (MW/yr) ⁽¹⁾	System-Level PYVTD Net (MW/yr) ⁽¹⁾	RTD (MW/yr)	System- Level VTD Gross (MW/yr) ⁽²⁾	System- Level VTD Net (MW/yr) ⁽²⁾
Non-Residential						
Custom	26.39	27.27	19.63	108.70	112.78	86.20
Efficient Equipment	21.01	21.77	14.60	83.23	83.75	55.61
Subtotal⁽³⁾	47.39	49.04	34.24	191.92	196.53	141.81
Low-Income						
Subtotal⁽³⁾	1.75	1.73	1.73	7.49	7.56	7.56
Residential						
Appliance Recycling	5.10	5.51	2.76	14.35	15.32	7.90
Efficient Lighting	-	-	-	1.27	1.41	1.51
Energy Efficient Homes	3.03	4.07	2.49	15.18	16.36	10.09
Home Energy Report	3.11	2.85	2.85	3.11	2.85	2.85
Student Energy Efficient Education	0.51	0.55	0.55	2.63	2.62	2.62
Subtotal⁽³⁾	11.75	12.99	8.64	36.54	38.56	24.97
Portfolio Total⁽³⁾	60.89	63.76	44.62	235.96	242.65	174.33

⁽¹⁾ Does not include PY15 or PY16 savings verified in PY17.

⁽²⁾ Includes PY15 and PY16 unverified savings, verified in PY17, and may not match figures or tables in other sections of the report due to rounding.

⁽³⁾ Subtotals and totals may not match the sums of rows due to rounding.

C.2. Program-Level Cost-Effectiveness Summary

Table C-3 and Table C-4 show the TRC ratios by program and for the portfolio for PY17. Cadmus calculated the benefits using gross verified impacts. Costs and benefits are expressed in 2025 dollars.

Table C-3. PY17 Gross TRC Ratios by Program (\$1,000)

Program/Initiatives	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Non-Residential				
Custom	\$94,352	\$84,424	1.12	\$9,927
Efficient Equipment	\$97,055	\$38,641	2.51	\$58,414
Non-Residential Subtotal⁽¹⁾	\$191,407	\$123,065	1.56	\$68,342
Residential				
Low-Income	\$12,872	\$7,626	1.69	\$5,245
Appliance Recycling	\$5,303	\$3,437	1.54	\$1,866
Efficient Lighting	\$0	\$0	n/a	\$0
Energy Efficient Homes	\$31,269	\$32,454	0.96	(\$1,185)
Home Energy Report	\$4,218	\$3,084	1.37	\$1,134
Student Energy Efficient Education	\$6,501	\$1,249	5.21	\$5,252
Residential Subtotal^{(1),(2)}	\$60,162	\$47,850	1.26	\$12,312
Common Portfolio Costs	N/A	\$9,195	N/A	N/A
Portfolio Total⁽¹⁾	\$251,569	\$180,110	1.40	\$71,459

Note: Costs and benefits are expressed as follows PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025

⁽¹⁾ Total may not match the sum of rows due to rounding.

⁽²⁾ The Low-Income Program is shown as a subsector of residential in this table.

Table C-4. PY17 Net TRC Ratios by Program (\$1,000)

Program/Initiatives	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Non-Residential				
Custom	\$67,933	\$63,024	1.08	\$4,909
Efficient Equipment	\$65,523	\$26,812	2.44	\$38,711
Non-Residential Subtotal⁽¹⁾	\$133,456	\$89,836	1.49	\$43,620
Residential				
Low-Income	\$12,872	\$7,626	1.69	\$5,245
Appliance Recycling	\$2,651	\$3,437	0.77	(\$785)
Efficient Lighting	\$0	\$0	n/a	\$0
Energy Efficient Homes	\$18,162	\$19,054	0.95	(\$893)
Home Energy Report	\$4,218	\$3,084	1.37	\$1,134
Student Energy Efficient Education	\$6,501	\$1,249	5.21	\$5,252
Residential Subtotal^{(1),(2)}	\$44,403	\$34,450	1.29	\$9,953
Common Portfolio Costs	N/A	\$9,195	N/A	N/A
Portfolio Total⁽¹⁾	\$177,859	\$133,481	1.33	\$44,378

Note: Costs and benefits are expressed as follows PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025

⁽¹⁾ Total may not match the sum of rows due to rounding.

⁽²⁾ The Low-Income Program is shown as a subsector of residential in this table.

Table C-5 and Table C-6 summarize cost-effectiveness by program for Phase IV of Act 129. Costs and benefits are expressed in 2021 dollars.

Table C-5. Phase IV Gross TRC Ratios by Program (\$1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Non-Residential				
Custom	\$333,450	\$250,776	1.33	\$82,674
Efficient Equipment	\$338,337	\$194,969	1.74	\$143,368
Non-Residential Subtotal⁽¹⁾	\$671,787	\$445,745	1.51	\$226,043
Residential				
Low-Income	\$50,033	\$33,565	1.49	\$16,468
Appliance Recycling	\$14,879	\$10,416	1.43	\$4,463
Efficient Lighting	\$5,886	\$2,594	2.27	\$3,292
Energy Efficient Homes	\$115,832	\$100,937	1.15	\$14,895
Home Energy Report	\$3,681	\$3,119	1.18	\$562
Student Energy Efficient Education	\$30,131	\$5,509	5.47	\$24,622
Residential Subtotal^{(1),(2)}	\$220,441	\$156,139	1.41	\$64,302
Common Portfolio Costs	N/A	\$31,912	N/A	N/A
Portfolio Total⁽¹⁾	\$892,229	\$633,796	1.41	\$258,433

Note: Costs and benefits are expressed as follows PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025

⁽¹⁾ Total may not match the sum of rows due to rounding.

⁽²⁾ The Low-Income Program is shown as a subsector of residential in this table.

Table C-6. Phase IV Net TRC Ratios by Program (\$1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Non-Residential				
Custom	\$274,151	\$200,719	1.37	\$73,432
Efficient Equipment	\$291,615	\$175,271	1.66	\$116,344
Non-Residential Subtotal⁽¹⁾	\$565,767	\$375,991	1.50	\$189,776
Residential				
Low-Income	\$50,033	\$33,565	1.49	\$16,468
Appliance Recycling	\$11,058	\$10,416	1.06	\$642
Efficient Lighting	\$5,886	\$2,594	2.27	\$3,292
Energy Efficient Homes	\$94,625	\$83,117	1.14	\$11,508
Home Energy Report	\$3,681	\$3,119	1.18	\$562
Student Energy Efficient Education	\$30,131	\$5,509	5.47	\$24,622
Residential Subtotal^{(1),(2)}	\$195,414	\$138,319	1.41	\$57,095
Common Portfolio Costs	N/A	\$31,912	N/A	N/A
Portfolio Total⁽¹⁾	\$761,181	\$546,222	1.39	\$214,959

Note: Costs and benefits are expressed as follows PY13 = 2021, PY14 = 2022, PY15 = 2023, PY16 = 2024, PY17 = 2025

⁽¹⁾ Total may not match the sum of rows due to rounding.

⁽²⁾ The Low-Income Program is shown as a subsector of residential in this table.

C.3. High-Impact Measure Net-to-Gross

Findings from NTG research are not used to adjust compliance savings in Pennsylvania. Instead, NTG research provides directional information for program planning purposes.

Table C-7 presents NTG findings for high-impact research in PY17. Additionally, Cadmus conducted NTG research on the EV Pilot but did not include results as a high-impact measure.

Table C-7. PY17 High Impact Measure Net-to-Gross

High-Impact Measure	PYVTD kWh/yr	Free Ridership	Spillover	Net-to-Gross Ratio
Custom ⁽¹⁾	128,202,354	28% ⁽²⁾	0%	0.72
Total	128,202,354	28%	0%	0.72

⁽¹⁾ Estimated from PY17 survey data.

⁽²⁾ Weighted by the survey sample-verified program kWh/yr savings.

C.4. Program-Level Comparison of Performance to Approved EE&C Plan

Table C-8 presents PY17 expenditures, by program, compared to the budget estimates set forth in the EE&C plan for PY17.³⁰ All the dollars are presented in 2025 dollars.

Table C-8. Comparison of PY17 Expenditures to Phase IV EE&C Plan (\$1,000)

Program	PY17 Budget from EE&C Plan ⁽¹⁾	PY17 Actual Expenditures ⁽²⁾	Ratio (Actual/Plan)
Non-Residential	\$34,673	\$39,899	115%
Low-Income	\$7,949	\$7,626	96%
Residential	\$12,823	\$16,202	126%
Total Direct Program Costs⁽³⁾	\$55,446	\$63,727	115%
Common Portfolio Costs ⁽⁴⁾	\$8,620	\$9,195	107%
Portfolio Total⁽³⁾	\$64,066	\$72,922	114%

⁽¹⁾ Budgets are from Table 6 of the PPL Electric Utilities EE&C plan.

⁽²⁾ Expenditures may not match the sum of incentives and program costs listed in the individual program cost-effectiveness tables due to rounding.

⁽³⁾ Total may not match the sum of rows due to rounding.

⁽⁴⁾ Common costs include costs for the SWE audit.

³⁰ PPL Electric Utilities Corporation. Revised March 27, 2025. *Energy Efficiency and Conservation Plan Act 129 Phase IV*. Docket No. M-2020-3020824.

Table C-9 presents P4TD expenditures, by program, compared to the budget estimates set forth in the EE&C plan for all of Phase IV. All the dollars are presented in 2025 dollars.

Table C-9. Comparison of P4TD Expenditures to Phase IV EE&C Plan (\$1,000)

Program	Phase IV Budget from EE&C Plan ⁽¹⁾	PIVTD Actual Expenditures ⁽²⁾	Ratio (Actual/Plan)
Non-Residential	\$162,745	\$142,602	88%
Low-Income	\$41,900	\$37,351	89%
Residential	\$64,747	\$62,649	97%
Total Direct Program Costs⁽³⁾	\$269,391	\$242,602	90%
Common Portfolio Costs ⁽⁴⁾	\$43,100	\$35,497	82%
Portfolio Total⁽³⁾	\$312,491	\$278,100	89%

⁽¹⁾ Budgets are from Table 6 of the PPL Electric Utilities EE&C plan.

⁽²⁾ Expenditures may not match the sum of incentives and program costs listed in the individual program cost-effectiveness tables due to rounding.

⁽³⁾ Total may not match the sum of rows due to rounding. The total does not match the infographics because they show expenditures compared to the full Phase IV goal.

⁽⁴⁾ Common costs include costs for the SWE audit.

Table C-10 compares PY17 verified gross program savings compared to the energy savings projections set forth in the EE&C plan.

Table C-10. Comparison of PY17 Actual Program Savings to EE&C Plan Projections for PY17

Program	EE&C Plan Projections for PY17 (MWh/yr) ⁽¹⁾	PY17 VTD Gross MWh/yr Savings ⁽²⁾	Ratio (Actual/Plan)
Non-Residential ⁽³⁾	204,444	243,010	119%
Low-Income ⁽³⁾	12,773	14,524	114%
Residential ⁽³⁾	34,941	79,241	227%
Total⁽³⁾⁽⁴⁾	252,158	336,775	134%

⁽¹⁾ Projections from Table 4 of the PPL Electric Utilities EE&C plan.

⁽²⁾ Does not include PY15 or PY16 unverified savings, verified in PY17.

⁽³⁾ May not match totals in infographics due to rounding.

⁽⁴⁾ Total may not match the sum of rows due to rounding.

Table C-11 compares Phase IV actual program savings to the EE&C projections through Phase IV to date.

**Table C-11. Comparison of Phase IV Actual Program Savings to
EE&C Plan Projections for Phase IV To-Date**

Program	EE&C Plan Through PY17 ⁽¹⁾	VTD Gross MWh/yr Savings	Carryover MWh/yr	Total VTD Gross MWh/yr Savings	Ratio (Actual/Plan)
Non-Residential ⁽²⁾	1,129,833	991,939	-	991,939	88%
Low-Income ⁽²⁾	67,093	66,138	31,089	97,227	145%
Residential ⁽²⁾	179,089	261,717	-	261,717	146%
Total⁽²⁾⁽³⁾	1,376,015	1,319,793	306,275⁽⁴⁾	1,626,068⁽⁵⁾	118%

⁽¹⁾ Projections are from Table 4 of the PPL Electric Utilities EE&C plan.

⁽²⁾ May not match totals in infographics due to rounding.

⁽³⁾ Total may not match the sum of rows due to rounding. The total does not match the infographics because they show savings compared to the full Phase IV goal.

⁽⁴⁾ The sum of the carryover column will not match the total row because only 31,089 MWh/yr is attributed to a specific program. The remaining 275,186 MWh/yr is attributed to the portfolio.

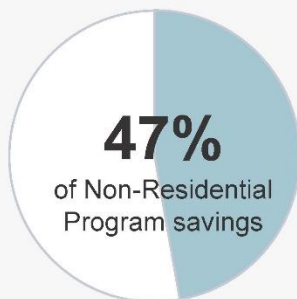
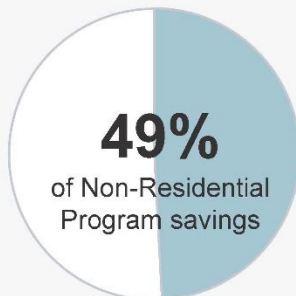
⁽⁵⁾ The sum of the Total VTD Gross Savings column will not match the total row because it includes portfolio-level carryover savings.

EFFICIENT EQUIPMENT

This component of the Non-Residential Program promotes the purchase and installation of high-efficiency equipment and lighting through four delivery channels by offering financial incentives to offset purchase costs and by providing information on efficiency features and benefits.

VERIFIED ENERGY SAVINGS

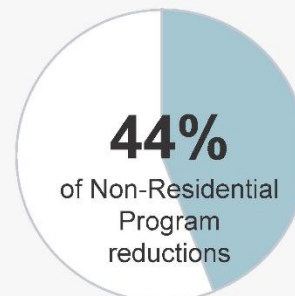
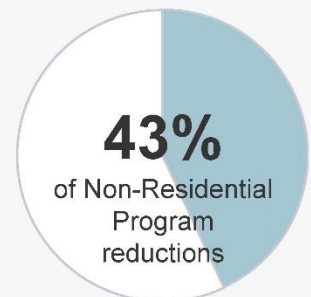
Phase IV
has saved
485,096 MWh/yr



PY17 saved
114,807 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
83.75 MW/yr



PY17 has
reductions of
21.77 MW/yr

PY17 PARTICIPATION

A total of **6,012** participants*

 **5,720**
Lighting

 **177**
HVAC

 **53**
Refrigeration

 **26**
Other

 **18**
Agriculture

 **13**
Motors

 **5**
Food Service

*Does not include incentive adjustments

PARTICIPANT SATISFACTION



Satisfied with
overall program
component

Appendix D. Evaluation Detail – Efficient Equipment

PPL Electric Utilities' Non-Residential Efficient Equipment component promotes the purchase and installation of a wide range of high-efficiency equipment, including lighting, HVAC, refrigeration, motors/drives, commercial kitchen, agricultural, equipment controls, and new construction projects.

The component offers incentives for lighting and equipment (non-lighting) through four delivery channels:

- **Downstream Rebates.** Customers, contractors, or trade allies submit applications for review and validation by the Non-Residential ICSP. The ICSP reviews and validates all submitted applications, processes eligible projects, and pays incentives upon project completion and final savings calculations.
- **Direct Discount.** This delivery channel is supported by a network of qualified contractors and higher incentives. The ICSP helps the contractor orchestrate the project from beginning to end on behalf of the customer. After the contractor completes and updates the application, the Non-Residential ICSP completes the verification and then reimburses the contractor with a check for the incentive.
- **Direct Install.** The Non-Residential ICSP targets hard-to-reach small C&I customers and provides a no-cost assessment to identify energy efficiency improvements and provide free LED bulbs and pre-rinse spray valves where needed.³¹ After the assessment, the Non-Residential ICSP sends the customer an assessment report with additional recommendations to support the customer's overall energy efficiency and peak demand needs and goals, along with recommendations for qualified trade allies.
- **Midstream.** This delivery channel helps customers choose and procure certain high-efficiency products more quickly and easily than through typical downstream methods. Trade allies and customers may purchase high-efficiency products directly from participating and qualified midstream distributors and receive an immediate rebate at the point of purchase.

Cadmus uses the term "downstream" to collectively refer to projects in the downstream, direct discount, and direct install delivery channels of the Efficient Equipment component.

D.1. Gross Impact Evaluation

D.1.1. Gross Impact Methodology and Sampling Approach

Cadmus verified savings for the Efficient Equipment component from a sample of 30 PY17 downstream lighting projects, 23 PY17 midstream lighting projects, and 16 PY17 midstream non-lighting projects.

³¹ Product installations are limited to a maximum of two pre-rinse sprayers, 50 A19 bulbs, and 24 PAR30 bulbs.

Cadmus applied PY16 realization rates to the PY17 downstream non-lighting projects shown in Table D-1. See the PY16 evaluation report for details on that evaluation approach.³²

Table D-1. Efficient Equipment Downstream Non-Lighting Component PY16 Realization Rates

Savings	Downstream HVAC Historical Realization Rate	Downstream Motors Historical Realization Rate	Downstream Refrigeration Historical Realization Rate	Downstream Other Historical Realization Rate
Energy Savings (MWh/yr)	92%	125%	122%	86%
Demand Reductions (MW/yr)	84%	100%	122%	87%

Sampling Details

Due to the timing of the evaluation, Cadmus used records from Q1, Q2, and Q3 to create samples. Cadmus reviewed the records in Q4 and determined that the sampled prescriptive lighting and non-lighting projects already had a sufficient mix to represent the population, but Q4 midstream projects were sampled due to issues with reaching customers sampled from Q1, Q2, and Q3.

Downstream, Direct Discount, Direct Install, and Midstream Non-Lighting

The Pennsylvania Technical Reference Manual (PA TRM) has established kilowatt-hour savings thresholds at the end-use category level to determine whether customer-specific information is required for estimating *ex ante* or *ex post* savings. Cadmus evaluated midstream non-lighting projects below the PA TRM threshold with a basic level of rigor in accordance with the Phase IV Evaluation Framework.³³ The Efficient Equipment component did not report midstream non-lighting projects above the defined threshold in the PA TRM in PY17.

Table D-2 summarizes the impact evaluation sampling strategy. Cadmus attempted to complete desk reviews and interviews for all Q1 through Q3 midstream non-lighting projects but completed only nine interviews due to unresponsive contacts. For projects without a completed interview, Cadmus performed a desk review and savings analysis using the provided project documentation and, if needed, reached out to implementation staff for additional information. Additionally, Cadmus attempted to complete three virtual site visits but, due to participant technology constraints and refusals, completed only two.

Cadmus verified energy savings for the overall Efficient Equipment non-lighting subcomponent at 85% confidence with $\pm 6.2\%$ precision.

³² PPL Electric Utilities. September 30, 2025. *Phase IV of Act 129 Program Year 16 Annual Report (June 1, 2024–May 31, 2025)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

³³ Pennsylvania Public Utility Commission. July 16, 2021. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc.

**Table D-2. PY17 Efficient Equipment Non-Lighting Downstream and Midstream Subcomponent
Gross Impact Evaluation Sample Design**

Stratum	Sampling Assumptions	Population Size ⁽¹⁾	Target Sample Size	Achieved Sample Size	Impact Evaluation Activity
Non-Lighting					
Downstream	N/A	N/A	N/A	N/A	Assignment of historical realization rates from PY16 results
Midstream	85/15; Cv of 0.50	21	Up to 20	16	16 desk reviews, 9 phone interviews, and 2 virtual site visits

⁽¹⁾21 projects were completed by 21 unique participants.

Downstream, Direct Discount, Direct Install, and Midstream Lighting

Lighting projects fell into three strata based on reported savings:

- More than 750 MWh per year (the lighting threshold in the PA TRM)
- 120 to 750 MWh per year
- Less than 120 MWh per year

Cadmus selected a stratified random sample of projects from Q1, Q2, and Q3 in PY17 for all downstream strata and a random sample of projects from Q1, Q2, Q3, and Q4 for all midstream lighting strata, evaluating lighting projects below the PA TRM threshold with basic rigor and those at or above the threshold with enhanced rigor. Table D-3 summarizes the impact evaluation sampling strategy. Cadmus attempted outreach to each site for an interview, site visit, or virtual site visit, targeting threshold projects for site visits and virtual site visits, and all non-threshold projects for interviews. The gross impact evaluation activities resulted in verified energy savings estimates for the Efficient Equipment lighting subcomponent at 85% confidence with $\pm 16.7\%$ precision.

**Table D-3. PY17 Efficient Equipment Lighting Subcomponent
Gross Impact Evaluation Sample Design**

Stratum	Sampling Assumptions	Population Size	Target Sample Size	Achieved Sample Size	Impact Evaluation Activity
Lighting					
Downstream threshold (>750 MWh/yr) ⁽¹⁾	90/10	3	Census	3	Enhanced Rigor: reviewed invoices, tech specs, rebate form, and <i>ex ante</i> documentation, conducted logger analysis 0 interviews, 1 in-person site visits, 0 virtual site visits, 3 logger analysis
Downstream (120-750 MWh/yr) ⁽¹⁾		32	Up to 13	13	Basic Rigor: reviewed invoices, tech specs, rebate form, and <i>ex ante</i> documentation, optional interviews 7 interviews, 0 in-person site visits, 0 virtual site visits, 0 logger analysis
Downstream (<120 MWh/yr) ⁽¹⁾		421	Up to 13	14	Basic Rigor: reviewed invoices, tech specs, rebate form, and <i>ex ante</i> documentation. 9 interviews, 0 in-person site visits, 0 virtual site visits, 0 logger analysis
Midstream ⁽²⁾		5,264	23	23	Basic Rigor: Conducted engineering analysis, reviewed invoices and tech specs, and conducted interviews. 23 interviews, 0 in-person site visits, 0 virtual site visits, 0 logger analysis

⁽¹⁾ Assuming a Cv of 0.35 based on historical findings from Phase III.

⁽²⁾ Assuming a Cv of 0.50.

Cadmus calculated annual sample sizes for the Efficient Equipment component to meet the Phase IV Evaluation Framework evaluation requirements of 85% confidence and $\pm 15\%$ precision. However, the sampling plan for the lighting subcomponent was designed to achieve 90% confidence, and $\pm 10\%$ precision (90/10) as lighting is a high-impact measure contributing 39% of reported energy savings and 42% of reported demand reductions to the Non-Residential Program.

Ex Post Verified Savings Methodology

Midstream Non-Lighting

Cadmus conducted desk reviews for all PY17 Q1-3 Midstream Non-Lighting projects to verify savings calculations, confirm quantities, equipment specifications, eligibility, and operating conditions. Cadmus reviewed all relevant project documentation, including invoices, specification sheets, and calculation inputs, to evaluate project savings. Interviews were conducted with all responsive Q1-3 participants, and virtual verification site visits were conducted for a sample of projects to verify installed equipment and operating conditions. Cadmus used findings from these activities to calculate energy savings and demand reduction changes.

Downstream, Direct Discount, and Direct Install Lighting

Cadmus verified savings calculations, incorporated quantity and eligibility confirmation, and adjusted *ex ante* assumptions of lighting equipment specifications and operating conditions for the sample of projects selected for desk reviews and virtual site visits. Cadmus reviewed all relevant project documentation, including invoices, specification sheets, lighting plans, and implementer's files for the PA TRM's Appendix C Lighting Audit and Design Tool for Commercial and Industrial Projects to evaluate savings.³⁴ For threshold projects, lighting logger data analysis verified hours of use and coincidence factors.

Cadmus reached out to each customer by phone and email, aiming to complete in-person or virtual site visits for threshold projects and phone interviews for non-threshold projects. PPL Electric Utilities account managers assisted with outreach by attempting contact with each customer, informing them of the upcoming evaluation, and providing Cadmus with updated points of contact and best times to reach out. Cadmus completed one in-person site visit and 16 interviews to verify fixture quantities, installation, controls, hours of use, and HVAC equipment. Using the verified parameters, Cadmus adjusted any inputs that may have changed or been incorrectly implemented in the reported savings. Fixture wattages were the most adjusted parameter, with roughly half the sites receiving at least one adjustment.

Midstream Lighting

Cadmus verified savings calculations, incorporated quantity and eligibility confirmation, and adjusted *ex ante* assumptions of lighting equipment specifications and operating conditions for the sample of projects selected for desk reviews and phone interviews. Cadmus reviewed customer invoices and the technical specifications for the reported installed equipment and verified these using the Design Lighting Consortium (DLC) or ENERGY STAR Qualified Products Lists. These reviews also confirmed the correct application of the baseline and efficient lighting pairing using the midstream lighting protocol in the PA TRM and verified the hours of use for the building type based on interview responses.

Cadmus interviewed either the customer or the contractor who purchased and installed the rebated equipment for the customer. Interviews with customers or contractors verified familiarity with the purchase and the installed location, confirmed reported lighting quantities, building type, hours of use, and space-conditioning system against PPL Electric Utilities' tracking database, and gathered information regarding the *in situ* baseline fixtures and lamps. Cadmus used this information to refine savings calculations by correcting errors and replacing TRM default assumptions as needed.

D.1.2. Gross Impact Results

Cadmus calculated realization rates for non-lighting and lighting strata by dividing total evaluated savings by total reported savings for the sampled projects. To determine gross verified savings, Cadmus

³⁴ The PA TRM Appendix C Lighting Audit & Design Tool documents the pre- and post-installation cases of the lighting retrofit to facilitate the calculation of energy and demand reductions for large lighting installations.

multiplied the reported savings of each project by the evaluated realization rate for the appropriate stratum and summed the results.

Table D-4 shows the verified gross energy savings and demand reductions for the Efficient Equipment component.

Table D-4. Efficient Equipment Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified	PY17 Verified	Phase IV Verified ⁽¹⁾
MWh/yr	89,330	115,100	81,131	84,727	114,807	485,096
System-Level MW/yr	14.28	18.78	12.68	16.23	21.77	83.75

⁽¹⁾ Phase IV verified savings may not match the sum of program years due to rounding.

In PY17, PPL Electric Utilities reported energy savings of 92,857 MWh per year (Table D-5) and demand reductions of 21.01 MW per year (Table D-6) for the Efficient Equipment component.

Table D-5. PY17 Efficient Equipment Component Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Non-Lighting Subcomponent					
Downstream HVAC	2,752	92%	0.04	2.7%	2,525
Downstream Motors	559	125%	0.66	41.2%	701
Downstream Other ⁽²⁾	499	86%	0.04	2.9%	429
Downstream Refrigeration	561	122%	0.15	13.7%	683
Midstream Agriculture Equipment	545	103%	0.06	1.4%	559
Midstream Food Service Equipment	116	95%	0.24	10.5%	111
Non-Lighting Total^{(3), (4)}	5,031	100%	0.20	4.8%	5,009
Lighting Subcomponent					
Downstream Threshold (>750 MWh/yr)	6,525	95%	0.00	0.0%	6,186
Downstream (120-750 MWh/yr)	8,139	99%	0.04	1.3%	8,093
Downstream (< 120 MWh/yr)	13,403	118%	0.53	21.1%	15,780
Midstream Lighting	59,759	133%	0.74	23.0%	79,739
Lighting Total^{(3), (4)}	87,826	125%	1.00	16.7%	109,798
Component Total^{(3), (4)}	92,857	124%	1.10	15.8%	114,807

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ The Other stratum includes measures such as automatic milker takeoffs (1 job), convection ovens (2 jobs), hot food holding cabinet (8 jobs), electric steam cookers (1 job), ice machines (1 job), ventilation fan (1 job) high-efficiency battery chargers (9 jobs), dishwashers (10 jobs), and heat pump water heaters (1 job).

⁽³⁾ Savings may not match other tables or figures due to rounding.

⁽⁴⁾ Totals may not sum due to rounding.

Table D-6. PY17 Efficient Equipment Component Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr) ⁽²⁾	System Level PYVTD (MW/yr)
Non-Lighting Subcomponent						
Downstream HVAC	0.67	84%	0.27	18.5%	0.56	0.60
Downstream Motors	0.08	100%	0.00	0.0%	0.08	0.09
Downstream Other ⁽³⁾	0.03	87%	0.05	4.9%	0.02	0.02
Downstream Refrigeration	0.08	122%	0.15	13.8%	0.10	0.11
Midstream Agriculture Equipment	0.22	102%	0.06	1.3%	0.22	0.24
Midstream Food Service Equipment	0.02	92%	0.25	10.6%	0.02	0.02
Non-Lighting Total^{(4), (5)}	1.09	92%	0.36	9.0%	1.00	1.08
Lighting Subcomponent						
Downstream Threshold (>750 MWh/yr)	0.79	94%	0.00	0.0%	0.74	0.79
Downstream (120-750 MWh/yr)	1.23	99%	0.02	0.6%	1.22	1.30
Downstream (< 120 MWh/yr)	2.21	121%	0.57	22.8%	2.68	2.89
Midstream Lighting	15.69	93%	0.36	11.2%	14.58	15.70
Lighting Total^{(4), (5)}	19.92	97%	0.45	8.8%	19.22	20.68
Component Total^{(4), (5)}	21.01	96%	0.53	8.4%	20.23	21.77

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

Cadmus applied realization rates to verified demand reductions before application of distribution losses.

⁽²⁾ PYVTD in this column represents meter-level savings before the application of line losses.

⁽³⁾ The Other stratum includes measures such as automatic milker takeoffs (1 job), convection ovens (2 jobs), hot food holding cabinet (8 jobs), electric steam cookers (1 job), ice machines (1 job), ventilation fan (1 job) high-efficiency battery chargers (9 jobs), dishwashers (10 jobs), and heat pump water heaters (1 job).

⁽⁴⁾ Savings may not match other tables or figures due to rounding.

⁽⁵⁾ Total may not sum due to rounding.

Realization Rate Findings

The following factors led to variation between the reported and verified energy savings and demand reductions, as well as the observed realization rates.

Midstream Non-Lighting

Cadmus made adjustments to agriculture and food service projects. The resulting energy savings realization rates were 103% for agriculture and 95% for food service. Demand reduction realization rates were 102% for agriculture and 92% for food service.

- **Agriculture stratum projects.** Cadmus corrected inputs for the fan size for two evaluated high-volume, low-speed fan projects based on a review of project documentation, interviews, and a virtual verification site visit. For the first project, tracking data listed three 16' fans; however, the invoice and interview confirmed the actual installed fans include two 16' fans and one 21' fan. For the second project, tracking data listed two fans in the >=20' and <24' range; however, the invoice indicated fans are 24', so >=24' is the correct designation.

CADMUS

- **Food service stratum projects.** Cadmus adjusted the installed idle steam and convection energy rates used in the calculations for two evaluated combination oven projects from kilowatts to watts per the IMP methodology. Cadmus also identified a savings calculation discrepancy in a dishwasher project. The discrepancy was a result of an incorrect input or calculation error. Cadmus requested additional details to identify the exact calculation discrepancy; however, the input file that was provided did not include all the relevant data necessary to do so.

Downstream and Midstream Lighting

Cadmus most frequently adjusted the fixture wattages, followed by hours of use and controls, in the reported energy savings and demand reduction estimates. These adjustments contributed to realization rates of 125% for energy savings and 97% for demand reduction. Many fixture wattage updates involved minor changes due to rounding and alignment with DLC listings.

- **Downstream threshold stratum projects.** Cadmus adjusted hours of use based on findings from the logger data analysis.
- **Downstream non-threshold stratum projects.** Cadmus adjusted hours of use and coincidence factors as needed, based on facility type determined through the desk review or site contact interviews.
- **Midstream stratum projects.** After the adjustments to controls and space conditioning, Cadmus most frequently updated hours of use and coincidence factors. There were a few projects where quantities and wattages were adjusted.

Site Visit and Desk Review Findings

Midstream Non-Lighting

Cadmus evaluated all 16 Q1-3 equipment projects from the non-lighting midstream channel in the PY17 gross impact evaluation. For each project, completed desk reviews verified as-built conditions and identified discrepancies in the reported savings inputs. Interviews with all responsive Q1-3 participants (nine), and virtual verification site visits for two projects verified installed equipment and operating conditions. Cadmus incorporated site-specific data into the verified savings. The most significant adjustments to reported savings included corrections to the following:

- High-volume low-speed fan size (agriculture)
- Idle steam and convection energy rate input units for combination ovens (food service)

Downstream Lighting

Cadmus conducted desk reviews for 30 downstream lighting projects in the impact evaluation sample to verify as-built conditions for each project and identify any discrepancies in inputs and savings. For five threshold lighting projects in the sample, Cadmus analyzed logger data collected by the ICSP and calculated hours of use and coincidence factors. Cadmus then used these results to determine the verified savings for each sampled project.

CADMUS

To verify downstream lighting savings, Cadmus conducted 30 desk reviews. Of these, 16 also included interviews, and one received an in-person site visit. Verified savings incorporated site- and equipment-specific data. Cadmus made adjustments to the following:

- Annual lighting hours of use calculated from metered logger data
- Fixture type and quantity
- Lighting control type
- Space cooling type
- Heating fuel type
- Fixture wattage
- Facility type

Cadmus most frequently adjusted reported lighting fixture or lamp wattage (14 of the 30 sampled projects), using DLC or ENERGY STAR data for evaluated savings. Cadmus also adjusted lighting controls in seven of the sampled projects where documentation did not support the fixtures reported as having controls. Additional adjustments involved quantities based on invoices and hours of use from the TRM. For three projects, Cadmus also adjusted metered hours of use when reported hours of use relied on a custom schedule (rather than directly referencing metered data) or misinterpreted metered data.

Midstream Lighting

In PY17, Cadmus conducted desk reviews and phone interviews to verify savings for the sample of 23 midstream lighting projects in PPL Electric Utilities' tracking database. The reviews resulted in adjusted calculation inputs to reported savings that differed from verified conditions, as summarized in Table D-7. Since projects could involve multiple adjustments, the total number of adjustments is greater than the sample size.

**Table D-7. PY17 Efficient Equipment Midstream Lighting Channel
Verified Savings Adjustments Summary**

Savings Adjustment Type	Number of Adjusted Projects	Percentage of Adjusted Projects ⁽¹⁾	Primary Reason for Adjustment
Facility Type	17	74%	For the midstream lighting program, hours of use, coincidence factors, and control types are assumed by the TRM. Cadmus interviewed each site to more accurately assign these values and calculate savings.
Fixture Control Type	23	100%	
Hours of Use ⁽²⁾	18	78%	
Coincidence Factor ⁽²⁾	15	65%	
Energy Interactive Factor	22	96%	
Demand Interactive Factor	22	96%	
Post-Install Lamp/Fixture Wattage	6	26%	
Post-Install Lamp/Fixture Quantity	4	17%	
Pre-Install Lamp/Fixture Quantity	4	17%	
Ineligible Fixture	0	0%	

⁽¹⁾ Cadmus calculated the percentage of adjusted projects based on 23 verified sample projects.

⁽²⁾ Hours of use and coincidence factor have more adjustments than facility type because some reported facility types were correct, but Cadmus used interview responses to more accurately calculate these inputs rather than using TRM defaults. There are fewer coincidence factor adjustments than hours of use adjustments because sometimes, when the facility type is changed, the coincidence factor for the reported and evaluated facility types is equivalent.

D.2. Net Impact Evaluation

Net Impact Methodology

Cadmus applied the methods in the PA PUC’s Evaluation Framework to estimate net savings for downstream, upstream, and midstream delivery channels.³⁵ The framework discusses the standard methods for determining free ridership and spillover. Cadmus did not conduct new primary research to assess net savings in PY17, but instead, used historical NTG ratios. Additional methodological details for each section can be found in the PY14 Annual Report for downstream equipment and in the PY15 Annual Report for midstream equipment.^{36, 37} Cadmus calculated net savings to inform future planning of the Efficient Equipment component. Energy savings and demand reduction compliance targets are met using verified gross savings.

D.2.1. Net-to-Gross Results

Table D-8 shows the NTG ratio results for the strata of the Efficient Equipment component.

Table D-8. PY17 Efficient Equipment Component NTG Ratio Summary by Stratum

Stratum	PYVTD kWh/yr	Evaluation Years	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision
Downstream, Direct Discount, Direct Install Lighting	30,059,733	PY14	35% ⁽¹⁾	0%	0.65	10% ⁽²⁾
Downstream, Direct Discount, Direct Install Non-Lighting	4,338,665	PY14	84% ⁽¹⁾	0%	0.16	84% ⁽³⁾
Midstream Lighting	79,738,741	PY15	30% ⁽¹⁾	0%	0.70	10% ⁽³⁾
Midstream Non-Lighting	670,192	PY15 Benchmarking	7%	0%	0.93 ⁽⁴⁾	-
Component Total ^{(4) (5)}	114,807,331	-	33%	0%	0.67	-

⁽¹⁾ Cadmus weighted the free ridership by the verified kWh/yr savings to ensure respondents who achieved higher savings through the component had greater influence on the stratum-level free ridership estimate than those with lower savings.

⁽²⁾ At 90% confidence interval.

⁽³⁾ At 85% confidence interval.

⁽⁴⁾ Midstream agriculture NTG ratio is 0.95, and midstream food service is 0.81.

⁽⁵⁾ Cadmus weighted stratum-level free ridership, spillover, and NTG estimates by each stratum’s verified kWh/yr component population savings to arrive at the Efficient Equipment component NTG ratio of 0.67.

⁽⁶⁾ Totals may not sum due to rounding.

³⁵ PA PUC. Final version July 16, 2021. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Demand Side Analytics, Brightline Group, and Optimal Energy.

³⁶ PPL Electric Utilities. November 15, 2023. *Phase IV of Act 129 Program Year 14 Annual Report (June 1, 2022–May 31, 2023)*. Presented to Pennsylvania Public Utility Commission. Prepared by Cadmus.
<https://www.puc.pa.gov/pdocs/1800780.pdf>

³⁷ PPL Electric Utilities. November 15, 2024. *Phase IV of Act 129 Program Year 15 Annual Report (June 1, 2023–May 31, 2024)*. Presented to Pennsylvania Public Utility Commission. Prepared by Cadmus.
<https://www.puc.pa.gov/pdocs/1851143.pdf>

D.3. Process Evaluation

Process activities in PY17 were generally consistent with planned activities, with one exception. At the request of PPL Electric Utilities, Cadmus conducted an additional online survey to measure customer satisfaction among participants. The results from these surveys are included in the Process Evaluation findings in this appendix, along with the overall Non-Residential Program satisfaction score found in Section 5.6.1. *Process Evaluation Key Findings* of this report.

The survey asked participants about their project outcomes, satisfaction with the program, and overall satisfaction with PPL Electric Utilities. Between April 2026 and June 2026, Cadmus made several attempts to reach participants through email invitations, concurrent with a round of telephone calls. Eleven participants responded to the survey fully, and one respondent provided a partial response. See *Appendix L* for details about Cadmus' approach to reducing survey bias and contact instructions.

Sample sizes noted in this report may vary by survey question because respondents could skip questions they preferred not to answer. As a result, not all respondents answered every question. Cadmus included all survey respondents who answered at least one question, even if they did not complete the survey.

Table D-9 lists the process evaluation sampling strategy.

Table D-9. Efficient Equipment Component Process Evaluation Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size ⁽¹⁾	Assumed Cv in Sample Design	Target Sample Size	Achieved Sample Size	Sample Frame ⁽²⁾	Percent Contacted ⁽³⁾
Downstream, direct discount	Participants	Online survey/Phone survey	563	N/A	All eligible	12	196	100%
Total			563	-	-	12	196	100%

⁽¹⁾ Population size includes the number of unique records available at the time of the survey or interview.

⁽²⁾ The sample frame is a list of participants with contact information who have a chance to complete the survey or interview. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the surveys and interviews. After selecting all unique records, Cadmus removed any records from the population if the customer had participated in a survey in the last three months, had been selected for another survey, did not have valid contact information (email or telephone number), participated in an impact interview, was a residential customer, was on PPL Electric Utilities' "do not call" list, or opted out of the online survey in a previous survey instance.

⁽³⁾ Percent contacted means the percentage of the sample frame contacted to complete surveys and interviews.

D.3.1. Downstream, Direct Install, and Direct Discount

Program Component Experience

The survey asked downstream and direct discount participants a series of questions to assess their satisfaction with the program they participated in and with PPL Electric Utilities as an energy provider, the

factors that impacted their satisfaction, and the outcomes of their most recent energy efficiency initiative. Respondents also rated how well the program met their expectations.

Program Component Satisfaction

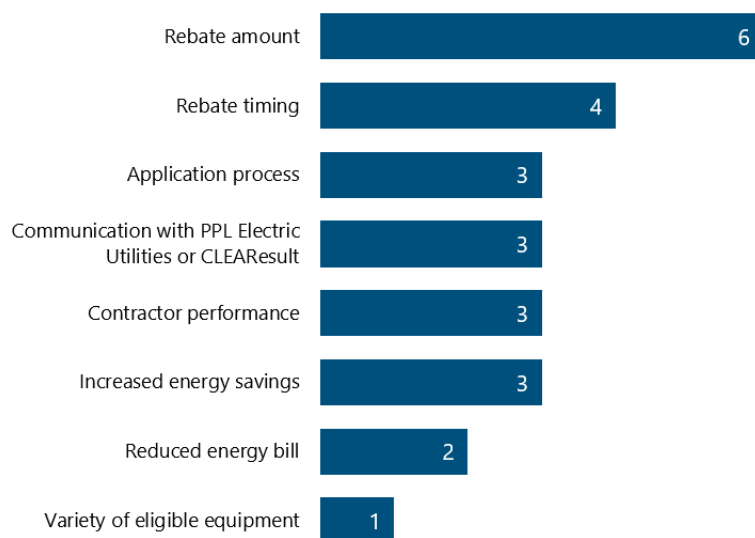
Of the 12 survey respondents who answered the satisfaction question, 83% (10 respondents) were satisfied with the Efficient Equipment component. Seven respondents were *very satisfied*, and three were *somewhat satisfied* with the program overall.³⁸

Drivers of Program Component Satisfaction

To better understand what drives satisfaction, the survey asked participants what factor(s) most affected their satisfaction rating. Figure D-1 details the factors that most affected the overall experience rating reported by respondents who rated their satisfaction as *very* or *somewhat satisfied*. The most common drivers of high satisfaction were rebate amount (six of 10 *satisfied* respondents), and the rebate timing (four respondents), although increased energy savings, the application process, communication with PPL Electric Utilities or CLEAResult, and contractor performance were also mentioned often (three respondents each).

Two respondents were not satisfied with the program. The respondent who was *not too satisfied* with the program cited the rebate amount and lack of variety of eligible equipment; the other was *neither satisfied nor dissatisfied* with the program because of the energy savings achieved.

Figure D-1. Efficient Equipment Component Drivers of Satisfaction



Source. Survey question: "What are the two most important factor(s) that most affected the overall experience rating you gave?" (Multiple responses allowed; satisfied respondents only; n=10)

³⁸ One respondent was *neither satisfied nor dissatisfied*, and one was *not too satisfied*, with the program overall, totaling 17% of survey respondents (two of 12).

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Opinion of PPL Electric Utilities

The two survey respondents who were less than satisfied with their program experience were asked if this affected their opinion of PPL Electric Utilities. One said their opinion of PPL Electric Utilities *decreased somewhat*, explaining that the new construction incentives were too low. The other said they didn't know if their opinion of PPL Electric Utilities had changed.

D.3.2. Improvement Suggestions

When asked for one thing PPL Electric Utilities could change to improve the Efficient Equipment component, four respondents offered suggestions. Three respondents reported difficulty with documentation and the application process, calling it "confusing," requesting "more clarity," and having to make "multiple calls" to complete the process. The other respondent said the rebates should be increased and that more equipment types should be rebated through the program.

D.3.3. Program Successes

Respondents were asked what worked particularly well with the Efficient Equipment component of the program, and seven respondents provided feedback. Five of the seven respondents provided positive comments on different service providers related to the program, including staff from PPL Electric Utilities and the ICSP. The respondent who provided feedback on their contractor was especially effusive in their praise, stating: "The contractor was very responsive throughout the project, promptly answering questions and addressing any concerns that arose. Any issues we encountered were resolved quickly and professionally. Their communication, attention to detail, and commitment to customer satisfaction contributed to a very positive experience." The other two respondents appreciated the ease and convenience of the program, with one specifically noting that the application could be completed entirely online.

Participant Survey Attrition

Table D-10 lists the total number of records contacted for the survey via online and telephone attempts and the outcome (final disposition) of each record. Additional details on Cadmus' survey methodology are provided in *Appendix L*.

Table D-10. Efficient Equipment Downstream Participant Sample Attrition

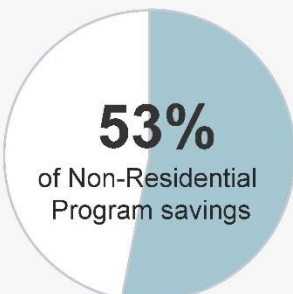
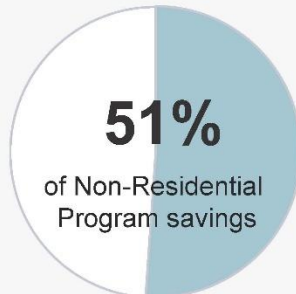
Description of Outcomes of Online and Telephone Participant Survey	Number of Records
Population (number of unique jobs)	563
Removed: inactive customer, residential sector, completed survey in past three months, on "opt out" list, selected for a different survey, duplicate contact, on "do not contact" list, or did not have accurate contact information	367
Survey Sample Frame	196
Not reached, left a message, or did not respond	157
Refused, opted out, bounce back, ineligible	27
Completed Surveys	12
Overall Response Rate	6%

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This component of the Non-Residential Program offers financial incentives to customers who install equipment that is not offered elsewhere in PPL Electric Utilities' Non-Residential Program.

VERIFIED ENERGY SAVINGS

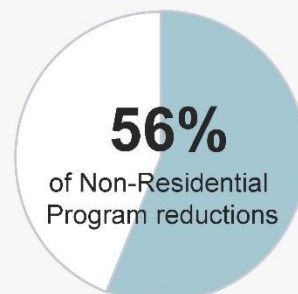
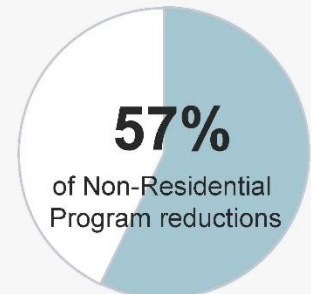
Phase IV
has saved
506,843 MWh/yr



PY17 saved
128,202 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
112.78 MW/yr



PY17 has
reductions of
27.27 MW/yr

PY17 PARTICIPATION

A total of **278** projects*

 **82**
Process

 **76**
Photovoltaic

 **39**
HVAC

 **36**
Compressed Air

 **14**
Refrigeration

 **13**
Agriculture

 **13**
Motors

 **5**
Combined Heating
and Power (CHP)

*Does not include incentive adjustments

PARTICIPANT SATISFACTION



Satisfied with overall
program component

Appendix E. Evaluation Detail – Custom Component

Through the Custom component, PPL Electric Utilities offers incentives to support the completion of complex and comprehensive projects that involve improvements not covered by the Efficient Equipment component. These improvements include operational process improvements, retro-commissioning, equipment optimization, combined heat and power (CHP), solar, advanced lighting controls, compressed air, and other custom improvements.

PPL Electric Utilities' Custom component is offered through a downstream delivery channel. The Non-Residential Implementation Contractor Service Provider (ICSP), CLEAResult, collaborates with customers and trade allies to identify and qualify custom projects. Customers or trade allies submit applications for review. The ICSP processes eligible projects and pays incentives upon project completion and final savings review.

A PY17 participant is defined as a project that was commercially operable between June 1, 2025, and May 31, 2026, and subsequently received an incentive payment.³⁹ An individual customer may have multiple participating projects. In PY17, there were 278⁴⁰ projects representing 263 unique customers.

E.1. Gross Impact Evaluation

E.1.1. Gross Impact Methodology and Sampling Approach

Cadmus evaluated all large and CHP stratum projects, verifying savings at a high level of rigor and using approaches described in the International Performance Measurement and Verification Protocol (IPMVP). Cadmus applied historical realization rates from the PY16 evaluation for small stratum projects to the PY17 reported savings (Table E-1).⁴¹ A discussion of the approach, by stratum, follows:

- **Large stratum.** Projects with expected energy savings greater than 2 million kWh/yr are assigned to the large stratum. Solar PV projects were included if their expected energy savings exceeded 1 million kWh/yr. In PY17, Cadmus verified savings for 18 large stratum projects.⁴² This includes one large project that was left unverified in PY16 and was verified in PY17.

³⁹ As defined by the Phase IV Evaluation Framework, savings claimed by an electric distribution company (EDC) are determined by the date the equipment is "installed and energized." Equipment that is installed and not commissioned or is not operating as intended is not considered commercially operable.

⁴⁰ This quantity does not include incentive adjustments associated with projects. The total quantity of projects with incentive adjustments included is 295.

⁴¹ PPL Electric Utilities. September 30, 2025. *Phase IV of Act 129 Program Year 16 Annual Report (June 1, 2024–May 31, 2025)*. Presented to the Pennsylvania Public Utility Commission. Prepared by Cadmus.

⁴² Eleven non-solar projects (five CHP stratum, six large stratum) were verified in PY17. One of these large stratum non-solar projects had verified savings of less than 1 million kWh/yr but was included in the large stratum because the expected savings exceeded 2 million kWh/yr.

- **CHP stratum.** All CHP projects were assigned to this stratum. In PY17, five CHP projects were verified.
- **Small stratum.** For all small stratum projects, Cadmus applied a historical realization rate from the PY16 evaluation report to reported PY17 energy savings and demand reductions (Table E-1). See the PY16 evaluation report for details on the PY16 evaluation approach.⁴³

Table E-1. Custom Component Historical Realization Rates

Savings	Small
Energy Savings (MWh/yr)	87%
Demand Reductions (MW/yr)	93%

Table E-2 summarizes the impact evaluation sampling strategy.

Table E-2. PY17 Custom Component Gross Impact Evaluation Sample Design

Stratum	Sampling Assumptions	Target Sample Size	Achieved Sample Size	Impact Evaluation Activity
Large	Census	18	18 ⁽¹⁾	Visual verification of improvement and site-specific conditions; M&V, including metering (in most cases); use of EMS or SCADA data
CHP	Census	5	5	

⁽¹⁾ Cadmus evaluated seven projects in the large stratum with expected savings over two million kWh/yr (six non-solar and one solar) and 11 solar projects with expected savings above 1 million kWh/yr. One of these projects was a project left unverified from PY16.

To calculate *ex post* savings with verified savings, Cadmus applied the sample-derived realization rate for each stratum to the respective population savings and then summed *ex post* and *ex ante* kWh savings across strata to calculate component-level realization rates and savings. Cadmus reported peak demand reductions (kW/yr) using the same approach.

E.1.2. Gross Impact Results

Table E-3 shows the Custom component's verified gross energy savings and demand reductions.

Table E-3. Custom Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified ⁽¹⁾	PY17 Verified	Phase IV Verified ⁽²⁾
MWh/yr	40,503	95,307	91,254	151,577	128,202	506,843
System-Level MW/yr	6.98	17.87	21.28	39.38	27.27	112.78

⁽¹⁾ PY16 verified savings include 1,317 MWh/yr savings and 0.42 system-level MW/yr demand reductions that were verified during the PY17 evaluation.

⁽²⁾ Phase IV verified savings may not match the sum of program years due to rounding.

⁴³ PPL Electric Utilities. September 30, 2025. *Phase IV of Act 129 Program Year 16 Annual Report (June 1, 2024–May 31, 2025)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

In PY17, PPL Electric Utilities reported 134,796 MWh/yr gross energy savings (Table E-4) and 26.39 MW/yr in demand reductions (Table E-5).

Table E-4. PY17 Custom Component Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Large	55,864	100%	0.00	0.0%	55,864
CHP	29,283	100%	0.00	0.0%	29,212
Small	49,649	87%	0.17	9.6%	43,127
Subtotal⁽²⁾	134,796	95%	0.11	2.9%	128,202
Component Total⁽²⁾	134,796	95%	0.11	2.9%	128,202
PY16 Large verified in PY17	1,317	100%	0.00	0.0%	1,317

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

Table E-5. Custom Component Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System-Level PYVTD (MW/yr)
Large	12.28	100%	0.00	0.0%	12.04	12.74
CHP	3.31	98%	0.00	0.0%	3.25	3.50
Small	11.05	93%	0.34	19.2%	10.31	11.03
Subtotal⁽²⁾	26.39	97%	0.27	6.9%	25.60	27.27
Component Total⁽²⁾	26.39	97%	0.27	6.9%	25.60	27.27
PY16 Large verified in PY17	0.39	100%	0.00	0.0%	0.39	0.42

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings. Cadmus applied realization rates to verified demand reductions before applying distribution losses.

⁽²⁾ Total may not match the sum of rows due to rounding.

Large and CHP Stratum Projects

The following factors led to variation between reported and verified energy savings and demand reductions and to the observed realization rates:

- For one CHP project, the ICSP reported the incorrect kW value, higher than the value listed in the final M&V report, which resulted in a demand realization rate of 92%.
- For another CHP project, the analysis was based on more than a year of actual CHP output data. The ICSP reported savings using this approach. However, the SWE determined that the results should be normalized to typical weather conditions based on their interpretation of the PA 2021 TRM. Hence, Cadmus created regressions for the electric and gas impacts and applied these to TMY3 weather data. This resulted in an energy realization rate of 104% and demand reduction realization rate of 102%.

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- For a third CHP project, Cadmus analyzed the microturbine output and estimated annual output by modeling the output as constant in outside air temperatures below 70°F and dependent on outdoor air temperatures above 70°F. The ICSP reported savings using this approach. The SWE determined that 50°F was a better inflection point for the regression. Cadmus updated the regression accordingly. The SWE used the revised regression to issue the Verified Savings Audit Report (VSAR). This resulted in an energy realization rate of 99% and a demand reduction realization rate of 97%.

E.2. Net Impact Evaluation

E.2.1. Net Impact Methodology

Cadmus used the methods outlined in the Evaluation Framework to determine net savings,⁴⁴ which includes the common methods for determining free ridership and spillover for downstream delivery channels. Cadmus used a self-report survey, administered online and by telephone, to assess free ridership and spillover for the Custom component.

Cadmus calculated net savings to inform future component planning. Energy savings and demand reduction compliance targets are met using verified gross savings.

Table E-6 lists the methods and sampling strategy used to determine net savings for the Custom component in PY17. Cadmus conducted the survey from April to June 2026 and received responses from eight of 140 Custom component participants.

Table E-6. Custom Component Net Impact Evaluation Sample Design

Stratum	Stratum Boundaries	Population ⁽¹⁾	Achieved Sample Size	Response Rate ⁽²⁾	NTG Activity
Custom	Participants	140	8	6%	Self-report survey

⁽¹⁾ Population size includes the number of unique records available at the time of the survey field period.

⁽²⁾ Cadmus calculated the response rate as the number of respondents who answered the free ridership questions (n=8) divided by the number of records in the population. The attrition table reports the response rate differently.

⁴⁴ PA PUC. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

E.2.2. Net-to-Gross Results

Table E-7 shows the free ridership, spillover, and NTG ratio for the Custom component. The survey respondents represented 4% of the PY17 Custom component verified gross population savings. Free ridership was 28%, weighted by the verified gross savings of the projects they completed. One project estimated at 0% free ridership represented 46% of the verified gross savings in the Custom subcomponent analysis sample. One respondent had a large stratum project, one had a CHP stratum project, and six had small stratum projects. No respondents reported any attributable spillover activity as a result of their participation.

Table E-7. PY17 Custom Component NTG Ratio Summary

Stratum	PYVTD kWh/yr	Evaluation Years	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (at 90% CL)
All	128,202,354	PY17	28%	0%	72%	44% ⁽¹⁾

⁽¹⁾ At 90% confidence interval.

Table E-8 shows PY17 Custom component free ridership by stratum. The weighted average free ridership for small stratum projects was 56%, and these surveyed projects represented 26% of the analysis sample verified savings. The overall component free ridership estimate of 28% was heavily weighted toward the CHP stratum free ridership of 0%, as the CHP stratum respondent represented 46% of verified savings in the overall Custom analysis sample.

Table E-8. PY17 Custom Component Free Ridership Comparison by Stratum

Stratum	n	Free Ridership (%) ⁽¹⁾	Percentage of Analysis Sample Verified Savings	Percentage of Component Population Stratum Verified Savings	Relative Precision at 85% C.L.
Custom – Large	1	51%	28%	3%	-
Custom – CHP	1	0%	46%	9%	-
Custom – Small	6	56%	26%	3%	29%
Component Total	8	28%	100%	4%	37%

⁽¹⁾ Weighted by verified kWh/yr savings.

E.3. Process Evaluation

The process evaluation activities were consistent with the approved evaluation plan.

The results from the participant surveys are included in the Process Evaluation findings in this appendix, along with the overall Non-Residential Program section 5.6.1. *Process Evaluation Key Findings* of this report.

The survey asked participants about their satisfaction with the component, the outcome of their projects, and with PPL Electric Utilities overall. From April 2026 through June 2026, Cadmus made several attempts to reach participants through email invitations concurrent with a round of telephone calls following initial

outreach. Eight participants responded to the survey. See *Appendix L* for details about Cadmus' approach to reducing survey bias and contact instructions.

Sample sizes noted in this report may vary by survey question because respondents could skip questions they chose not to answer; therefore, not all respondents answered every question. Cadmus included all survey respondents who answered at least one question, even if they did not complete the survey.

Table E-9 lists the participant survey sampling strategy.

Table E-9. PY17 Custom Component Participant Survey Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size	Assumed Proportion or Cv in Sample Design	Target Sample Size	Achieved Sample Size	Records in Sample Frame	Percent of Sample Frame Contacted to Achieve Sample ⁽¹⁾
Custom	Participants	Online and phone survey	140 ⁽²⁾	N/A	All eligible	8 ⁽³⁾	84 ⁽⁴⁾	100%
Component Total			140	-	-	8	84	100%

⁽¹⁾ Percent contacted means the percentage of the sample frame contacted to complete surveys and interviews.

⁽²⁾ Population size includes number of unique records available at the time of the survey field period.

⁽³⁾ The achieved sample includes five manufacturing companies, two agricultural, and one educational store.

⁽⁴⁾ The sample frame includes a list of participants with contact information who had a chance to complete the survey. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the survey. After selecting all unique records, Cadmus removed any records from the population if the customer had participated in a survey in the last three months, had been selected for another program component survey, was a residential customer, did not have valid contact information (email or telephone number), was on the do not call list, or opted out of the online survey.

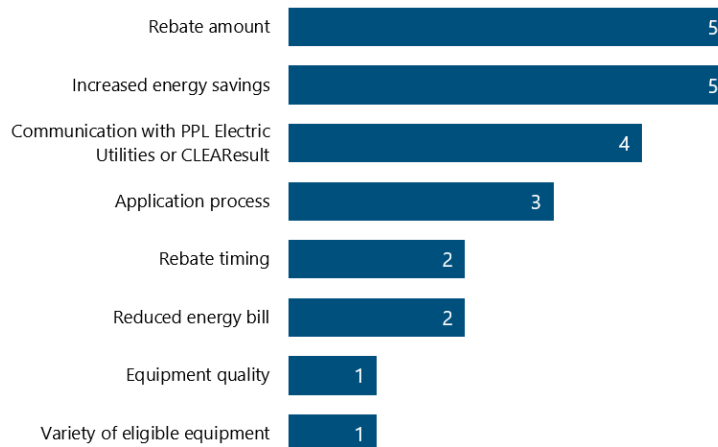
E.3.1. Component Experience

The survey asked respondents a series of questions to assess their satisfaction with the program component and the factors that influenced their level of satisfaction.

The program component was delivered effectively in PY17, maintaining high levels of customer satisfaction. All survey respondents indicated satisfaction with the custom program: six were *very satisfied*, two were *somewhat satisfied* (n=8), and none gave lower ratings.

The survey next asked for the reasons why they were satisfied with the program and allowed them to select as many options as they wished that contributed to their rating. The top responses were the rebate amount and increased energy savings (five mentions apiece), followed by communication with PPL Electric Utilities or CLEAResult (four mentions). All options presented in the survey were selected at least once, except for contractor performance. Figure E-1 shows the full breakdown of reasons for respondents' satisfaction with the program.

Figure E-1. PY17 Reasons for Respondent Satisfaction



Source: Survey data: "What factor(s) most affected the overall experience rating you gave? Select all that apply." Respondents were able to select as many reasons as they desired; no respondents selected "Contractor performance," and it was excluded from this graphic.

The survey asked respondents for feedback on what worked well with their program experience in PY17 and what could be improved. Two respondents provided feedback; the first respondent reported that the interconnection fee was high (a factor the program does not control) but was satisfied that their project was completed quickly, while the other said communications from ICSP staff could be improved, but did not identify specific areas for improvement. Both of these respondents were *somewhat satisfied* with the program despite the suggestions for improvement.

E.3.2. Survey Sample Attrition

Table E-10 lists the total number of records contacted for the survey via online and telephone attempts and the outcome (final disposition) of each record. Of 84 records in the final sample frame, eight participants responded to the survey, for a 10% response rate. See *Appendix L* for additional details on survey methodology.

Table E-10. Custom Component Sample Attrition

Description of Outcomes of Online and Telephone Participant Survey	Number of Records
Population (number of unique jobs)	140
Removed: inactive customer, residential sector, completed survey in past three months, on "opt out" or "do not contact" list, selected for a different survey, duplicate contact, or did not have accurate contact information	56
Survey Sample Frame	84
Not reached, left a message, or did not respond	16
Refused, opted out, bounce back, ineligible	60
Completed Surveys	8
Overall Response Rate	10%

Appendix F. Evaluation Detail – Low-Income Program

F.1. Gross Impact Evaluation

PPL Electric Utilities provided four types of service (also known as job types) at no cost to the income-qualified customer: baseload, low-cost, full-cost, and welcome kits. The program offers baseload services to customers without electric heat and without an electric water heater, low-cost services to customers without electric heat but with electrically heated water, and full-cost services to customers with both electric heat and electrically heated water. The welcome kit is sent to any eligible customer who has not received a kit or participated in the program within the past three years.

Cadmus conducted the following activities to evaluate Low-Income Program participants:

- **Database Review.** Cadmus evaluated the census of projects in the welcome kit stratum for all welcome kit data using a combination of the 2021 PA TRM⁴⁵ inputs and data from PPL Electric Utilities' tracking database. Cadmus also used algorithms and inputs from sections 2.3.7 and 2.3.8 of the 2021 PA TRM, the PY17 participant survey, and the 2018 Residential Baseline Study.⁴⁶
- **Audit desk review.** Cadmus reviewed a random sample of 23 of the ICSP's assessment records for the full-cost stratum across audit types. A review of home assessment records involved verifying reported home and measure-level data from participant records in the ICSP's database and relevant inputs for savings calculations using the PA TRM. Cadmus verified all data fields in the assessment records against the PPL Electric Utilities' tracking database (e.g., home address, water heater fuel type, heating fuel type, reported quantities, count of home occupants, and baseline conditions).
- **Engineering analysis.** Cadmus conducted an engineering analysis for full-cost stratum and used the findings from the assessment records review as inputs to the engineering algorithms from the 2021 PA TRM, when available, and the IL TRM⁴⁷ for algorithms (not inputs) not listed in the PA TRM.

F.1.1. Gross Impact Methodology and Sampling Approach

In PY17, Cadmus coordinated with PPL Electric Utilities and the ICSP to collect the required data to verify energy savings and demand reductions for the Low-Income Program. The ICSP provided an extract from its tracking database of participant and energy assessment records, and Cadmus analyzed the census of

⁴⁵ PA PUC. Revised February 2021. *Technical Reference Manual Volume 2: Residential Measures*. <https://www.puc.pa.gov/pcdocs/1692531.docx>

⁴⁶ PA PUC. February 12, 2019. *2018 Pennsylvania Statewide Act 129 Residential Baseline Study*. [2018 pa residential baseline study.pdf](https://www.puc.pa.gov/pcdocs/1692531.pdf)

⁴⁷ Illinois Energy Efficiency Stakeholder Advisory Group. September 19, 2025. *2026 Illinois Statewide Technical Reference Manual for Energy Efficiency. Version 14.0. Volume 3: Residential Measures*. [IL-TRM Effective 010126 v14.0 Vol 3 Res 09192025 FINAL.pdf](#)

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projects for welcome kit installations. Cadmus selected a random sample of REA and in-home participants to verify that products were installed as reported.

Cadmus designed the verification sample for the Low-Income Program to meet 85% confidence with $\pm 15\%$ precision. To examine savings in detail, Cadmus stratified the population into baseload, low-cost, full-cost, and MMMF job types. Cadmus sampled the population by project number rather than by account number for simplicity and consistency with previous years.

The impact evaluation sampling strategy is summarized in Table F-1. Using a random sample of homes for verification, Cadmus estimated energy savings with a margin of error of $\pm 6.43\%$ at an 85% confidence level.

Table F-1. PY17 Low-Income Program Gross Impact Evaluation Sample Design

Sample Stratum	Population Size ⁽¹⁾	CP	Sampling Assumptions Cv in Sample Design	Target Sample Size	Achieved Sample Size ⁽¹⁾	Impact Evaluation Activity
Remote Energy Assessment ⁽²⁾						
REA – Baseload	721	85/15	0.35	-	-	Participant surveys, recordings, desk review, and engineering analysis
REA - Low-Cost	940			-	-	
REA – Full-cost	48			23 ⁽²⁾	0 ⁽²⁾	
Direct Install						
In-home—Baseload	3,665	85/15	0.30	-	-	Participant surveys, desk review, and engineering analysis
In-home—Low-cost	2,516			-	-	
In-home—Full-cost	4,657			23 ⁽²⁾	23 ⁽²⁾	
In-home—MMMF (all job types)	1,608			-	-	
Welcome Kits						
Welcome Kits	26,368	N/A	N/A	Census	N/A	Census and database review
Program Total	40,523	-	-	-	-	-

⁽¹⁾ Population size and sample size counts are based on unique job numbers, which differ slightly from unique households.

⁽²⁾ Cadmus pulled a random sample across REA and in-home full-cost jobs and completed 23 desk reviews across both channels. No REA jobs were randomly selected in the final sample.

At the end of the program year, within each stratum, Cadmus weighted and combined the realization rates for each sampled project into a single, stratum-level realization rate. To calculate verified savings, Cadmus applied each stratum-level realization rate to each respective population's reported kW and kWh savings represented by each stratum. Total verified savings for the population is the sum of these stratum-level savings.

Energy Education and Behavior Savings

Cadmus evaluated the impacts of behavior changes on electric consumption among program participants using calculations based on engineering estimates, secondary research, and survey data. Cadmus selected

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three behavioral recommendations—adjust thermostats, wash clothes in cold water, and take shorter or fewer showers—that reasonably corresponded to energy-saving activities in the PA TRM.

Adjust Thermostat for Heating and Cooling Season

Cadmus assumed that participants who adjusted their thermostats saved energy similar to that saved by a programmable thermostat and applied the PA TRM's algorithms accordingly.⁴⁸

Wash More Loads of Laundry in Cold Water

Cadmus estimated the energy savings from participants washing clothes in cold water in two steps:

1. Estimated the energy usage of a clothes washer (using algorithms from the PA TRM)⁴⁹
2. Weighted the results based on PY17 survey responses

Based on survey responses, Cadmus assigned an approximate percentage of time that clothes were washed in cold water (e.g., *always* indicated that 100% of laundry was washed in cold water, *more than half the time* assumed 75%, and so on). The team then assessed the relative change before and after energy education.

Take Shorter Showers

Cadmus assumed that participants who said they take short showers took a five-minute shower per their reported frequency (e.g., *always*, *more than half the time*). And, similar to the laundry behavior change, an associated percentage was applied to each frequency. To estimate shower energy use, Cadmus followed section 2.3.8 in the 2021 PA TRM and adjusted shower length from the 7.8-minute default based on the energy education recommendation.⁵⁰

F.1.2. Gross Impact Results

Welcome Kit Findings

Findings from Cadmus' census evaluation are shown in Table F-2. These findings explain the differences between reported and verified savings.

⁴⁸ PA PUC. Revised February 2021. Technical Reference Manual Volume 2: Residential Measures. Section 2.2.11 <https://www.puc.pa.gov/pcdocs/1692531.docx>

⁴⁹ Section 2.3.5 of the PA TRM concerns the water heater temperature setback. One component in the algorithm estimates savings from the clothes washer. Cadmus used these savings to estimate energy consumption of a clothes washer.

⁵⁰ The PA TRM groups like terms and takes the difference of the variables that are changed. In this instance, Cadmus set the flow rate to be constant and changed the time of the showers.

Table F-2. PY17 Welcome Kits Findings

Product	Finding	Number of Jobs Impacted	Effect on Savings
Welcome Kits	PY17 participant survey data indicates that 68% of welcome kit recipients have electric water heat. Cadmus factored this into its PY17 analysis, which resulted in a lower realization rate (See TRM ELEC term)	26,368	Negative
Welcome Kits	Recovery Efficiency (See TRM RE term) was estimated using a weighted average of the water heater based on data from the 2018 SWE baseline study. This resulted in a mild negative impact on the realization rate	26,368	Negative
Welcome Kits	Cadmus observed 59 duplicates within the ICSP's dataset. Per previous communication, it was confirmed that these duplicate welcome kits were sent in error and omitted their associated savings. This resulted in a lower realization rate.	59	Negative

Detailed Desk Review Findings

Findings from Cadmus' review of records are shown in Table F-3. These findings, along with in-service rates (ISRs) for products and energy education savings, account for the differences between reported and verified savings.

Table F-3. PY17 On-Site Desk Review Findings

Product	Finding	Number of Jobs	Effect on Savings
Bathroom aerators	Number of occupants observed in home assessment data was less than those assumed in TRM	7	Negative
Kitchen aerators	Number of occupants observed in home assessment data was greater than those assumed in TRM	7	Positive
Showerheads	Number of occupants observed in home assessment data was greater than those assumed in TRM	17	Positive
Thermostatic shower restriction valves	Number of occupants observed in home assessment data was greater than those assumed in TRM	6	Positive

In-Service Rates

The participant survey asked questions about nine products—LEDs, LED nightlights, kitchen aerators, bathroom aerators, showerheads, tier 1 advanced power strips, thermostatic shower restriction valves, air purifiers, and dehumidifiers. Cadmus calculated the on-site ISRs for these items, as shown in Table F-4.

Table F-4. PY17 In-Service Rates for Energy-Saving Items

Product	On-Site In-Service Rate
LEDs	100%
Air Purifiers	100%
Dehumidifiers	100%
Tier 1 Advanced Power Strips	98%
Kitchen Aerators	97%
Showerheads	92%
Thermostatic Shower Restriction Valves	92%
Bathroom Aerators	91%
LED Nightlights	79%

Energy Education Savings Findings

Table F-5 shows the energy-savings recommendations considered in estimating energy education savings, any behavioral elements that energy education could change, 2021 PA TRM reference, and per-unit energy savings and demand reductions. The estimated PY17 per-household verified energy education savings is 36.82 kWh/yr; the *ex ante* assumption was 60 kWh/yr per PPL Electric Utilities' participant tracking database. Adjustment of the thermostat during colder months was the primary reason for the discrepancy in verified and *ex ante* savings. The reduction in energy savings from adjusting thermostats in the summer and winter months in Phase IV is attributed to a change in how participant data is categorized. On a recommendation from the SWE, the survey identified participants with central cooling and heating systems. In previous years, home heating fuel type and cooling served as a proxy for central air-based systems.

Table F-5. Low-Income Program Verified Energy Education Savings and Assumptions Summary

Energy Savings Recommendation	Behavioral Assumption	2021 PA TRM Reference	Ex Post Verified Savings	
			kWh/yr	kW/yr
Adjust Thermostats – Summer	Participants lower their thermostat in winter and raise it in summer	ENERGY STAR-Certified Connected Thermostats – Section 2.2.11	1.91	0.0007
Adjust Thermostats – Winter			29.72	-
Wash Clothes in Cold Water	Participants increase the number of loads of laundry they wash in cold water	Water Heater Temperature Setback– Section 2.3.5	1.82	0.0001
Take Shorter Showers	Participants decrease the duration of each shower	Low Flow Showerheads – Section 2.3.8	3.37	0.0003
Total ⁽¹⁾			36.82	0.0011

⁽¹⁾ Each component is summed to get the total. Total may not sum due to rounding.

F.2. Process Evaluation

F.2.1. Survey Sample Attrition

The PY17 customer surveys collected demographic information about Low-Income Program participants. Thirty-one percent of survey respondents reported living in a multifamily apartment building with four or more units, and 30% reported living in a single-family detached residence (n=380). Twenty percent of respondents reported living in an attached house (townhouse, row house, or twin), 7% reported living in a mobile or manufactured home, and 11% reported a different dwelling type.⁵¹

Table F-6 lists the total number of records contacted via online survey and the outcome (final disposition) of each record (all strata). *Appendix L* includes additional detail on the survey methodology.

Table F-6. Low-Income Program Survey Sample Attrition

Description of Outcomes of Online Participant Survey	Number of Records		
	Full Cost	Low Cost and Baseload	Welcome Kits
Population (number of unique jobs at the time the sample was drawn)	3,856	4,722	25,020
Removed: inactive customer, completed survey in past three months, on "opt out" list, selected for a different survey, duplicate contact, on "do not contact" list, incomplete or invalid email address or phone number	1,040	1,131	9,691
Survey Sample Frame (records selected)	2,816	3,591	15,329
Not reached or non-working: Refused or opted out, email returned (bounce back), did not respond	2,672	3,470	6,779
Did not attempt because they were not needed to reach the plan	-	-	8,329
Completed Surveys (online)	144	121	221
Overall Response Rate	5%	3%	3%⁽¹⁾

⁽¹⁾ Excludes records not attempted in the selected sample frame from the denominator used to calculate response rate.

⁵¹ The total does not sum to 100% due to rounding.

APPLIANCE RECYCLING

This component of the Residential Program offers an incentive to customers who turn in eligible appliances and provides free pick-up and environmentally responsible recycling services.

VERIFIED ENERGY SAVINGS

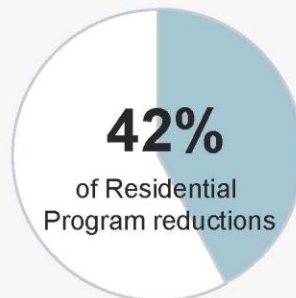
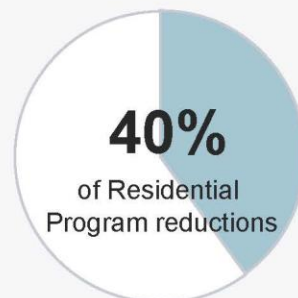
Phase IV
has saved
49,521 MWh/yr



PY17 saved
13,523 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
15.32 MW/yr



PY17 has
reductions of
5.51 MW/yr

PY17 PARTICIPATION

A total of **11,763** customers
recycled **26,435** units



10,228 Room air conditioners



9,057 Refrigerators



5,130 Dehumidifiers



2,020 Freezers

PARTICIPANT SATISFACTION



Satisfied with
overall program
component

Appendix G. Evaluation Detail - Appliance Recycling Component

In the Appliance Recycling component, PPL Electric Utilities offers an incentive to customers who turn in eligible appliances and provides free pick-up, small appliance drop-off events, and environmentally responsible recycling services. The component primarily targets residential customers but is available to all PPL Electric Utilities customers with a working residential-grade refrigerator, freezer, room air conditioner, or dehumidifier. For evaluation purposes, Cadmus defined participants as unique appliances decommissioned through the Appliance Recycling component during the program year.

PPL Electric Utilities' energy efficiency program staff provides overall strategic direction and program management. The evaluation staff oversees evaluation activities and coordinates with the program component's delivery staff. In PY17, CLEAResult, the ICSP, delivered the Appliance Recycling component, along with its pick-up and recycling subcontractor.

Participating customers had the option of requesting in-person pick-up or contactless curbside pick-up. Refrigerators had to measure between 10 and 30 cubic feet to qualify for pick-up. Both primary and secondary refrigerators and freezers were eligible. Eligible appliances had to be functional at the time of pick-up. Customers who recycled a refrigerator or freezer could also turn in room air conditioners and dehumidifiers. The ICSP also offered customers the option to schedule pick-up of two or more room air conditioners and dehumidifiers without recycling a refrigerator or freezer, an expansion of the "neighborhood sweep" initiative the ICSP began in PY15 (e.g., scheduling pick-up of two or more small units is now allowed throughout PPL Electric Utilities territory and not just for specific times and places). During PY17, the ICSP also held eight bulk recycling events to collect room air conditioners and dehumidifiers from customers without requiring them to schedule a pick-up. Additionally, the school fundraiser recycling drives that support student clubs, organizations, and teams continued throughout PY17.

Table G-1 shows the appliance eligibility parameters and incentives for PY17, which were unchanged from the end of PY15.

Table G-1. Appliance Recycling Component Eligible Equipment and Incentives

Equipment	Eligibility Rating	Incentive Range
Refrigerator	Working unit; > 10 cubic feet and ≤ 30 cubic feet	\$35-\$50
Freezer	Working unit; > 10 cubic feet and ≤ 30 cubic feet	\$35-\$50
Room Air Conditioner	Working unit removed from mounting	\$10 ⁽¹⁾
Dehumidifiers	Working unit	\$10 ⁽¹⁾

⁽¹⁾The program component increased the rebate for a limited time from \$10 per appliance to \$25 per appliance.

G.1. Gross Impact Evaluation

G.1.1. Gross Impact Methodology and Sampling Approach

Cadmus reviewed a census of records for room air conditioners and dehumidifiers and based savings for dehumidifiers and room air conditioners on a reference city in the PA TRM. Cadmus verified that each participant's ZIP code was mapped to the correct reference city and verified that the reported per-unit savings matched those listed in the PA TRM.

For refrigerators and freezers, Cadmus reviewed reported equipment-level savings to confirm whether the ICSP had updated them to match verified equipment-level savings from PY15, the evaluation year used to determine the historical realization rate applicable to PY17. Cadmus' approved evaluation plan for PY17 stated that, if the ICSP updated reported equipment-level savings to match verified equipment-level savings from the evaluation year of the historical realization rate, the impact evaluation would pass through reported savings because applying the historical realization rate after the equipment-level savings have been updated double-counts verified savings adjustments. Based on the review of the data, Cadmus passed through reported savings as verified savings for approximately 90% of records, with reported savings that aligned with PY15 evaluated savings. However, approximately 10% of records for both refrigerators and freezers had not been updated with PY15 verified savings, units that were picked up in PY16, but incentives processed and were paid out in PY17. For these records, Cadmus set verified per-unit savings equal to those passed through from the 90% that aligned with PY15. The reported savings passed through as verified PY17 energy savings and demand reductions are shown in Table G-2. See the PY15 evaluation report for details on the PY15 evaluation approach.⁵²

Table G-2. Appliance Recycling Component Historical Verified Savings

Savings	Refrigerator Historical Per-unit	Freezer Historical Per-unit
Energy Savings (kWh/yr)	732.81	689.33
Demand Reductions (kW/yr)	0.1183	0.1113

Table G-3 summarizes the impact evaluation sampling strategy. The impact evaluation activities produced results with $\pm 15\%$ precision at 85% confidence.

Table G-3. Appliance Recycling Component Gross Impact Evaluation Sample Design

Stratum	Sampling Assumptions	Target Sample Size	Achieved Sample Size	Impact Evaluation Activity
Room Air Conditioners and Dehumidifiers	N/A	Census	Census	Database review
Refrigerators and Freezers	N/A	N/A	N/A	Apply PY15 historical realization rate to the PY17 reported savings

⁵² PPL Electric Utilities. September 30, 2024. *Phase IV of Act 129 Program Year 15 Annual Report (June 1, 2023–May 31, 2024)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

G.1.2. Gross Impact Results

Table G-4 shows the Appliance Recycling component's verified gross energy savings and demand reductions.

Table G-4. Appliance Recycling Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified	PY17 Verified	Phase IV Verified ⁽¹⁾
MWh/yr	7,900	8,569	8,565	10,963	13,523	49,521
System-Level MW/yr	1.90	2.09	2.28	3.53	5.51	15.32

⁽¹⁾ Phase IV verified savings may not match the sum of program years due to rounding.

Table G-5 shows verified energy savings and realization rates by stratum for PY17, and Table G-6 shows verified demand savings and realization rates.

Table G-5. Appliance Recycling Component Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Refrigerators and Freezers	8,193	98%	N/A	10.0%	8,030
Room Air Conditioners and Dehumidifiers	5,494	100%	N/A	N/A	5,494
Component Total⁽²⁾	13,686	99%	-	-	13,523

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Totals may not sum due to rounding.

Table G-6. Appliance Recycling Component Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System Level PYVTD (MW/yr)
Refrigerators and Freezers	1.32	98%	N/A	10.0%	1.30	1.41
Room Air Conditioners and Dehumidifiers	3.78	100%	N/A	N/A	3.78	4.10
Component Total⁽²⁾	5.10	99%	-	-	5.07	5.51

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

Cadmus applied realization rates to verified demand reductions before applying distribution losses.

⁽²⁾ Totals may not sum due to rounding.

G.2. Net Impact Evaluation

G.2.1. Net Impact Methodology

Cadmus did not conduct new primary research to assess net savings for the Appliance Recycling component in PY17 and used a historical NTG ratio of 0.50 from PY15.⁵³

G.2.2. Net-to-Gross Results

Table G-7 shows NTG ratio results for the Appliance Recycling component.

Table G-7. Appliance Recycling Component NTG Ratio Summary

Stratum	PYVTD MWh/yr	Evaluation Year	Free Ridership and SMI (%)	Spillover (%)	NTG Ratio
Refrigerators and Freezers	13,523	PY15	50%	0%	0.50

⁵³ PPL Electric Utilities. September 30, 2024. *Phase IV of Act 129 Program Year 15 Annual Report (June 1, 2023–May 31, 2024)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

G.3. Process Evaluation

The approved PY17 evaluation plan did not include a participant survey, but PPL Electric Utilities added one. The results from these surveys are included in the Process Evaluation findings in this appendix, along with the overall Residential Program section *7.5.1 Process Evaluation Key Findings* of this report.

The participant survey asked questions about satisfaction with the program. In April 2026, Cadmus made several attempts to reach participants, beginning with an initial email invitation, followed by an email reminder. See *Appendix L* for details about Cadmus' approach to reducing survey bias and contact instructions. Completed surveys produced component satisfaction with $\pm 4\%$ precision at 90% confidence.

Sample sizes noted in this report may vary by survey question because respondents could skip questions they chose not to answer; therefore, not all respondents answered every question. Cadmus included all survey respondents who answered at least one question, even if they did not complete the survey.

Table G-8 lists the process evaluation sampling strategy.

Table G-8. Appliance Recycling Component Process Evaluation Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size ⁽¹⁾	Assumed Cv in Sample Design	Target Sample Size	Achieved Sample Size	Sample Frame ⁽²⁾	Percent Contacted ⁽³⁾
Appliance Recycling	Participants	Online	10,371	0.50	68	93	4,440	100%
Program Total			10,371	N/A	68	93	4,440	100%

⁽¹⁾ For participant survey sampling purposes, Cadmus defined participants in the population size as unique customers who recycled refrigerators or freezers through the Appliance Recycling component at the time of the survey and included Q1 through Q3 participants.

⁽²⁾ The sample frame includes a list of participants with contact information who had a chance to complete the survey. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the survey. After selecting all unique records, Cadmus removed any records from the population if the customer had participated in a survey in the last three months, had been selected for another program component survey, did not have valid contact information (email), was on the do not contact list, or opted out of the online survey.

⁽³⁾ Percent contacted means the percentage of the sample frame contacted to complete the survey or interviews.

G.3.1. Component Experience

Cadmus contacted Appliance Recycling component participating customers with email addresses who recycled refrigerators and freezers in PY17 Q1 through Q3.⁵⁴ Survey respondents rated their satisfaction with Appliance Recycling and explained what drove their satisfaction ratings. They also indicated how their participation influenced their opinion of PPL Electric Utilities.

Component Satisfaction

Of 92 survey respondents, 97% were satisfied with the PY17 Appliance Recycling component. Ninety-five percent were *very satisfied*, and 2% were *somewhat satisfied* with the program overall.⁵⁵

Drivers of Component Satisfaction

To better understand what drives program satisfaction, the survey asked respondents what factor(s) most affected their rating of the Appliance Recycling component.

Figure G-1 shows the most common drivers, with the top drivers among respondents who reported *very* or *somewhat satisfied* being contractor performance on the timing of appliance pick-up (60%; n=86) and their professionalism (53%).⁵⁶ Participants' high satisfaction was also driven by the application process and communication with PPL Electric Utilities (43% and 41%, respectively).

Compared to PY15, in PY17 more respondents reported the application process (43%; n=86 vs. 26%; n=274, p<0.10) and variety of eligible equipment (33%; n=86 vs. 10%; n=274, p<0.10) as greater drivers of satisfaction, while fewer cited reduced energy bill as a motivator (8%; n=86 vs. 21%; n=274, p<0.10).

Only three PY17 survey respondents were less than *satisfied*, citing dissatisfaction with communication with PPL Electric Utilities, equipment quality, increased savings, and reduced energy bills.⁵⁷

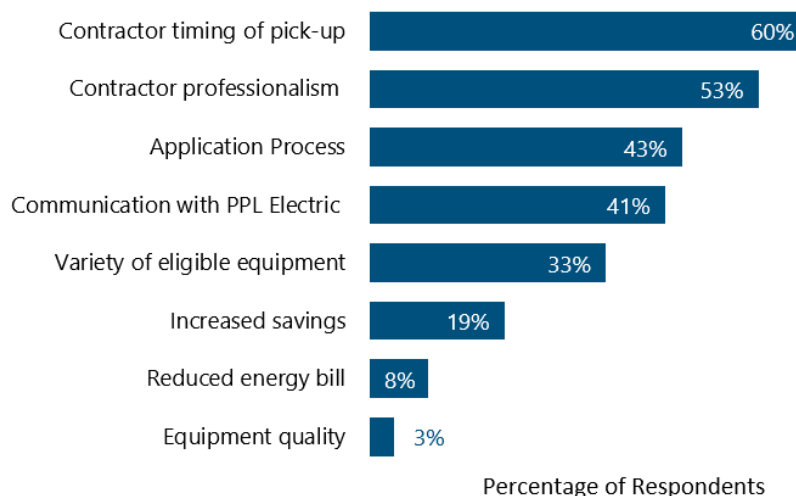
⁵⁴ Due to evaluation timing, Q4 data were not available at the time of the participating customer survey.

⁵⁵ Two respondents were *neither satisfied nor dissatisfied*, and one was *not at all satisfied* with the program overall, totaling 3% of survey respondents (three of 92).

⁵⁶ Of the 89 participants who reported being *very satisfied* or *somewhat satisfied*, 86 respondents indicated drivers of their high satisfaction.

⁵⁷ Respondents provided multiple responses.

Figure G-1. Drivers of High Satisfaction with Appliance Recycling



Source: Participating customer survey, "What factor(s) most affected the overall experience rating you gave?" (n=86 respondents who were *very satisfied* or *somewhat satisfied* and answered this question; multiple responses allowed)

Opinion of PPL Electric Utilities

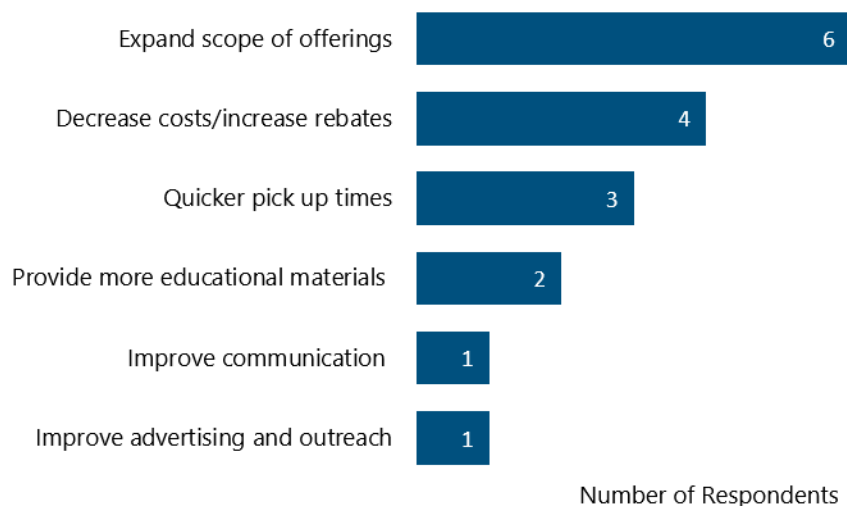
Of 91 survey respondents who answered the question, 47% said their opinion of PPL Electric Utilities had improved after participating in the Appliance Recycling component, 49% said their opinion had not changed, and 2% said their opinion had declined.

The survey asked the two respondents whose opinions of PPL Electric Utilities had declined why they felt this way, and each cited a different reason. One had not yet received their rebate payment, and the other had also not received theirs and was dissatisfied with the lack of communication about the rebate status.

G.3.2. Improvement Suggestions

When asked for one thing PPL Electric Utilities could change to improve the Appliance Recycling component, 17 respondents offered suggestions (Figure G-2). Of this subset, six respondents suggested that the program recycles more items than it currently does.

Figure G-2. Suggestions for Improving the Appliance Recycling Component

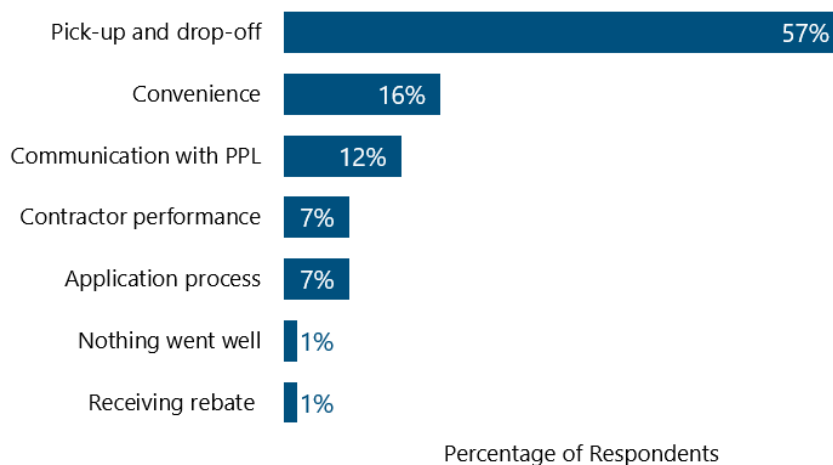


Source: Participating customer survey, "What is the one thing PPL Electric Utilities could change about the program to improve it? Please describe." (n=17; multiple responses allowed)

G.3.3. Program Successes

The survey asked respondents what worked particularly well with the Appliance Recycling component; 76 participants provided positive feedback. The top response, as shown in Figure G-3, was pick-up and drop-off services (57%). Participants described the pick-up crew as "timely" and "courteous" and described the program, from application process to receiving an incentive, as "simple" and "quick."

Figure G-3 Positive Program Aspects



Source: Participating customer survey, "What do you think worked particularly well with the program? Please describe." (n=76; multiple responses allowed)

G.3.4. Other Findings

The PY17 Appliance Recycling survey collected the following demographic information:

- Most respondents lived in a single-family detached residence (83%; 76 of 92).
- Eleven percent of respondents (n=92) lived in an attached house (townhouse, row house, or twin)

Table G-9 lists the total number of records contacted for the survey and the outcome (final disposition) of each record. Additional details on survey methodology are in *Appendix L*.

Table G-9. Appliance Recycling Component Sample Attrition

Description of Outcomes of Online and Telephone Participant Survey	Number of Records
Population (number of unique jobs)	10,371
Removed: inactive customer, residential sector, completed survey in past three months, on opt-out list, selected for a different survey, duplicate contact, on do not contact list, or did not have accurate contact information	5,931
Survey Sample Frame	4,440
Non-working: email returned (bounce back)	44
Not reached: refused or opted out, did not respond	4,301
Disqualified Surveys: screened out	1
Partially Completed Surveys: not reported	1
Completed Surveys	93
Overall Response Rate	2%

Appendix H. Evaluation Detail – Efficient Lighting

At the end of PY14, PPL Electric Utilities sunset this component and stopped offering upstream incentives to manufacturers due to changes in federal lighting efficiency standards. The final program LEDs were processed in the first quarter of PY15. There were no claimed savings in PY16 or PY17.

H.1.1. Gross Impact Results

Table H-1 shows the Efficient Lighting component’s verified gross energy savings and demand reductions.

Table H-1. Efficient Lighting Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified	PY17 Verified	Phase IV Verified ⁽¹⁾
MWh/yr	4,349 ⁽²⁾	4,226	394	-	-	8,969
System-Level MW/yr	0.68 ⁽³⁾	0.66	0.06	-	-	1.41

⁽¹⁾ Phase IV verified savings may not match the sum of program years due to rounding.

⁽²⁾ PY13 verified savings for the Efficient Lighting component were reduced by 3.65 MWh/yr to conform with the SWE’s PY13 Annual Report findings.

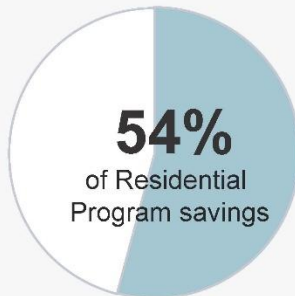
⁽³⁾ PY13 verified demand reductions for the Efficient Lighting component were reduced by 0.0001 MW/yr to conform with the SWE’s PY13 Annual Report findings.

ENERGY EFFICIENT HOMES

This component of the Residential Program provides a wide range of energy-efficient products, rebates, education, and services that give customers a variety of customizable and comprehensive solutions to increase their home's energy efficiency.

VERIFIED ENERGY SAVINGS

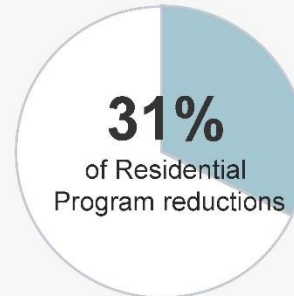
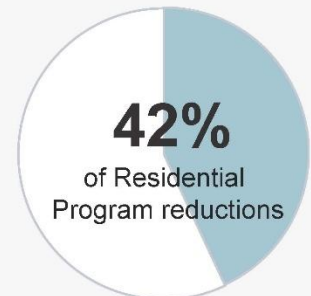
Phase IV
has saved
141,825 MWh/yr



PY17 saved
32,094 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
16.36 MW/yr



PY17 has
reductions of
4.07 MW/yr

PY17 PARTICIPATION

A total of **63,310** received rebates for

	44,959	Instant Discount
	11,186	Efficient Equipment (downstream and midstream)
	2,666	Online Marketplace
	1,587	New Homes
	1,411	Weatherization
	1,020	Online and in-home audit and energy conservation kits
	481	EV Charging Pilot

PARTICIPANT SATISFACTION



88%

Satisfied with
overall program
component

94%

downstream equipment participants
satisfied with program

89%

EV charging pilot participants
satisfied with program

84%

in-home audit, online assessment,
and weatherization participants
satisfied with program

83%

online marketplace participants
satisfied with program

Appendix I. Evaluation Detail – Energy Efficient Homes Component

The Energy Efficient Homes component is designed for both new construction and existing homes. The component offers a wide range of energy-efficient products, rebates, education, and services that give customers various customizable solutions to increase their homes' energy efficiency.

In PY17, the component had seven subcomponents: Downstream Equipment, Midstream Equipment, the Online Marketplace, Audit and Weatherization, Instant Discount, New Homes, and the EV Charging Pilot.

PPL Electric Utilities' energy efficiency program staff provides overall strategic direction and program management. CLEAResult, the ICSP, manages the Energy Efficient Homes component, with assistance from two subcontractors for the New Homes and the Online Marketplace subcomponents. Retailers participating in the Instant Discount subcomponent include hardware and home improvement stores. Charger manufacturers engaged with the EV Charging Pilot to enable the sharing of customer charging data with the ICSP and PPL Electric Utilities. The ICSP also engaged car dealerships to promote and market the EV Charging Pilot.

For all subcomponents of Energy Efficient Homes, a participant is defined as a rebated project, and each project is assigned a unique job number in PPL Electric Utilities' participant tracking database.

I.1. Gross Impact Evaluation

I.1.1. Gross Impact Methodology and Sampling Approach

In PY17, Cadmus used findings from desk reviews, participant surveys, and database reviews to evaluate savings from the Online Marketplace, Instant Discount, and New Construction subcomponents, as well as the EV Charging Pilot. Cadmus also verified PY16 savings for New Construction and PY15 and PY16 savings for Deep Energy Retrofit projects in PY17. Activities include those detailed below:

- For the **Online Marketplace subcomponent**, Cadmus conducted a database review for all products purchased through Online Marketplace. Cadmus also conducted a participant survey, attempting to contact all customers who purchased products through the Online Marketplace in PY17, and used the results to calculate an in-service rate (ISR) for individual measures.
- For the **Instant Discount subcomponent**, Cadmus conducted a database review for all rebated products and used the Online Marketplace participant surveys to calculate an ISR for individual measures.
- All PY15 and PY16 savings for the **Deep Energy Retrofits** pilot were previously unverified, but Cadmus verified them in PY17 with a billing regression analysis. There were no **Deep Energy Retrofits** projects in PY17.
- For the PY16 **New Construction subcomponent** left unverified in PY16, Cadmus reviewed REM/Rate and Ekotrope model inputs for a sample of 26 program homes, including three

additional projects that received heat pump bonus incentives, to verify annual energy savings and peak demand savings. Using participant tracking data, project documentation, and PA TRM methodologies, Cadmus recalculated savings, verified key model inputs, and evaluated heating, cooling, and domestic hot water system characteristics. Cadmus developed realization rates from the sample results, adjusted those rates to reflect the distribution of Ekotrope- and REM/Rate-modeled projects in the program population, and applied the resulting realization rates to the remaining population to estimate evaluated savings. For demand savings, Cadmus applied coincidence factors from the PA TRM and incorporated supplemental lighting and appliance demand impacts informed by PY14 site visit findings. Cadmus also resolved selected tracking data inconsistencies identified during the review to support savings.

- For the PY17 **New Construction subcomponent**, Cadmus reviewed hourly Ekotrope model outputs and program tracking data for a sample of 25 program homes, including a stratified random sample of 23 projects and two additional projects selected for targeted review. Cadmus stratified the sample by heating equipment and fuel type, cooling system type, and domestic hot water fuel type to represent the major combinations of measures within the modeled population. Cadmus recalculated annual electric energy savings (kWh/yr) and peak demand savings (kW/yr), developed realization rates for the Ekotrope-modeled population, and retained PY16 realization rates for projects modeled in REM/Rate. There were no **High Performance Homes** projects in PY17.
- For the **EV Charging Pilot**, Cadmus conducted a desk review of third-party network service provider EV charging data provided for a sample of participants to calculate *ex post* savings. Using all available EV charging data that included the required fields, Cadmus also calculated weekday average and peak hourly EV charging load shapes for months with data from 50 or more participants, assuming constant power over the charging period.

Additionally, Cadmus applied historical realization rates from PY16 to reported PY17 energy savings and demand reductions (Table I-1) for the **Audit and Weatherization** and **Downstream** and **Midstream Equipment subcomponents**. See the PY16 evaluation report for details on the PY16 evaluation approach of the Audit and Weatherization and Downstream and Midstream Equipment subcomponents.⁵⁸ The final PY17 realization rates may differ from those in PY16 due to differences in the measure mix.

⁵⁸ PPL Electric Utilities. September 30, 2025. *Phase IV of Act 129 Program Year 16 Annual Report (June 1, 2024–May 31, 2025)*. Prepared by Cadmus. Presented to Pennsylvania Public Utility Commission.

Table I-1. Energy Efficient Homes Historical Realization Rates

Subcomponent	Program Year	Historical Realization Rate	
		Energy Savings (MWh/yr)	Demand Reductions (MW/yr)
Downstream HVAC	PY16	107%	89%
Downstream Other Equipment	PY16	103%	99%
Midstream Equipment	PY16	101%	93%
Audit	PY16	141%	143%
Weatherization	PY16	64%	101%

Table I-2 summarizes the evaluation sampling strategy. Cadmus evaluated the subcomponents with basic levels of rigor and used different sampling approaches for each subcomponent.

Table I-2. Energy Efficient Homes Component Gross Impact Evaluation Sample Design

Stratum	Sampling Assumptions	Planned Sample Size	Achieved Sample Size ⁽¹⁾	Impact Evaluation Activity
Online Marketplace	Census	N/A	N/A	Participant survey, attempted census, database review
Instant Discount	Census	N/A	N/A	Database review; invoice review
Deep Energy Retrofits	N/A	N/A	N/A	Billing regression analysis on PY15 and PY16 projects; no PY17 projects
New Homes PY16	85/15 (Cv=0.50)	23	26	Desk review of REM/Rate and Ekotrope models, database review, and engineering analysis. PY16 sample size increased to include three heat pump bonus homes.
New Homes PY17	85/15 (Cv=0.50)	23	25	Desk review of Ekotrope models, tracking data, and engineering calculations. Stratified random sample of 23 Ekotrope homes plus two supplemental reviews; PY16 realization rates applied to REM/Rate homes.
EV Charging Pilot	N/A	N/A	481	Desk review of all available third-party network service provider EV charging data from program participants

⁽¹⁾ The number of respondents who answered questions about the ISR may not equal the total number of survey respondents used in the process section of the report, infographics, or net savings analysis.

The PY17 impact evaluation verified energy savings with $\pm 6.44\%$ precision at 85% confidence and demand reductions with $\pm 7.13\%$ precision at 85% confidence.

Ex Post Savings Calculation

Online Marketplace

Cadmus used a one-year census to evaluate PY17 for the Online Marketplace subcomponent. To calculate *ex post* savings for each subcomponent measure, the team applied the survey-derived installation rates for each stratum to all measures and then applied the census realization rate for each stratum to the

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respective population savings. Cadmus then summed *ex post* and *ex ante* kWh/yr savings across strata to calculate subcomponent-level realization rates and savings.

Cadmus verified savings per the PA TRM and confirmed inputs from PPL Electric Utilities' participant tracking database using project documentation, third-party sources such as ENERGY STAR, AHRI, and product manufacturer websites, or deemed inputs from the PA TRM, where relevant.

Instant Discount

To calculate *ex post*, Cadmus completed a database review on a census of all measures. Cadmus then summed *ex post* and *ex ante* kWh/yr savings across all tracking database records to calculate subcomponent-level realization rates and savings.

Deep Energy Retrofits

PPL Electric Utilities provided historical AMI and billing data for 2021-2025 for three PY15/PY16 participants. The analysis periods for the participants started the year prior to treatment and ran through the year following treatment. To estimate energy savings, Cadmus first aggregated the AMI data to the daily level. For each participant, the team then estimated variable heating and cooling degree PRISM (PRinceton Scorekeeping Method) type models in both the pre- and post-periods to weather-normalize energy use and isolate the base load, heating, and cooling components of consumption.⁵⁹ Both the pre- and post-usage and savings were normalized to TMY3 weather, with savings calculated as the difference between the weather-normalized pre-period usage and post-period usage. To estimate demand savings at the site level, Cadmus estimated variable heating and cooling models for each hour and day of the week (weekday/weekend).⁶⁰

New Homes

For PY16 projects, Cadmus reviewed REM/Rate and Ekotrope model outputs, program tracking data, and project documentation for a sample of 26 program homes, including three projects that received heat pump bonus incentives. Cadmus verified annual electric energy savings (kWh/yr) and peak demand savings (kW/yr) by reviewing modeled reference and proposed home performance, validating key tracking data inputs, and recalculating savings using the applicable evaluation methodology.

Cadmus used the sampled projects to develop realization rates for annual electric energy savings and peak demand savings. For each sampled project, the team compared the evaluated savings to the claimed savings reported in the program tracking data. Because the evaluation applied different methodologies to Ekotrope- and REM/Rate-modeled projects, Cadmus developed software-specific realization rates and weighted those rates based on the distribution of modeling platforms within the PY16 program

⁵⁹ The heating degree bases were allowed to vary from 45°F to 65°F, and the cooling bases were allowed to vary from 65°F to 85°F. The model with the highest R-square was selected as the final model.

⁶⁰ A total of 48 models (24 hours * 2 day-types) were estimated for each heating and cooling degree-hour base. The heating bases were allowed to vary from 45°F to 65°F, and the cooling bases were allowed to vary from 65°F to 85°F. The model with the highest R-square was selected as the final model.

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population. Cadmus then applied the weighted realization rates to the non-sampled population and combined sampled and non-sampled savings to calculate program-level evaluated savings and realization rates.

For Ekotrope-modeled projects, Cadmus used hourly (8,760-hour) model outputs to calculate annual energy savings and peak demand savings directly from modeled project performance. For REM/Rate-modeled projects, Cadmus calculated annual energy savings using modeled fuel summary reports and calculated peak demand savings using PA TRM algorithms based on modeled peak cooling load, equipment efficiency, and coincidence factors. For REM/Rate-modeled projects, the evaluation also incorporated additional lighting and appliance demand impacts based on findings from the PY14 site visit analysis.

For PY17 projects, Cadmus reviewed hourly Ekotrope model outputs and program tracking data for a sample of 25 program homes, including a stratified random sample of 23 projects and two additional projects selected for targeted review. Cadmus calculated annual electric energy savings (kWh/yr) and peak demand savings (kW/yr) directly from the hourly model outputs, reviewed modeled reference and proposed home performance, and verified key tracking data inputs.

The team used the sampled projects to develop realization rates for annual electric energy savings and peak demand savings for the Ekotrope-modeled portion of the program population. The stratified random sample represented the Ekotrope-modeled population and included projects selected across heating equipment and fuel type, cooling system type, and domestic hot water fuel type. For each sampled project, the team compared the modeled evaluated savings with the claimed savings reported in the program tracking data. Cadmus applied the realization rates derived from the stratified random sample to the non-sampled Ekotrope population, while retaining the PY16 realization rates for projects modeled in REM/Rate. Cadmus then combined the evaluated savings for sampled projects, realized savings for non-sampled Ekotrope projects, and evaluated savings for REM/Rate projects (based on PY16 realization rates) to calculate program-level evaluated savings and realization rates.

Cadmus calculated annual electric savings as the difference between modeled reference and proposed whole-home electric consumption and calculated peak demand savings as the reduction in each project's maximum daily average demand during summer peak periods (as defined per the PA TRM).

EV Charging Pilot

Cadmus verified savings using the protocol included in the approved evaluation plan. The calculations relied on inputs from PPL Electric Utilities' participant tracking database, project documentation, ChargePoint, Emporia, and Tesla EV charging data, and third-party sources such as ENERGY STAR and product manufacturer websites, or deemed inputs from the algorithm, where relevant.

For the ChargePoint and Emporia Chargers stratum, Cadmus calculated a single stratum-wide *ex post* savings based on EV charging data from a sample of participants collected by ChargePoint and Emporia. From this dataset, the team determined the annual plugged-standby hours and annual unplugged-standby hours for each charger in the sample. The team then calculated a weighted sample-wide average of annual plugged- and unplugged-standby hours using each charger's total data collection period as the

weighting factor. Using these calculated values and deemed inputs included in the approved evaluation plan, Cadmus calculated the *ex post* savings for the stratum.

For the Tesla Chargers stratum, Cadmus used two approaches. For participants in the Tesla Chargers stratum verified as having Tesla ENERGY STAR Level 2 chargers based on the PPL Electric Utilities' participant tracking database and ENERGY STAR website, the team applied the same *ex post* savings as the ChargePoint and Emporia Chargers stratum. Cadmus could not use Tesla charging data to calculate savings as it lacked the required plug-in and plug-out time data. For participants that could not be verified as having ENERGY STAR Level 2 chargers, Cadmus applied an *ex post* savings of zero.

I.1.2. Gross Impact Results

Table I-3 shows the verified gross energy savings and demand reductions for Energy Efficient Homes.

Table I-3. Energy Efficient Homes Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified ⁽¹⁾	PY16 Verified ^{(2) (3)}	PY17 Verified	Phase IV Verified ⁽⁴⁾
MWh/yr	17,556	25,763	34,681	31,731	32,094	141,825
System-Level MW/yr	1.87	2.83	3.47	4.12	4.07	16.36

⁽¹⁾ PY15 verified savings include unverified savings from Deep Energy Retrofits verified in PY17, reflecting 8 MWh/yr and 0.0004 MW/yr.

⁽²⁾ PY16 verified savings include unverified savings from Deep Energy Retrofits (3 MWh/yr and 0.00028 MW/yr) and New Homes (6,148 MWh and 2.13 MW/yr) verified in PY17. Due to an evaluation clerical error in the PY16 report, a portion of Deep Energy Retrofits savings was already included in the PY16 verified savings. Therefore, the incremental increase in PY16 shown in this table is 1 MWh/yr and 0.0002 MW/yr. The values presented in this table and the Phase IV totals reflect the corrected savings and will not reconcile with the originally reported PY16 results.

⁽³⁾ PY16 verified savings reflect an adjustment to conform with the SWE's PY16 Annual Report findings. Energy savings increased by 193 MWh/yr and by 0.16 MW/yr.

⁽⁴⁾ Phase IV verified savings may not match the sum of program years due to rounding.

Table I-4 shows incentive costs, verified electric savings, and demand reductions by subcomponent.

Table I-4. PY17 Incentives and Verified Energy Savings and Demand Reductions by Subcomponent

Parameter	Downstream Equipment	Midstream Equipment	Online Marketplace	New Homes	Audit and Weatherization	Instant Discount	EV Charging Pilot	Total ⁽¹⁾
PY17 Participants	11,158	28	2,666	1,587	2,431	44,959	481	63,310
PYRTD (MWh/yr)	20,604	69	541	5,416	922	2,856	28	30,436
PYRTD (MW/yr)	1.19	0.01	0.06	1.16	0.06	0.55	0.003	3.03
PYVTD (MWh/yr)	22,077	69	606	5,408	664	3,248	22	32,094
PYVTD (MW/yr)	1.07	0.01	0.06	1.94	0.06	0.61	0.002	3.74
System-Level PYVTD (MW/yr)	1.16	0.01	0.07	2.11	0.06	0.66	0.002	4.07
PY17 Incentives (\$1,000)	\$2,759	\$16	\$92	\$1,433	\$564	\$535	\$113	\$5,513

⁽¹⁾ Column sums may not add up to the total column due to rounding.

In PY17, the Energy Efficient Homes component reported energy savings of 30,436 MWh/yr, as shown in Table I-5, and demand reduction of 3.03 MW/yr, as shown in Table I-6.

Table I-5. Energy Efficient Homes Component Gross Impact Results for Energy

Stratum	PYRTD (MWh/yr)	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Downstream Equipment HVAC	19,601	107%	0.33	10.7%	21,045
Downstream Equipment Other	1,002	103%	0.05	1.6%	1,032
Downstream Subtotal⁽²⁾	20,604	107%	0.44	10.1%	22,077
Midstream HVAC	69	101%	0.04	0.8%	69
Midstream Equipment Subtotal⁽²⁾	69	101%	0.04	0.8%	69
Audit	101	141%	0.18	5.8%	141
Weatherization	821	64%	1.34	48.8%	523
Audit and Weatherization Subtotal⁽²⁾	922	72%	1.44	37.5%	664
Online Marketplace Kits	362	85%	N/A	N/A	309
Online Marketplace Other	177	167%	N/A	N/A	296
Online Marketplace Weatherization	1	108%	N/A	N/A	1
Online Marketplace Subtotal⁽²⁾	541	112%	N/A	N/A	606
Instant Discount Other	2,856	114%	N/A	N/A	3,248
Instant Discount Subtotal⁽²⁾	2,856	114%	N/A	N/A	3,248
Ekotrope Modeled Homes - Certainty	5	100%	N/A	N/A	5
Ekotrope Modeled Homes	5,390	100%	0.00	0.1%	5,381
REM/Rate Modeled Homes	21	101%	0.03	1.1%	21
New Homes Subtotal⁽²⁾	5,416	100%	0.00	0.1%	5,408
ChargePoint and Emporia Chargers	20	97%	N/A	N/A	20
Tesla Chargers	8	27%	N/A	N/A	2
EV Charging Pilot Subtotal	28	78%	N/A	N/A	22
Component Subtotal⁽²⁾	30,436	105%	0.52	6.4%	32,094
Deep Energy Retrofits (PY15 verified in PY17)	17	45%	2.03	26.4%	8
Deep Energy Retrofits ⁽³⁾ (PY16 verified in PY17)	7	45%	2.03	26.4%	3
New Homes Ekotrope Modeled Homes (PY16 verified in PY17)	4,221	100%	0.00	0.1%	4,214
New Homes REM/Rate Modeled Homes (PY16 verified in PY17)	1,919	101%	0.02	1.1%	1,934

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

⁽³⁾ Due to an evaluation clerical error in the PY16 report, a portion of the Deep Energy Retrofits savings was already included in the PY16 verified savings. The values presented in this table and the Phase IV totals reflect the corrected savings and will not reconcile with the originally reported PY16 results.

Table I-6. Energy Efficient Homes Component Gross Impact Results for Demand

Stratum	PYRTD (MW/yr)	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System Level PYVTD (MW/yr)
Downstream Equipment HVAC	1.08	89%	0.67	21.9%	0.96	1.04
Downstream Equipment Other	0.11	99%	0.12	4.3%	0.11	0.12
Downstream Subtotal⁽²⁾	1.19	90%	0.82	19.4%	1.07	1.16
Midstream HVAC	0.01	93%	0.38	5.3%	0.01	0.01
Midstream Equipment Subtotal⁽²⁾	0.01	93%	0.38	5.3%	0.01	0.01
Audit	0.01	143%	0.19	6.3%	0.01	0.01
Weatherization	0.05	101%	0.05	2.0%	0.05	0.05
Audit and Weatherization Subtotal⁽²⁾	0.06	107%	0.08	1.9%	0.06	0.06
Online Marketplace Kits	0.03	83%	N/A	N/A	0.03	0.03
Online Marketplace Other	0.03	131%	N/A	N/A	0.03	0.04
Online Marketplace Weatherization	0.00001	110%	N/A	N/A	0.00001	0.00001
Online Marketplace Subtotal⁽²⁾	0.06	105%	N/A	N/A	0.06	0.06
Instant Discount Other	0.55	110%	N/A	N/A	0.61	0.66
Instant Discount Subtotal⁽²⁾	0.55	110%	N/A	N/A	0.61	0.66
Ekotrope Modeled Homes - Certainty	0.001	141%	N/A	N/A	0.0027	0.002
Ekotrope Modeled Homes	1.15	167%	0.20	6.9%	1.93	2.10
REM/Rate Modeled Homes	0.01	100%	0.13	4.8%	0.01	0.01
New Homes Subtotal⁽²⁾	1.16	167%	0.30	6.8%	1.94	2.11
ChargePoint and Emporia Chargers	0.002	107%	N/A	N/A	0.002	0.002
Tesla Chargers	0.001	30%	N/A	N/A	0.0002	0.0002
EV Charging Pilot Subtotal	0.003	85%	N/A	N/A	0.002	0.002
Total ⁽²⁾	3.03	124%	0.36	7.1%	3.74	4.07
Deep Energy Retrofits (PY15 verified in PY17)	0.0004	73%	2.03	46.9%	0.0003	0.0004
Deep Energy Retrofits ⁽³⁾ (PY16 verified in PY17)	0.0004	73%	2.03	46.9%	0.0003	0.0003
New Homes Ekotrope Modeled Homes (PY16 verified in PY17)	0.92	167%	0.20	6.9%	1.54	1.68

Stratum	PYRTD (MW/yr)	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System Level PYVTD (MW/yr)
New Homes REM/Rate Modeled Homes (PY16 verified in PY17)	0.41	100%	0.11	4.8%	0.41	0.45

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

⁽³⁾ Due to an evaluation clerical error in the PY16 report, a portion of Deep Energy Retrofits savings was already included in the PY16 verified savings. The values presented in this table and the Phase IV totals reflect the corrected savings and will not reconcile with the originally reported PY16 results.

The following sections describe the factors that led to discrepancies between the reported and verified savings and the observed realization rates.

Online Marketplace

Aerators and Showerheads Purchased Outside of Kits

Aerators purchased outside of kits have a realization rate of 120% because an ISR of 100% was assumed for the *ex post* analysis, opposed to the savings brief *ex ante* value of 83%, which was based on the average kit-measure ISR from the PY15 evaluation. The same explanation applies to showerheads purchased outside of kits. For both measures, the *ex post* analysis assumes 100% rather than 83%, resulting in higher overall savings estimates and realization rates. Aerators and showerheads should be interpreted with caution, as they are based on only three units per measure.

Room Air Conditioners, Smart Strips, Dehumidifiers, Thermostats, and Weatherization

Room air conditioners, smart strips, dehumidifiers, thermostats, and weatherization measures all achieved realization rates above 100% because the *ex post* analysis had higher survey-based ISRs from PY17 data than the *ex ante* analysis did, which utilized the PY15 evaluated ISRs. This higher assumption for active measure use increased the *ex post* savings estimates. Room air conditioner results should be interpreted with caution, as they are based on a single unit.

Total Kits

The overall realization rate for total kits was 85%, below the expected 100%. This is because *ex post* analysis used lower ISR values than the *ex ante* calculations for several measures in the kit. ISRs decreased for LED nightlights (from 83% to 79%) and for showerheads, bathroom aerators, kitchen aerators, and pipe insulation (all from 83% to 42%). Advanced power strips increased from 83% to 96%, but the increase is not enough to offset the overall decreases for other measures.

Instant Discount

Discrepancies between reported and verified energy and demand realization rates for the Instant Discount subcomponent were also largely driven by ISRs. Table I-7 lists the *ex ante* and *ex post* ISRs for each Instant Discount measure. The *ex ante* ISRs were based on the PY15 evaluation report. Cadmus based *ex post* ISRs on the PY17 Online Marketplace survey, which were higher across the board. As such, the overall energy and demand realization rates exceed 100%.

Table I-7. Instant Discount In-Service Rates

Measure Category	<i>Ex Ante</i> ISR	<i>Ex Post</i> ISR	Difference	<i>Ex Post</i> Source
Stand-Alone Purchases				
Dehumidifier	83%	98%	+15%	Survey Data. Combined appliance data from the Online Marketplace.
Air Purifier	83%	98%	+15%	Survey Data. Combined appliance data from the Online Marketplace.
Smart Thermostat	75%	76%	+1%	Survey Data. Online Marketplace thermostats.
Room Air Conditioner	83%	98%	+15%	Survey Data. Combined air purifier and dehumidifier data from the Online Marketplace and Downstream Equipment.
Air Filter	100%	100%	0%	Deemed. Assumed to be 100%.
Pipe Insulation	89%	93%	+4%	Survey Data. Average of weatherization measures from the Online Marketplace.
Showerhead	83%	100%	+17%	New measure for PY17, assuming 100%. Insufficient Online Marketplace showerheads sold (n=3).

The following factors also contributed to differences between *ex ante* and *ex post* realization rates:

- **Dehumidifier.** *Ex ante* savings included some units that had lost their ENERGY STAR Most Efficient designation when the recognition criteria were updated in 2024. For evaluated savings, Cadmus treated them as standard ENERGY STAR-certified units.
- **Air Purifier.** *Ex ante* savings did not incorporate new federal minimum standards that took effect in PY16. Additionally, some units were purchased before June 1, 2025, in Q1, but *ex ante* calculations used an older ISR assumption of 100%.
- **Smart Thermostat.** Cadmus calculated the evaluated savings using TRM default assumptions for heating and cooling system types, while *ex ante* savings calculations used heating and cooling saturation percentages from the PY15 evaluation report.
- **Pipe Insulation.** Most, but not all, pipe insulation measures were pre-slit, self-sealing foam. The remainder were either foil-backed fiberglass pipe wrap or foam insulation tape; however, the tracking data incorrectly listed the length of the wrap/tape rather than the length of the insulated pipe. Additionally, some units in Q1 and early Q2 were purchased before June 1, 2025, and *ex ante* calculations used an older 62% ISR taken from the PY13 evaluation.

Deep Energy Retrofit

Cadmus included three participants in the Deep Energy Retrofit analysis. The overall energy realization rate for all three projects was 45%. Two participants achieved an energy realization rate of approximately 114%, but one participant claimed *ex ante* savings of 16,990 kWh/yr, which exceeded the entire pre-usage period of 16,267 kWh/yr. There were three ductless heat pumps installed at this project site, and each claimed over 5,000 kWh/yr, resulting in a total of 16,525 kWh/yr claimed for ductless heat pumps. The heat pumps were installed in two primary rooms and a secondary room. The savings for each zone were too high for this participant. Prospectively, the energy realization rate could be approximately 114% if the

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savings for multiple ductless units are allocated to the zone, rather than using the same home total value for each unit.

New Homes

For the PY17 New Homes evaluation, Cadmus determined a program-level realization rate of 100% for annual electric energy savings and 167% for peak demand savings. The close alignment between evaluated and claimed annual energy savings indicates that the Ekotrope models generally produced accurate estimates. In contrast, evaluated peak demand savings exceeded claimed peak demand savings by a substantial margin.

The higher evaluated demand savings were primarily due to the peak demand calculation methodology used. Cadmus calculated peak demand savings directly from hourly Ekotrope model outputs and identified each home's maximum daily average demand reduction during summer peak periods, as defined per the TRM. For many sampled homes, the resulting peak demand reductions exceeded the corresponding claimed demand savings, producing a demand realization rate significantly above 100%.

The hourly Ekotrope analysis identified greater coincident summer peak demand reductions than reflected in the claimed demand savings. By calculating each home's maximum daily average demand reduction during TRM-defined summer peak periods, the evaluation captured project-specific peak impacts directly from the hourly model outputs rather than relying on simplified demand assumptions. Because annual electric savings closely matched reported values while demand savings were substantially higher, the results suggest that the claimed demand savings methodology may have understated coincident summer peak demand reductions.

EV Charging Pilot

For the EV Charging Pilot evaluation, Cadmus determined realization rates of 78% for annual electric energy savings and 85% for peak demand savings for the pilot. Two factors caused demand and energy realization rates to differ from 100%. First, the charging behavior of participants included in the third-party network service provider dataset and attributed to participants with ENERGY STAR Level 2 chargers differed from the expected behavior for EV charging. On average, participants in the sample spent less total time with their vehicles plugged in and more time actively charging their vehicles than anticipated. These EV chargers realized less energy savings from total time spent in plugged- or unplugged-standby modes, resulting in an energy savings realization rate below 100%. Although participants' EV chargers spent a higher ratio of standby time unplugged, a greater energy savings state, it was not enough to offset the greater active charging time. However, this higher-than-expected ratio of unplugged-standby time contributed to a demand savings realization rate slightly above 100%.

The second and more significant factor behind the energy realization rate below 100% is that a significant number of participants in the Tesla Chargers stratum of the EV Charging Pilot could not be verified as having an ENERGY STAR Level 2 charger. These participants were associated with a Tesla vehicle or an unverifiable Tesla charger and were assigned an *ex post* demand and energy savings of zero. This population of participants with zero demand or energy savings resulted in the overall EV Charging Pilot demand and energy savings realization rate being significantly below 100%.

Figure I-1 shows the average weekday coincident load from ChargePoint, Emporia, and Tesla charging by month for the EV Charging Pilot. In all months, average charging load peaked between 8:00 p.m. and 10:00 p.m. with a maximum average load of 306 kW recorded in February 2026.

Figure I-1. Average Weekday Charging Load

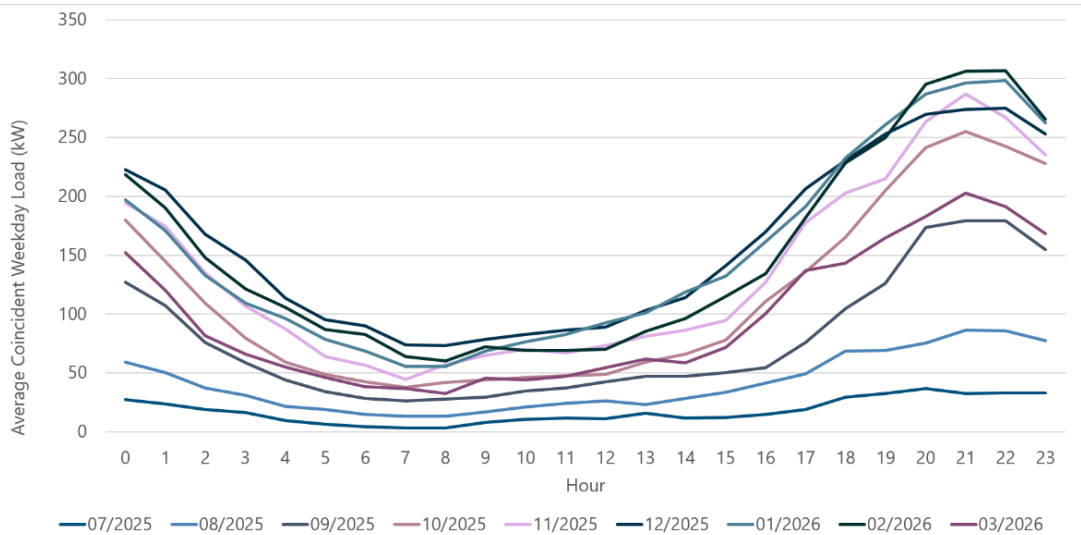
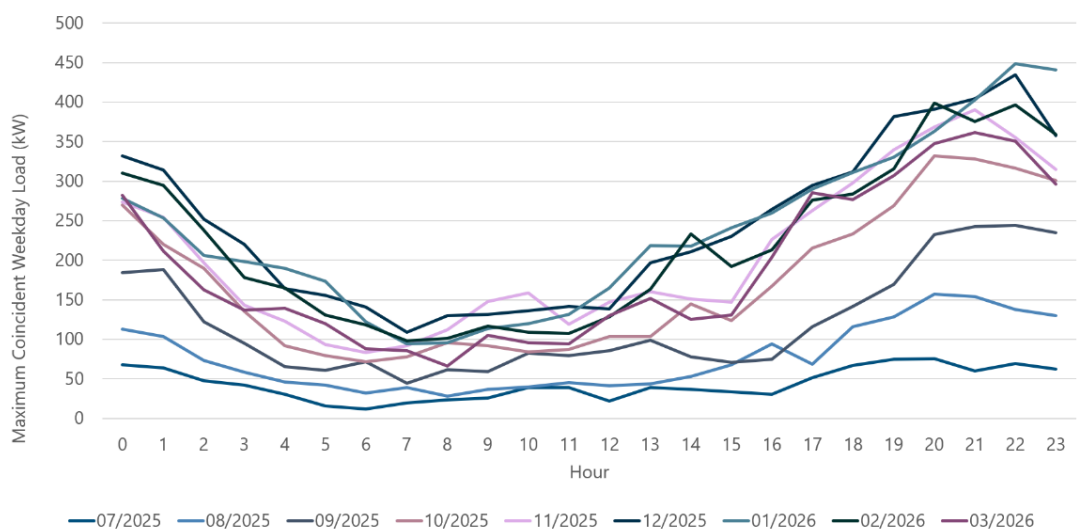


Figure I-2 shows the maximum weekday coincident load by month from ChargePoint, Emporia, and Tesla charging for the EV Charging Pilot. In all months, maximum charging load peaked between 7:00 p.m. and 10:00 p.m., with a single point maximum coincident charging load of 448 kW recorded in January 2026.

Figure I-2. Maximum Weekday Coincident Charging Load by Month



I.2.Net Impact Evaluation

I.2.1.Net Impact Methodology

Cadmus applied methods outlined in the Evaluation Framework to determine free ridership, spillover, and net savings for downstream, upstream, and midstream programs.⁶¹ Cadmus applied historical net-to-gross ratios to all gross savings values except EV Charging Pilot, in which the team used online self-report surveys to assess free ridership and spillover.

Cadmus calculated net savings to inform future program planning. Energy savings and demand reduction compliance targets are measured using verified gross savings.

Table I-8 summarizes the methods and sampling strategy used to determine net savings for the EV Charging Pilot.

**Table I-8. Energy Efficient Homes EV Charging Pilot
Net Impact Evaluation Sample Design**

Stratum	Evaluation Year	Stratum Boundaries	Population Size ⁽¹⁾	Achieved Sample Size ⁽²⁾	NTG Activity
All Chargers	PY17	Participants (Customers)	481	122 ⁽³⁾	Participant online survey

⁽¹⁾ The population sizes may differ among impact, process, and net savings analyses.

⁽²⁾ The number of respondents used in the net savings analysis differs from the number used in the gross impact and process evaluation.

⁽³⁾ Achieved sample size is based on the number of survey respondents answering the free ridership question, “What would you most likely have done if the EV charger you purchased from the PPL Energy Efficiency Marketplace was not discounted? Or the free ridership question, “What would you most likely have done if a rebate had not been available for the EV charger that you purchased?” Plus, answering at least one of the questions, “Please rate the following items on how much influence each item had on your decision to purchase the ENERGY STAR, Level 2, Networked EV charger(s). Please use a scale from 1 to 5, 1 meaning *no influence*, and 5 meaning the item was *extremely influential* in your decision. The instant discount from PPL Electric Utilities for the EV charger, the rebate from PPL Electric Utilities for the EV charger, PPL Electric Utilities’ information about energy efficiency and peak demand, the convenience of being able to buy online from PPL Electric Utilities, Information about the EV chargers on the PPL Electric Utilities Online Marketplace, and information about EV chargers from PPL Electric Utilities.”

Free Ridership

Cadmus summed the intention and influence free ridership components to estimate the average total intention and influence free ridership by stratum, weighted by verified gross kWh/yr savings.

Table I-9 summarizes the intention, influence, and free ridership scores for the EV Charging Pilot.

⁶¹ Pennsylvania Public Utility Commission. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

**Table I-9. Energy Efficient Homes EV Charging Pilot
Intention, Influence, and Free Ridership Score**

Stratum	Number of Respondents	Intention Score	Influence Score	Free Ridership Score
EV Charging Pilot	122	38%	11%	49%

Spillover

Table I-10 lists the quantity of spillover energy-efficient equipment that the respondents for the EV Charging Pilot attributed to PPL Electric Utilities. The table also lists the per-unit energy savings and the source of the estimated energy savings used in the spillover analyses.

Table I-10. Energy Efficient Homes EV Charging Pilot Spillover Calculation

Spillover Product	Respondent Quantity	Per-Unit Savings (kWh/yr)	Savings Source
Refrigerator	1	54	PY17 PPL Electric Utilities Gross Verified Savings

Table I-11 shows the PY17 spillover results for the EV Charging Pilot.

**Table I-11. Energy Efficient Homes Component Spillover Calculation for
EV Charging Pilot**

Variable	Variable Description	Downstream Equipment	Source
A	Survey Sample Size (n)	122	Survey Data
B	Total Survey Sample Spillover kWh/yr Savings	54	Survey Data/Engineering Estimates
C	Average Spillover kWh/yr Savings Per Survey Respondent	0.45	Variable B ÷ Variable A
D	Program Participant Population	481 ⁽¹⁾	Program Tracking Data
E	Spillover kWh/yr Savings Extrapolated to the Participant Population	214	Variable C × Variable D
F	Evaluated Program Population kWh/yr Savings	21,941	Evaluated Gross Impact Analysis
G	Spillover Percentage Estimate	1.0%	Variable E ÷ Variable F

⁽¹⁾ 481 unique PY17 participants.

I.2.2. Net-to-Gross Results

Table I-12 shows the EV Charging Pilot free ridership, spillover, and NTG ratios.

**Table I-12. Energy Efficient Homes Component – EV Charging Pilot
Net Impact Evaluation Results**

Stratum	PYVTD kWh/yr	Evaluation Year	Free Ridership (%) ⁽¹⁾	Spillover (%)	NTG Ratio ⁽¹⁾
EV Charging Pilot	21,941	PY17	49%	1%	52%
Total	21,941	-	49%	1%	52%

⁽¹⁾ Free ridership estimates were weighted by the survey sample-verified component kWh/yr savings. This method ensures that respondents who achieved higher energy savings through the component have a greater influence on the equipment-level free ridership estimate than respondents who achieved lower energy savings.

Table I-13 shows the NTG ratio results for each stratum of the Energy Efficient Homes component. The overall Energy Efficient Homes component NTG ratio of 0.56 is heavily weighted towards the Downstream Equipment stratum NTG ratio of 0.52, as this stratum represents 69% of the Energy Efficient Homes component verified gross population energy savings.

Table I-13. Energy Efficient Homes Component NTG Ratio Summary

Stratum	PYVTD kWh/yr	Evaluation Year	Free Ridership (%)	Spillover (%)	NTG Ratio
Audit and Weatherization	663,922	PY14	52% ⁽¹⁾	14%	0.62
Downstream Equipment	22,077,104	PY16	48% ⁽¹⁾	0%	0.52
Midstream Equipment	69,167	PY16 ⁽²⁾	48%	0%	0.52
Online Marketplace	606,088	PY15	20% ⁽³⁾	8%	0.88
Instant Discount ⁽⁴⁾	3,247,937	PY15	35%	0%	0.65
New Homes	5,407,649	PY13	36% ⁽³⁾	0%	0.64
EV Charging Pilot	21,941	PY17	49% ⁽³⁾	1%	0.52
Component Total^{(5),(6)}	32,093,808	-	44.23%	0.44%	0.56

⁽¹⁾ Measure category-level free ridership estimates within the stratum were weighted by the survey sample-verified component kWh/yr savings. This method ensured that respondents who achieved higher energy savings had a greater influence on the measure category-level free ridership estimate than respondents who achieved lower energy savings. The measure category-level free ridership estimates within the stratum were weighted by PY17 population verified kWh/yr savings associated with each measure category to arrive at the stratum-level free ridership ratio for PY17.

⁽²⁾ Due to low participation, Cadmus applied PY16 downstream NTG ratios as approved by the SWE in the evaluation plan.

⁽³⁾ Stratum-level free ridership estimates were weighted by the survey sample-verified component kWh/yr savings. This method ensured that respondents who achieved higher energy savings through the component products had a greater influence on the equipment-level free ridership estimate than respondents who achieved lower energy savings.

⁽⁴⁾ Benchmarked NTG ratios were weighted by PY17 gross verified kWh/yr savings to arrive at the Instant Discount stratum's NTG ratio of 0.65.

⁽⁵⁾ The stratum-level free ridership, spillover, and NTG ratio estimates were weighted by the component population's verified kWh/yr savings to arrive at the final Energy Efficient Homes component NTG ratio of 0.56.

⁽⁶⁾ Total may not match the sum of rows due to rounding.

I.3.Process Evaluation

Cadmus conducted a process evaluation of the Energy Efficient Homes component using data collected through online participant surveys and interviews with staff from PPL Electric Utilities, the ICSP, and participating EV charger manufacturers. The research objectives for the process evaluation were to assess participant satisfaction, review component changes and performance, assess component design, and make recommendations for improvement.

Process activities were consistent with planned activities. A total of 361 respondents—73 in Downstream Equipment, 77 in Audit and Weatherization, 74 in Online Marketplace, and 137 EV Charging Pilot subcomponents—completed the online survey from April through May 2026. See [Appendix L](#) for details on Cadmus' approach to reduce survey bias and contact instructions.

Cadmus also completed interviews with manufacturers participating in the EV Charging Pilot. The team made multiple outreach attempts via email and telephone to manufacturers (three records) and completed two interviews with this group. Interviews assessed program experience and satisfaction, challenges to participation, program influence on manufacturer behavior, and gathered feedback for improvement.

Sample sizes noted in this report may vary by survey or interview question because respondents could skip questions they chose not to answer; therefore, not all respondents provided answers to every question. Cadmus included all survey and interview respondents who were eligible and answered at least one question, regardless of whether they completed the survey or interview.

Table I-14 shows the sampling strategy for the process evaluation.

Table I-14. Energy Efficient Homes Component Process Evaluation Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size	Assumed Proportion or Cv in Sample Design	Planned Sample Size	Achieved Sample Size	Records in Sample Frame ⁽¹⁾	Percent of Sample Frame Contacted to Achieve Sample ⁽²⁾
EV Charging Pilot	Key individuals from PPL Electric Utilities, ICSP, and the ICSP's subcontractors	Telephone in-depth interview	3	N/A	3	3	N/A	100%
EV Charging Pilot	Participating OEMs	Telephone in-depth interview	3	N/A	2	2	3	100%
Component Participants	Downstream Equipment	Online survey	7,213 ⁽³⁾	0.50	40	73 ⁽⁴⁾	5,584	18%
	Audit & Weatherization	Online survey	1,115 ⁽³⁾	0.50	23	77 ⁽⁴⁾	825	85%
	Online Marketplace	Online survey	2,385 ⁽³⁾	0.50	23	74 ⁽⁴⁾	1,891	100%
	EV Charging Pilot	Online survey	452 ⁽³⁾	N/A	AMAP	137	452	100%
Component Total			11,171	N/A	91+	366	8,755	N/A

⁽¹⁾ A sample frame is a list of participants and stakeholders with contact information who had a chance to complete the survey or interview. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the surveys. After selecting all unique records, Cadmus removed any records from the population that lacked valid contact information (email or telephone number), were on the "do not contact" list, or opted out of the online survey.

⁽²⁾ Percent contacted means the percentage of the sample frame contacted to complete surveys/interviews.

⁽³⁾ Number of participants in the PPL Electric Utilities' tracking database at the time of the PY17 survey, which occurred before the end of the program year.

⁽⁴⁾ The achieved sample size shows the number of respondents who completed the survey. When reporting, Cadmus included all responses in the analysis, even if the respondent did not complete the survey. The number of respondents used in the process evaluation differs from the numbers used in the gross impact and net impact analysis.

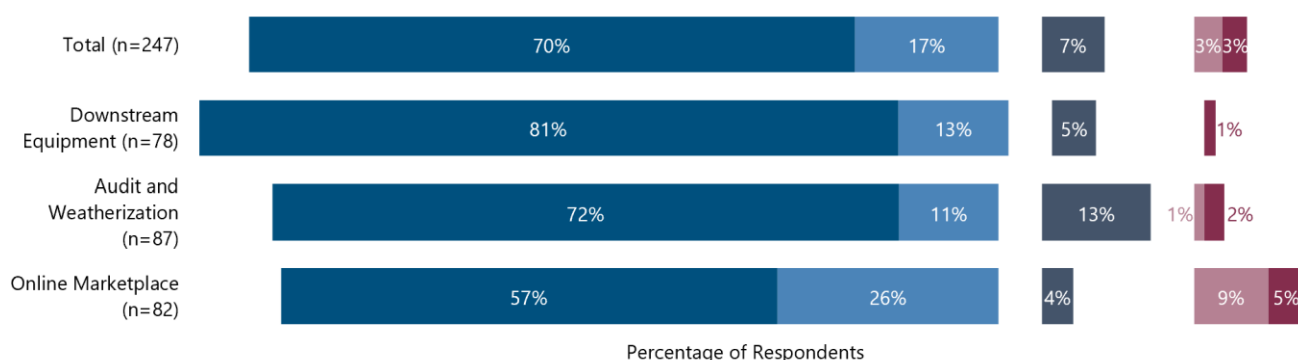
I.3.1. Program Component Experience: Downstream Equipment, Audit and Weatherization, and Online Marketplace

Downstream Equipment, Audit and Weatherization, and Online Marketplace survey respondents rated their satisfaction with different aspects of the Energy Efficient Homes component, provided insights about their satisfaction ratings, and rated the effect of their participation on their opinion of PPL Electric Utilities.

Overall Program Component Satisfaction

Across all subcomponents, a large majority of respondents (87%) were satisfied with their experience (Figure I-3), with overall satisfaction rated at either *very* (70%) or *somewhat satisfied* (17%).

Figure I-3. PY17 Overall Satisfaction with Energy Efficient Homes by Subcomponent



Source: Downstream Equipment, Audit and Weatherization, and Online Marketplace Participant Surveys, "Thinking about your overall experience with the PPL Electric Utilities [program], how would you rate your satisfaction?" Note: Totals may not sum due to rounding and may not match the totals in the infographic. Sample sizes reflect partially completed surveys.

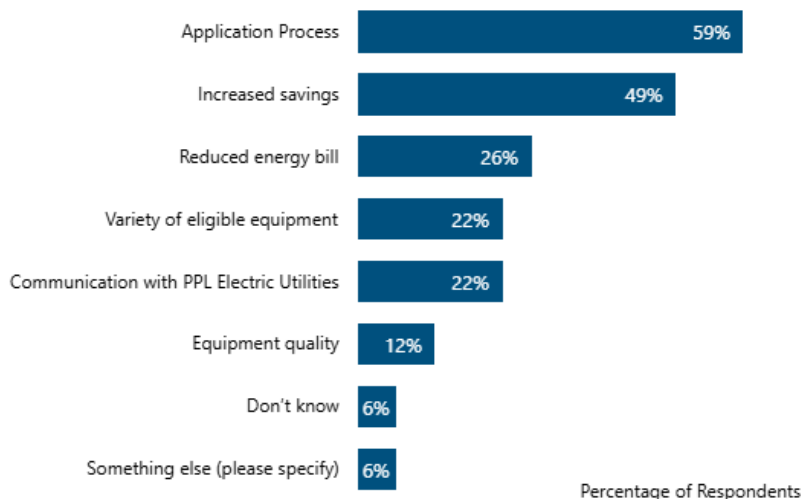
Drivers of Program Component Satisfaction

To better understand what drives satisfaction, the survey asked participants of the Downstream Equipment and Audit and Weatherization subcomponents what factor(s) led to their satisfaction rating.

In Downstream Equipment, as shown in Figure I-4, top drivers of high satisfaction were the application process (59%), increased energy savings (49%), and a reduced energy bill (26%).

Four of the Downstream Equipment respondents who were *not too satisfied* or *not at all satisfied* with their overall experience with the program provided a reason for their dissatisfaction. The main factors these participants cited as impacting their experience were the application process (three respondents) and equipment quality (one respondent).

Figure I-4. Drivers of High Satisfaction for Downstream Equipment



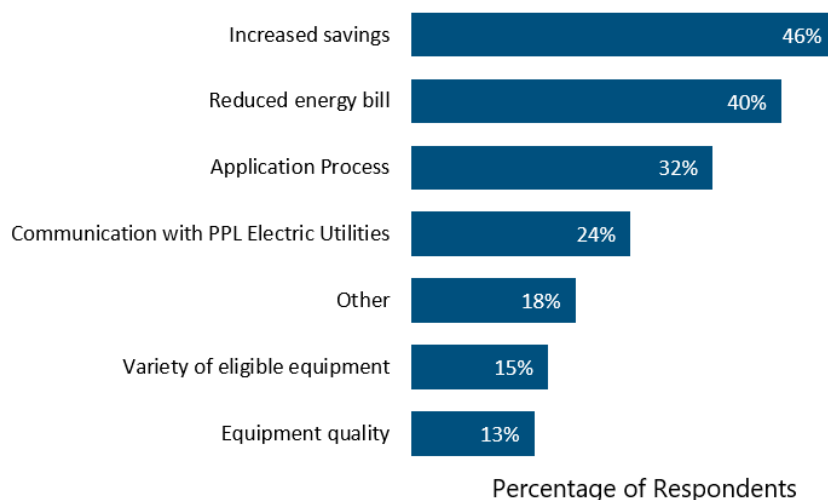
Source: Downstream Equipment Participant Survey, "What factor(s) most affected the overall experience rating you gave?" (n=68; multiple responses allowed)

Note: *Not at all satisfied* (n=1) and *Neither satisfied nor dissatisfied* (n=4) responses not included in this chart

As shown in Figure I-5, the top drivers of high satisfaction for the Audit and Weatherization respondents were increased energy savings (46%), reduced energy bill (40%), and the application process (32%).

One Audit and Weatherization respondent was *not too satisfied* with their overall experience with the program, two were *not at all satisfied*, and 11 were *neither satisfied nor dissatisfied*. The drivers for the low ratings were related to the quality of the equipment or services they received (three respondents), the application process (three respondents), communication with PPL Electric Utilities (two respondents), a variety of eligible equipment (two respondents), not experiencing increased savings (two respondents), and not seeing a reduction in energy bills (two respondents).

Figure I-5. Audit and Weatherization Drivers of High Satisfaction



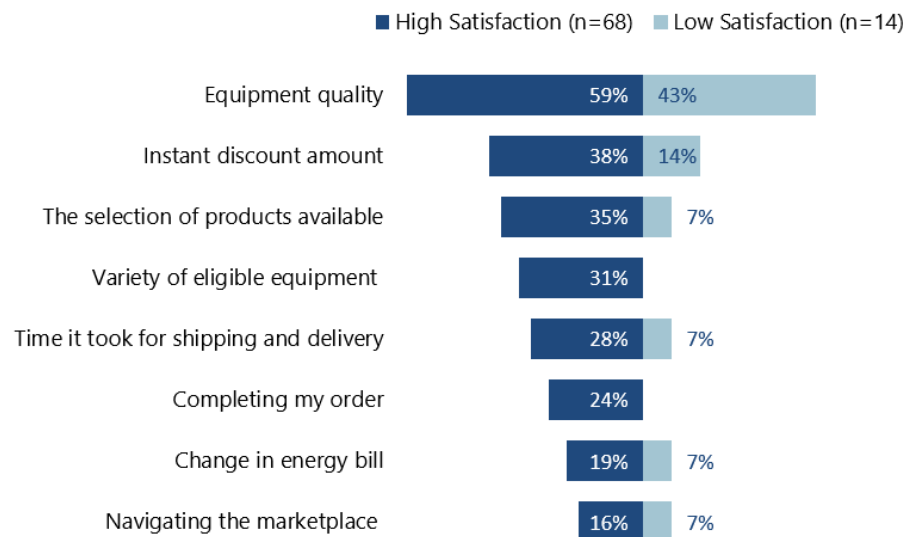
Source: Audit and Weatherization Participant Survey, “What factor(s) most affected the overall experience rating you gave?” (n=68; multiple responses allowed)

Note: *Not too satisfied* (n=1), *Not at all satisfied* (n=2) and *Neither satisfied nor dissatisfied* (n=11) responses not included in this chart.

For the Online Marketplace, as shown in Figure I-6, top drivers of positive experiences were the equipment quality (59%), the instant discount amount (38%), and the selection of products available (35%).

Fourteen of the Online Marketplace respondents who were *not too satisfied*, *not at all satisfied*, or *neither satisfied nor dissatisfied* with their overall experience with the rebate provided a reason for their dissatisfaction (Figure I-6). The main reasons these participants cited as impacting their experience were the quality of the equipment (six respondents) and the amount of the instant discount (two respondents).

Figure I-6. Drivers of High and Low Satisfaction for Online Marketplace



Source: Online Marketplace Participant Survey, “What factor(s) most affected the overall experience rating you gave?” (n=82; multiple responses allowed)

Opinion of PPL Electric Utilities

Offerings in the Downstream Equipment and Audit and Weatherization subcomponents impacted how customers view PPL Electric Utilities. Forty six percent of Downstream Equipment respondents and 48% of Audit and Weatherization respondents said their opinion of PPL Electric Utilities had improved. No Downstream Equipment respondents said that their opinion of PPL Electric Utilities decreased, and only 8% of Audit and Weatherization respondents said that their opinion of the utility decreased. The remaining respondents said their opinion had not changed.

When asked why their opinion of PPL Electric Utilities decreased since participating in the program, five Audit and Weatherization respondents provided reasons. Two were frustrated because they did not receive all the rebates they applied for or an explanation for why their applications were denied. Two respondents were not happy with the value of the rebates, and one respondent said they had to work hard to ultimately receive them.

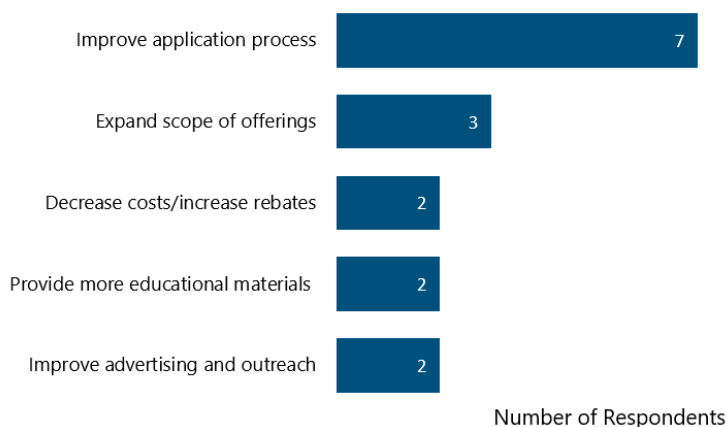
Forty percent of Online Marketplace respondents said their opinion of PPL Electric Utilities increased since ordering a product, and only 3% said it decreased. For the two respondents whose opinion decreased, both had challenges using the product they ordered from the marketplace and did not feel that PPL Electric Utilities addressed their concerns.

Suggestions for Improvement

The survey asked respondents what PPL Electric Utilities could do to improve the Energy Efficient Homes component. Not all respondents had a suggestion.

For the Downstream Equipment subcomponent, 22% of respondents suggested improvements, as shown in Figure I-7. The most common suggestion was for PPL Electric Utilities to improve the application process (seven respondents). Several respondents struggled, for example, with navigating and applying through the subcomponent’s website. Two respondents mentioned that they had to make several application attempts before they were successful. The second most common suggestion (three respondents) was to expand the scope of product offerings under the Downstream Equipment subcomponent. Respondents specifically suggested new windows, and dishwashers as included offerings, along with mini-split heat pumps which are offered through the program.

Figure I-7. Downstream Equipment Improvement Suggestions

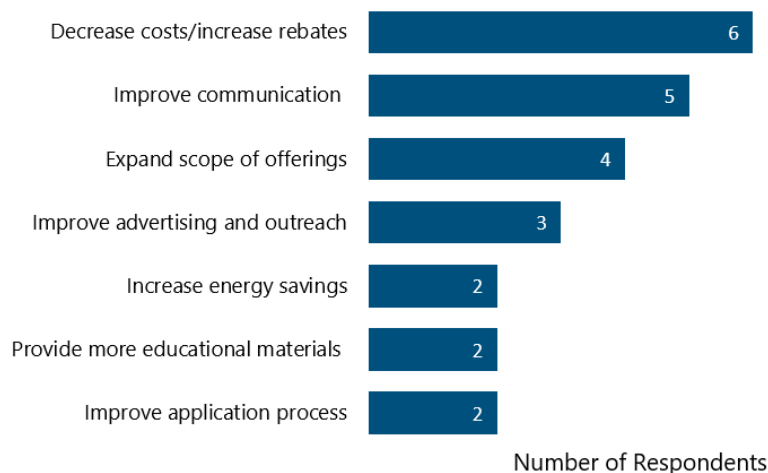


Source: Downstream Equipment Participant Survey, “What is the one thing PPL Electric Utilities could change about the program to improve it?” (n=16)

For the Audit and Weatherization subcomponent, 31% of respondents offered suggestions, as shown in Figure I-8. The most common suggestions were to decrease costs or increase rebates (six respondents), improve communication (five respondents), and expand the scope of product offerings (four respondents). Respondents who wanted improved communication explained that they had trouble finding

clear answers to questions from program staff, such as why rebates they applied for were not approved. One respondent suggested expanding offerings to include window and door replacements.

Figure I-8. Audit and Weatherization Improvement Suggestions



Source: Audit and Weatherization Participant Survey, "What is the one thing PPL Electric Utilities could change about the program to improve it?" (n=24)

For the Online Marketplace subcomponent, 28% of respondents suggested improvements, as shown in Figure I-9. The most common suggestions were for PPL Electric Utilities to increase product variety and availability (eight respondents) and improve product quality and variety (four respondents). Several respondents suggested broadening product offerings in general, though a few mentioned specific products such as light bulbs and remote-operated power strips.

Figure I-9. Online Marketplace Improvement Suggestions



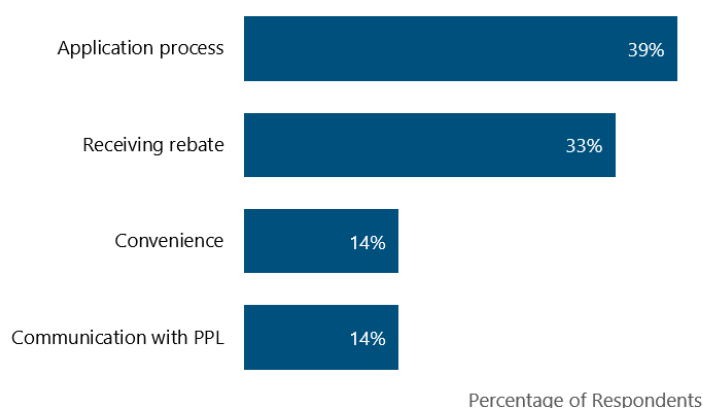
Source: Online Marketplace Participant Survey, "What is the one thing PPL Electric Utilities could change about the program to improve it?" (n=21)

Program Component Successes

The survey asked respondents which aspects of the program worked especially well. Not all respondents had a suggestion.

For the Downstream Equipment subcomponent, 36 respondents offered examples of what went well during their participation, as shown in Figure I-10. The most common successful aspects were the application process (39%), receiving the rebate (33%), convenience (14%), and communication with PPL Electric Utilities (14%). Many respondents simply said the process was easy; however, one explained they “lost the [rebate] check,” but “it was easy to contact PPL [Electric Utilities], and they reissued it in a timely manner.”

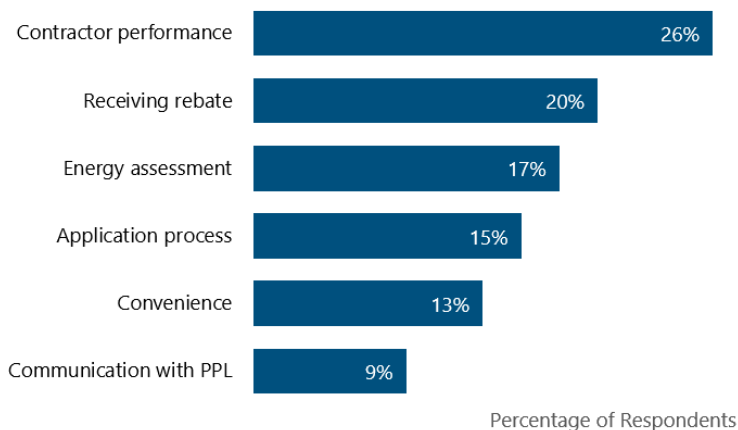
Figure I-10. Downstream Equipment Component Success



Source: Downstream Equipment Participant Survey, “Please describe what went well” (n=36)

For the Audit and Weatherization subcomponent, 46 respondents offered examples of what went well during their participation, as shown in Figure I-11. The most common successful aspects of the subcomponent were the contractor performance (26%), receiving the rebate (20%), and the energy assessment (17%). Respondents who were happy with their assessors or contractors described them as “knowledgeable” and “professional,” with five respondents specifically mentioning the ease of having their contractor submit the application for them.

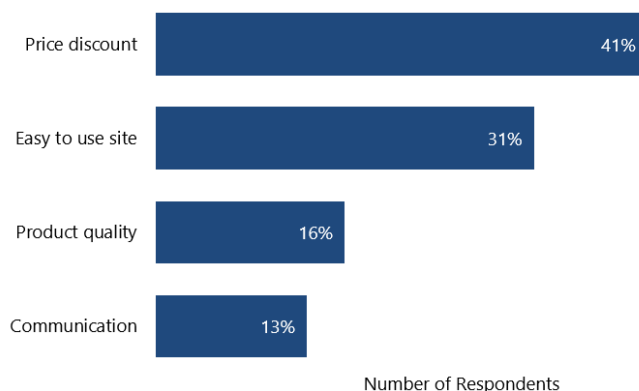
Figure I-11. Audit and Weatherization Component Success



Source: Audit and Weatherization Participant Survey, "Please describe what went well" (n=46)

For the Online Marketplace, 32 respondents offered examples of what went well during their participation, as shown in Figure I-12. The most common successful aspects of the component were the price discount on products (41%), the ease of use of the Online Marketplace website (31%), the product quality (16%), and communication from the Marketplace (13%). One respondent said that the discounts available on the marketplace were "the best [they] could find." Another respondent said that "great prices on quality [smart power] strips encourage customers to replace their outdated strips."

Figure I-12. Online Marketplace Component Success



Source: Online Marketplace Participant Survey, "What do you think worked particularly well with the program? Please be as detailed as possible." (n=32)

I.3.2.EV Charging Pilot

The process evaluation for the EV Charging Pilot included three in-depth interviews with PPL Electric Utilities and implementation staff, two interviews with charger manufacturers, and one online survey with participants.

The survey received 140 responses, with 137 respondents completing it. Fifty-two respondents reported purchasing an EV charger using the PPL Electric Utilities Online Marketplace, and 83 respondents reported pursuing a downstream rebate for at least one EV charger. Table I-15 and Table I-16 show the breakdown of responses by housing type, for the delivery channel used, and the type of vehicle charged.

Table I-15. Survey Responses by Home Type

Home Type	Delivery Channel	
	Downstream	Online Marketplace
Single-family detached	68	44
Multifamily	1	1
Attached house	11	4
Other	0	1

Source: EV Charging Pilot Participant Survey, "Which type of home do you live in?" (n=130)

Table I-16. Survey Responses by Vehicle Type

Home Type	Vehicle Type			
	Sedan	SUV	Truck	Other
Single-family detached	26	66	10	7
Multifamily	0	2	0	0
Attached house	4	10	0	1
Other	0	1	0	0
Total	30	79	10	8

Source: EV Charging Pilot Participant Survey, "Which type of home do you live in?" and "What type of electric vehicle are you primarily charging with your purchased EV charger(s)?" (n=127; three respondents did not provide vehicle type)

Respondents reported the type of vehicle they are charging with their purchased EV charger (n=127), with 24% charging sedans, 62% charging SUVs, and 8% charging trucks. Six percent of respondents reported charging an "Other" type of vehicle, including hatchbacks and vans. Eighty-four percent of respondents (n=127) said their vehicle was a battery-only electric vehicle, while 16% said their vehicle was a plug-in hybrid. Twenty-one percent of respondents (n=126) also reported using their charger for a second vehicle.

Pilot Design and Implementation

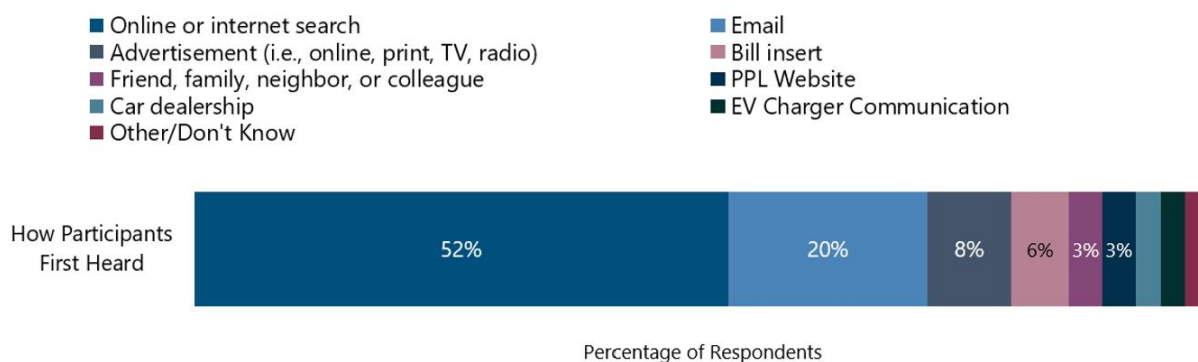
The pilot, which took place from July 2025 to January 2026, sought to increase PPL Electric Utilities' understanding of a new and growing market in its territory, support future program design, and understand opportunities for load management. The pilot enabled customers to receive an incentive either as a discount on chargers on the Online Marketplace or a rebate for a recently purchased charger. At launch, the incentive was delivered upon submission of marketplace or rebate information, but the timing was adjusted in November to follow installation and enrollment in data sharing. The pilot was offered to all residential customers in PPL Electric Utilities' territory.

Findings from interviews with ICSP and program staff indicate that the pilot's relatively short timeframe contributed to pilot design changes during implementation, specifically to support customer enrollment and data sharing. During the pilot, the program implementation team developed an installer list and

offered it to Online Marketplace customers through selected outreach channels in November, and 2% of survey respondents reported receiving an installer list associated with the EV Charging Pilot. The team also shifted how incentives were paid in November, with customers receiving a larger share of the incentive after enrolling in data sharing. According to the ICSP, this led to a higher percentage of customers enrolling in data sharing after the shift than before it.

Marketing efforts included online marketing (for example, ads during relevant Google searches), ads placed in social media, and email outreach to customers believed to have EVs, as well as door-to-door handout distribution and face-to-face visits to car dealerships. Program staff also engaged car dealerships and charger OEMs for pilot promotion. The survey asked pilot participants how they first heard about the pilot, and respondents most frequently reported learning about the pilot via online/internet searches (52%, Figure I-13).

Figure I-13. How Participants Learned About the Pilot



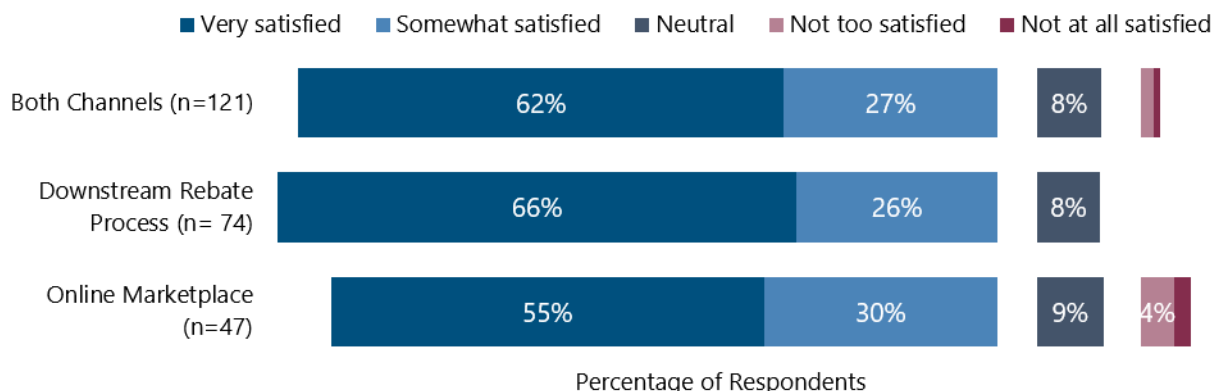
Source: Electric Vehicle Charging Pilot Survey, "Please select how you first heard about the EV Charging Pilot." (n=122)

Program Satisfaction

Cadmus assessed satisfaction with the EV Charging Pilot among participating customers and manufacturers, gathering customer feedback through surveys and manufacturer feedback through interviews.

A large majority (89%) of survey respondents were satisfied with their overall program experience (Figure I-14).

Figure I-14. Participant Satisfaction with Rebate Process and Online Marketplace



Source: Electric Vehicle Charging Pilot Survey, "Thinking about your overall experience with the PPL Electric Utilities rebate process, how would you rate your satisfaction?" (n=74) and "Thinking about your overall experience with the PPL Electric Utilities Marketplace, how would you rate your satisfaction?" (n=47)

The survey further asked downstream rebate participants (n=73) about their satisfaction with the rebate enrollment process. Eighty-one percent said they were *somewhat* or *very satisfied*, and 8% said they were *not too satisfied* or *not at all satisfied* (the remaining were neither satisfied nor unsatisfied).

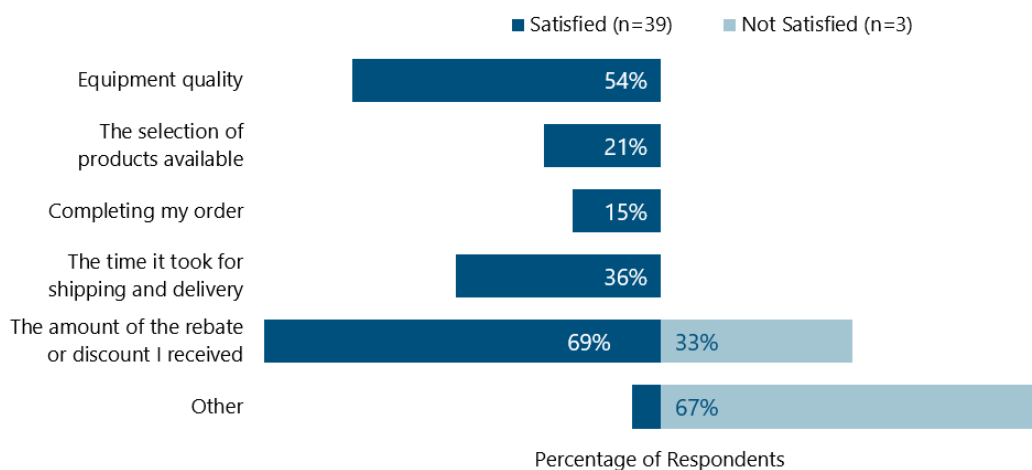
During interviews, Cadmus asked manufacturers about their experiences participating in the EV Charging Pilot. One manufacturer said that communication with program staff went smoothly, and the pilot was easy to engage with. Another manufacturer said the manual data entry to add participants was slightly challenging because they typically collect customer consent and enroll users directly through their app.

Drivers of Program Satisfaction

The survey asked respondents what factors most contributed to the satisfaction ratings they provided regarding their experience with the Online Marketplace and the downstream rebate process.

Satisfied Online Marketplace respondents most frequently reported satisfaction with the amount of rebate or discount received and the quality of the equipment as drivers of satisfaction. They also reported the amount of rebate and other factors as the main drivers of dissatisfaction (see Figure I-15). Respondents who reported "other" noted installation complexity, lack of information on rebate timing, and difficulty enrolling their charger.

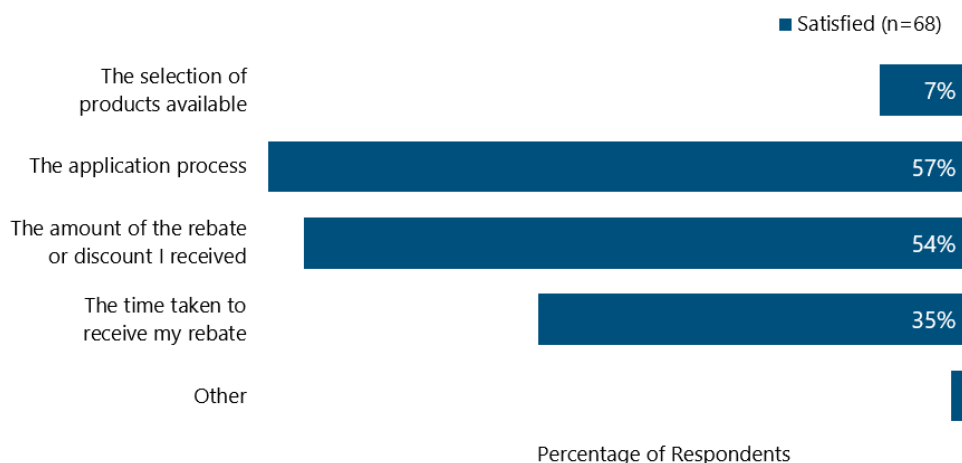
Figure I-15. Drivers of Pilot Participant Online Marketplace Experience



Source: Electric Vehicle Charging Pilot Survey, "What factor(s) most affected the overall experience rating you gave?" (n=42).

Satisfied downstream rebate respondents most frequently reported satisfaction with the application process and amount of rebate or discount received as drivers for their satisfaction (see Figure I-16). Though still satisfied, respondents who reported "other" noted difficulty getting the rebate and support from rebate staff.

Figure I-16. Drivers of Pilot Participant Downstream Rebate Experience

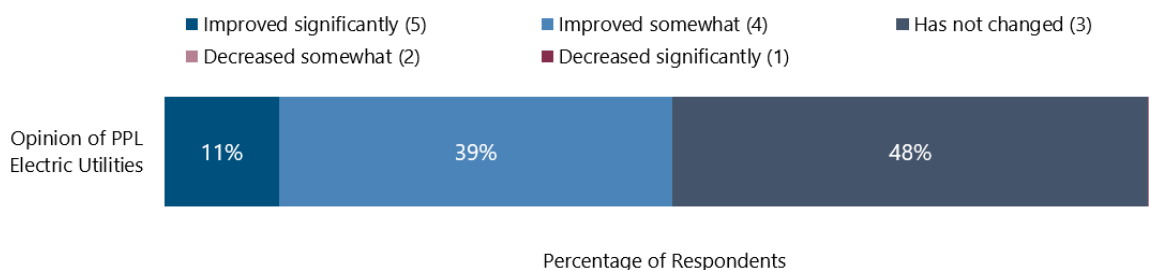


Source: Electric Vehicle Charging Pilot Survey, "What factor(s) most affected the overall experience rating you gave?" (n=68). Downstream rebate survey respondents who declined to answer (n=7) or who answered "Don't know" to their satisfaction (n=1) are not included in this figure.

Opinion of PPL Electric Utilities

The survey asked respondents whether their opinion of PPL Electric Utilities has changed since participation in the pilot. Nearly half (48%) of respondents said their opinion *has not changed*, while half (50%) said their opinion *improved significantly or somewhat* (Figure I-17).

Figure I-17. Participant Opinion of PPL Electric Utilities

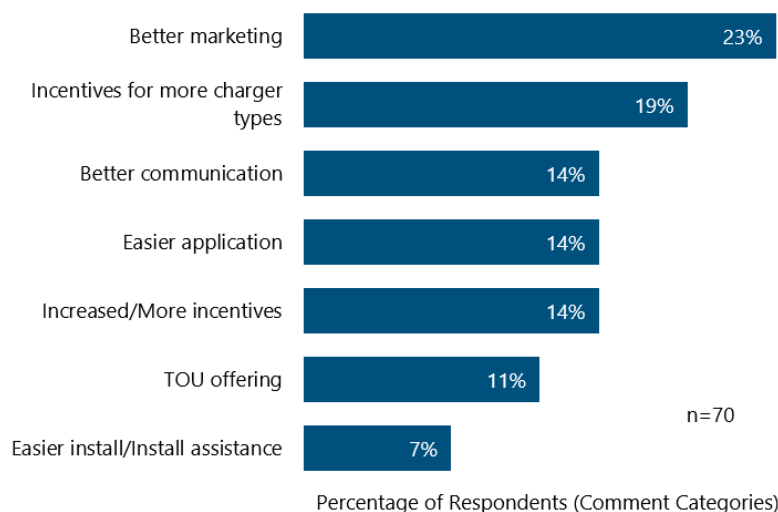


Source: Electric Vehicle Charging Pilot Survey, “After participating in the Home EV Charging Pilot, how has your opinion of PPL Electric Utilities changed, if at all?” (n=122)

Program Improvements

Cadmus analyzed the open-text responses about program improvements, and most respondents commented that the program could have better marketing and more incentives for different charger types (Figure I-18). Pilot staff said the marketing and communications materials used during the pilot included a website FAQ to guide enrollment and a call support script.

Figure I-18. Categorized Improvements to the Program



Source: Electric Vehicle Charging Pilot Survey, “What is the one thing PPL Electric Utilities could change about how it offers rebates for EV chargers to improve it?” (n=70)

Note: Multiple responses were allowed.

During interviews, Cadmus asked charger manufacturers whether they would recommend any changes to program operations. One manufacturer said automating enrollment in subsequent programming would streamline their role, noting they participate in numerous other EV utility programs and therefore appreciate streamlined processes. The other interviewed manufacturer did not have any recommended changes but similarly noted that they were engaged with many utility programs and appreciated programs that keep participation simple for manufacturers.

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Program Successes

The evaluation identified the following successes for the EV Charging Pilot:

- **Strong customer participation in a short timeframe.** Given the short timeline staff had to market and implement the pilot, both program and ICSP staff reported feeling positive about the number of customers enrolled. As of July 2026, data show 481 participants in the pilot.
- **Chargers are installed in PPL Electric Utilities' territory.** Survey results indicate that nearly all chargers were installed in PPL Electric Utilities' territory; only one survey respondent reported purchasing a charger but not installing it.⁶² This respondent reported "Don't Know" as their reason for not installing it.
- **High customer satisfaction.** Pilot participants were satisfied with their experience, with 85% *very satisfied* or *somewhat satisfied* with the Online Marketplace (n=47), and 92% *very satisfied* or *somewhat satisfied* with the downstream rebate (n=74).
- **Manufacturer collaboration.** Some manufacturers were able to offer targeted ads to customers through their apps. While program and ICSP staff reported they were unable to see the success of the manufacturers' marketing efforts, they did see some referrals come in through manufacturers' apps. Survey results show that 2% of respondents reported first hearing about the pilot through EV charger apps, EV charger emails, and other marketing. Interviewed manufacturers were positive about different offerings to support EV charger programs, including customized marketing and marketing statistics, and integrating their equipment with managed charging programs.

Program Motivators and Challenges

One of the EV Charging Pilot evaluation goals is to identify areas where opportunities for enhancement of EV program deployment exist and to inform and optimize program design for PPL Electric Utilities' EV programming in future years. The evaluation identified the following challenges with pilot deployment:

- **Limited visibility around pilot promotion through car dealerships.** Interviews with the ICSP indicated that car dealerships were provided with marketing materials and engaged as a partner for pilot promotion, and that while some dealerships appeared interested, others expressed less interest. Interviews suggested that this may have been due to low enthusiasm around the promotion of EV sales, given the removal of the federal tax credit in September 2025. Some dealerships also noted that manufacturers, including Cadillac, Ford, and Volvo, offered free Level 2 chargers with some EV sales. Dealers also seemed to rely on manufacturers for guidance on sales and which deals to prioritize. Survey results indicate that some car dealerships are engaging with pilot promotions, with 2% of respondents reporting they first heard about the pilot through their car dealership.

⁶² Only three respondents reported purchasing and not installing at their home address. One said they installed at a vacation home (in PPL Electric Utilities' territory), and another said they installed at another address.

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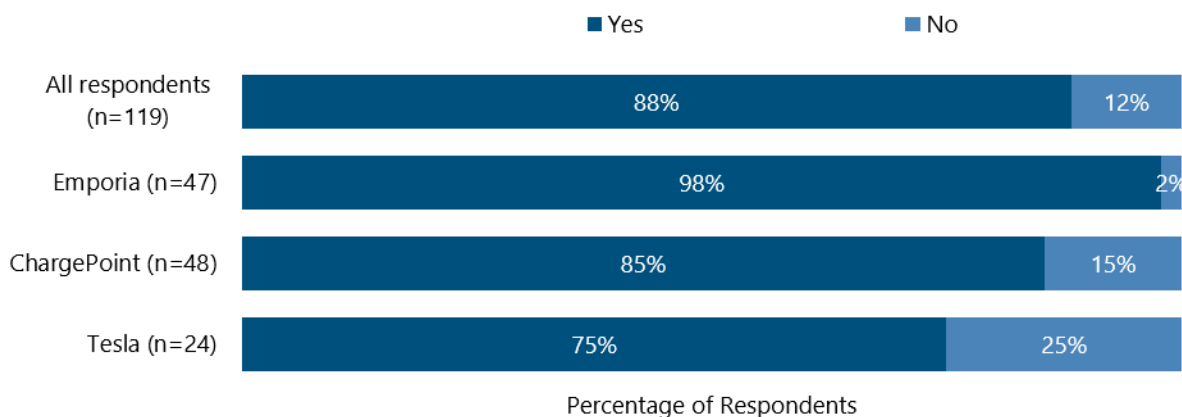
- **Data Sharing.** Interviews with program staff and the ICSP identified that it was challenging to have participants follow through with enrollment in data sharing with PPL Electric Utilities following the installation of their charger. ICSP interviews in particular identified that the protocols needed to enable successful data sharing varied by charger manufacturer and required confirmation of successful data sharing after enrollment; for example, more than 40 enrolled customers who used Tesla EVs and chargers were, in the end, unsuccessful in their data sharing due to leaving location sharing off in their manufacturer app settings.

Additional Details on Data Sharing

In response to data-sharing issues, staff adjusted the rebate amount to decrease the rebate received prior to data-sharing enrollment and increase the rebate received following enrollment. Since this change was made with only two months remaining in the pilot, changes in data-sharing trends were difficult to identify, but the ICSP did report a higher rate of data-sharing enrollment among customers following the shift in the incentive.

As shown in Figure I-19, the participant survey asked respondents whether they were sharing their data with PPL Electric Utilities, with 12% (n=119) reporting they are not currently enrolled to share data. Cadmus notes that some level of self-selection bias may be contributing to the relatively high rates of data sharing in respondent data (participants motivated to respond to the survey may also be more responsive and willing to follow through on data sharing).

Figure I-19. Rate at Which Respondents Report Sharing Charging Data, by Charger



Source: Electric Vehicle Charging Pilot Survey, "Are you currently enrolled to deliver data to PPL Electric Utilities regarding your charging?" (n=119).

The survey asked respondents who reported not sharing their data (n=15) why they were not sharing data. More than half of respondents said they were not sharing because they did not see the value of sharing this data (n=8). Respondents also reported not sharing due to a technical issue with the charger that prevented data sharing (n=4) and not being comfortable sharing this data with PPL Electric Utilities (n=3).

Challenges with data sharing persisted even when participants registered successfully. Interviews identified that elements of data sharing could be difficult to manage due to individual manufacturers' data options. For example, 42 Tesla customers registered but did not check a box allowing their location to be tracked, so their data was not shared despite their registration.

Interviews with the ICSP suggested a weekly review of data to ensure enrolled customers were continuing to deliver data and to help troubleshoot any issues.

Other Findings

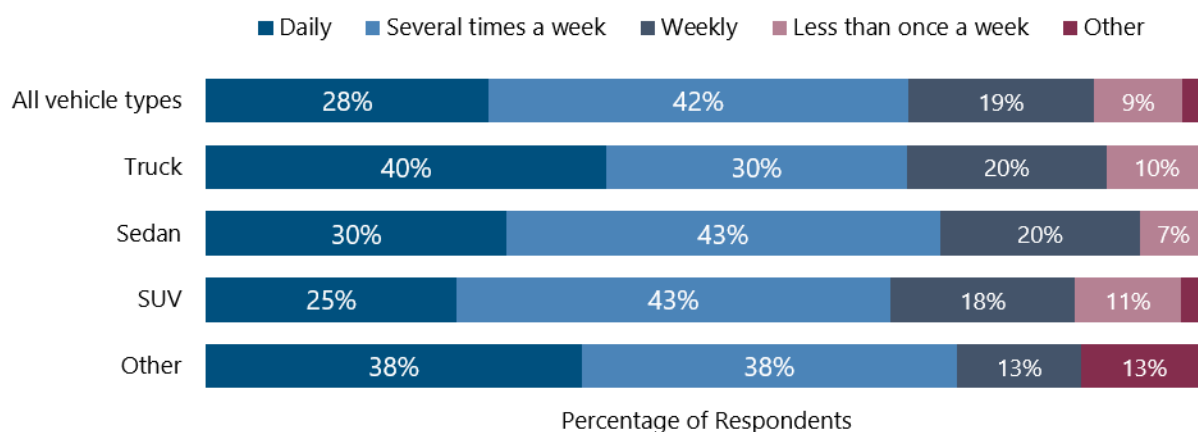
Other findings include insights into customer charging behavior, installation needs, and interest in TOU rates and EV managed charging programming.

Customer Charging Behavior

One goal of the EV Charging Pilot was to gather customer adoption insights, including information on charging behavior, to support PPL Electric Utilities' alignment of future EV programming with its customers.

The participant survey asked customers several questions about their charging behavior, including how often they charge, and when and where they charge. As shown in Figure I-20, respondents (n=124) most frequently reported that the timing of charging varied depending on when the battery was low. Respondents who reported a specific time (n=78) most frequently reported charging in the early evening (46% of those reporting a specific time, 29% of all respondents); the next most frequent response was the late evening (27% of all respondents reporting a specific time, 17% of all respondents).

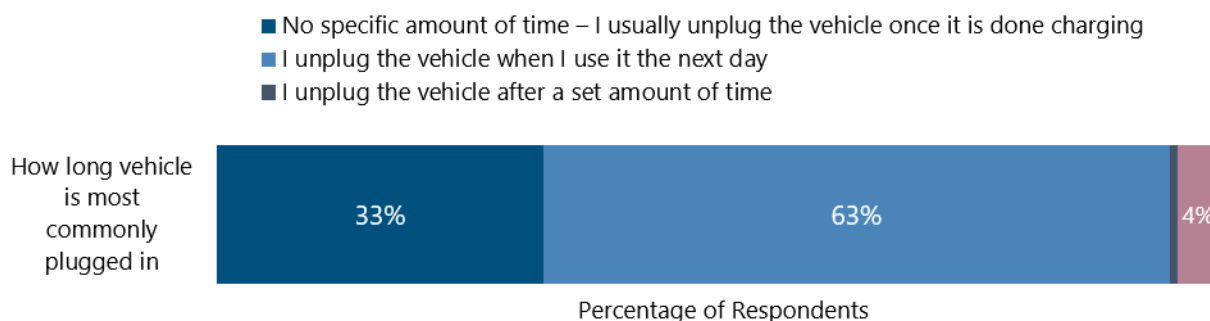
Figure I-20. How Frequently Participants Charge on Purchased Chargers, by Vehicle Type



Source: Electric Vehicle Charging Pilot Survey, "How frequently do you charge your vehicle using your EV charger(s) purchased with PPL Electric Utilities incentives?" (n=124)

The survey asked respondents when they typically unplug their vehicle (n=123). Sixty-three percent reported unplugging when they use the vehicle the next day, and 33% reported unplugging whenever the car was fully charged (Figure I-21).

Figure I-21. When Respondents Typically Unplug their Vehicle

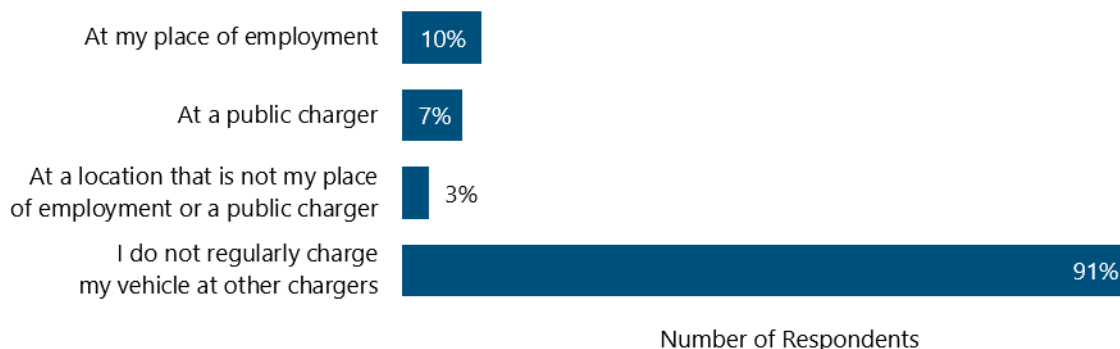


Source: Electric Vehicle Charging Pilot Survey, “How long do you most commonly leave your vehicle plugged in after it has charged?” (n=123) Respondents who selected “Other” (n=5) noted leaving the vehicle plugged in almost all the time (n=2), and leaving plugged in but scheduling charging through their charger app (n=2). One respondent noted charging for 3 hours (n=1).

The survey also asked respondents to estimate, on average, how many hours their vehicle is plugged in each day, and the average was 7.5 hours. Respondents who charged trucks charged an average of 9.6 hours, whereas sedan drivers charged an average of 5.5 hours and SUV drivers charged 7.9 hours (n=69).

The survey asked respondents about their use of other chargers (n=121), and 91% reported not regularly using other chargers to charge their vehicle (Figure I-22).

Figure I-22. Use of Chargers at Different Locations



Source: Electric Vehicle Charging Pilot Survey question, “Do you regularly charge your vehicle on a different charger? (for example, a charger at a different location?) Select all that apply.” (n=121; multiple responses allowed)

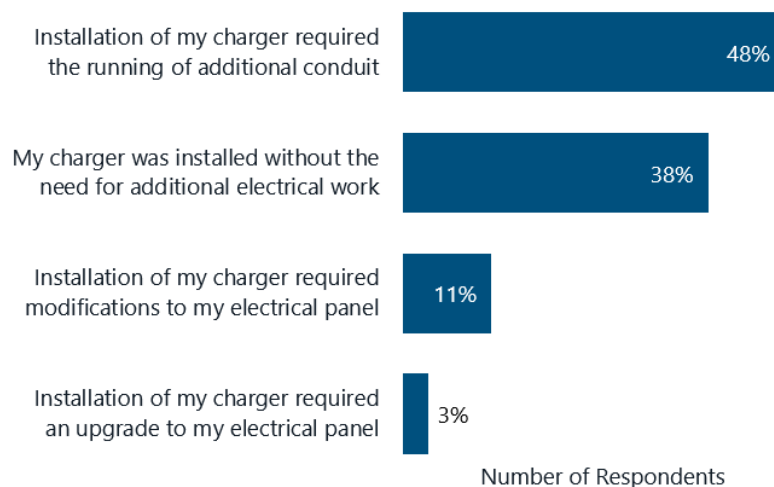
The survey also asked what percentage of their total charging occurs at home. Of respondents who answered this question (n=24), 29% said that 40% or less of their charging takes place at home. More than half of respondents (54%, n=13) said that more than 60% of their charging takes place at home.

Customer Installation Needs

To support an understanding of customer experience and barriers to EV adoption, the survey asked respondents questions regarding the need for additional electrical work during charger installation and customer experience in finding an installer.

Customers who require electrical work face additional costs for EV charger adoption. The survey asked respondents about the electrical work needed for their charger installation. Forty-eight of 125 respondents (38%) said they did not need to complete additional electrical work to install their EV charger (Figure I-23).

Figure I-23. Electrical Work Required for Charger Install



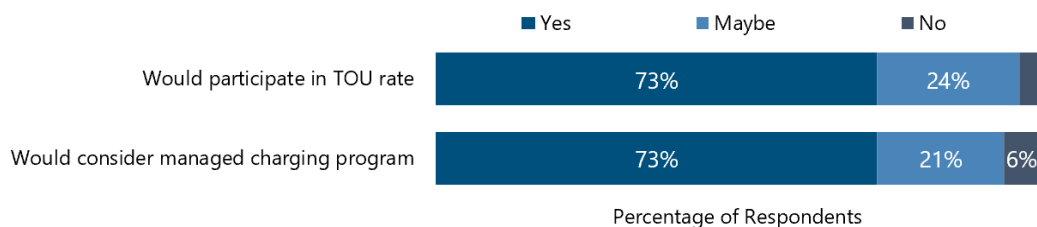
Source: Electric Vehicle Charging Pilot Survey question, "Did you have enough panel space and capacity to install your charger, or did you need to install a subpanel? Select all that apply." (n=125)

Respondents were asked how they found their EV charger installer. Forty-one percent of respondents (n=121) said they used installers they had used before, while 19% said they found them through an internet search, and another 19% said they found their installer through word of mouth. Twelve percent of respondents reported self-installation or installation through a friend or family member. Five respondents said they received a list of qualified installers through the EV Charging Pilot; three respondents said they used the list to find their installer. The survey also asked respondents about their satisfaction with their charger installation; 87% were *very satisfied* (71%) or *somewhat satisfied* (16%) with their installation experience, while 3% were *not too satisfied* (2%) or *not at all satisfied* (1%) (n=120). Thirty-six percent of respondents said that it would have been useful to have a referral to a qualified electrician (n=91).

Customer Interest in TOU Rates and Managed Charging Programming

Another goal of the pilot was to support understanding of customer interest in managed charging and EV programming. To address this, the survey asked respondents questions regarding their interest in TOU rates and EV managed charging programming. Seventy-three percent of respondents (n=123) said that they would take advantage of a TOU rate if one were offered. Seventy-three percent of all respondents (n=123) also said they would consider participation in a managed charging program if offered (Figure I-24).

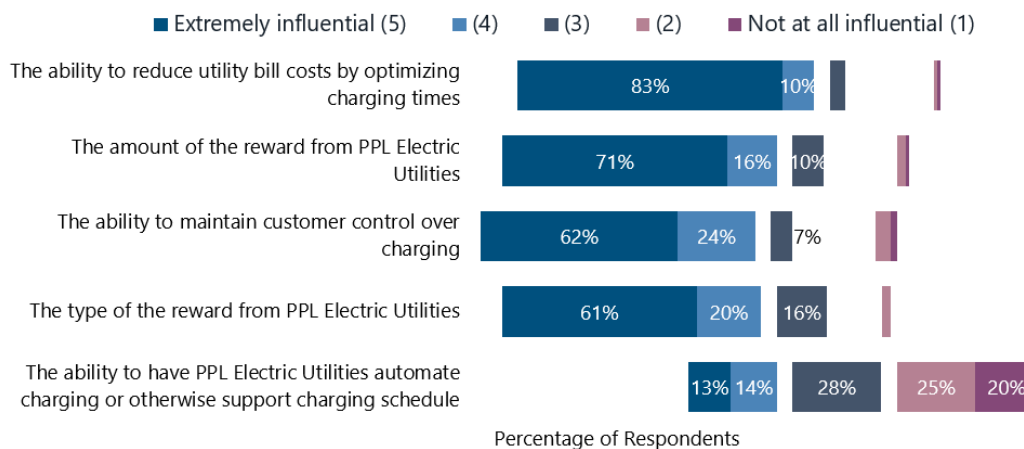
Figure I-24. Customer Interest in TOU Rates and Managed Charging Programming



Source: Electric Vehicle Charging Pilot Survey questions, "PPL Electric Utilities is considering other ways to support EV customers. Would you take advantage of an EV charging time of use electric rate if one were offered?" (n=123) and "Some utilities offer managed charging programs to their EV customers. Managed charging allows customers – or in some cases, the utility – to schedule customer charging to occur during off-peak hours and offer credits to the customer for this off-peak charging in the form of monthly bill rewards or other benefits. Would you consider taking advantage of a managed charging program if one were offered?" (n=123).

The survey asked respondents who responded *maybe* or *yes* to considering participation in EV managed charging programming what was most influential in their response. Respondents most commonly reported the ability to reduce bill costs and the amount of the reward as influential (Figure I-25).

Figure I-25. Customer Interest in Managed Charging Program



Source: Electric Vehicle Charging Pilot Survey question, "Please rate how influential each of the following would be on your decision to participate in a managed charging program using a scale from 1 to 5, 1 meaning no influence, and 5 meaning the item would be extremely influential in your decision." (n=103).

I.3.3. Sample Attrition

Table I-17 lists the total number of records contacted via online survey and the outcome (final disposition) of each record. Additional details on the survey methodology are in *Appendix L*.

Table I-17. Energy Efficient Homes Online Participant Survey Sample Attrition

Description of Outcomes of Online Participant Survey	Number of Records			
	Downstream Equipment	Audit and Weatherization	Online Marketplace	EV Charging Pilot
Population (number of unique jobs)	7,213	1,115	2,385	452
Removed: inactive customer, completed survey in past three months, on "opt out" list, selected for a different survey, duplicate contact, on "do not contact" list	1,396	278	270	0
Removed: incomplete or invalid email address or phone number	233	12	224	0
Survey Sample Frame (records attempted)	5,584	825	1,891	452
Not released because they were not needed	4,584	125	0	0
Not reached or non-working: Opted out, email returned (bounce back), did not respond	920	608	1,799	312
Partially completed survey; ineligible for survey	7	15	18	3
Completed Surveys (online)	73	77	74	137
Overall Response Rate ⁽¹⁾	7%	11%	4%	30%

⁽¹⁾ Response rate does not include records sampled but not needed because the target was met.

STUDENT ENERGY EFFICIENT EDUCATION

This component of the Residential Program provides a school-based energy efficiency education curriculum through classroom presentations to students and classroom materials for teachers.

VERIFIED ENERGY SAVINGS

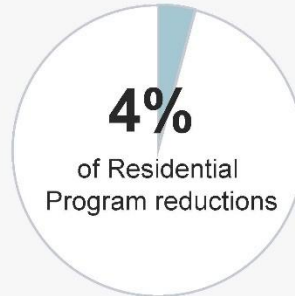
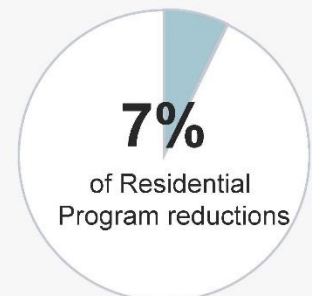
Phase IV
has saved
25,145 MWh/yr



PY17 saved
4,929 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV has
reductions of
2.62 MW/yr



PY17 has
reductions of
0.55 MW/yr

PY17 PARTICIPATION



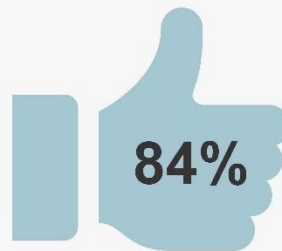
A total of **20,096** participants

5,402 Bright Kids (2nd – 3rd grades)

4,369 Take Action (5th – 7th grades)

10,325 Innovation (9th – 12th grades)

PARTICIPANT SATISFACTION



Satisfied with
overall program
component

91% Bright Kids (2nd – 3rd grades)

83% Take Action (5th – 7th grades)

79% Innovation (9th – 12th grades)

100% Teachers

Appendix J. Evaluation Detail – Student Energy Efficient Education Component

The Student Energy Efficient Education (SEEE) component provides a school-based energy efficiency education curriculum through classroom presentations to students and classroom materials for teachers. The component includes a poster contest for elementary and middle grade students to submit posters illustrating how they would save energy and help the environment. The SEEE component invites students at the high school level to participate in an Innovation Challenge to communicate innovative ideas about increasing energy and water efficiency, communicated through artwork, a science project, an essay, literature, photography, music, a service project, video, a website project, or any other work of innovation. The curriculum is offered once during the school year, typically in the fall. Students receive educational materials and a take-home kit of energy-saving items to install at home with a trusted adult.

The SEEE component provides kits to students in three cohorts:

- Bright Kids (2nd – 3rd grades)
- Take Action (5th – 7th grades)
- Innovation (9th – 12th grades)

The kits are tailored to each grade level participating in the component. Table J-1 shows the kit items by cohort. Each kit included installation instructions and a cross-promotional insert for other program components offered by PPL Electric Utilities to residential customers. There were no changes to the kit contents in PY17 compared to the prior year.

Table J-1. Student Energy Efficient Education Energy-Savings Items by Cohort

Cohort	Kit Items
Bright Kids	LED nightlight, 8W A19 LED light bulb, two 15W A21 LED light bulbs, Tier 1 advanced power strip
Take Action	LED nightlight, 8W A19 LED light bulb, two 15W A21 LED light bulbs, showerhead, kitchen faucet aerator, Tier 1 advanced power strip, furnace whistle, water heater setback card
Innovation	8W A19 LED light bulb, two 15W A21 LED light bulbs, showerhead, kitchen faucet aerator, bathroom faucet aerator, Tier 1 advanced power strip, furnace whistle, water heater setback card

CLEAResult distributes and records each kit as a participant in the residential ICSP database and PPL Electric Utilities tracking database with an identifier for the school, classroom, and teacher. PPL Electric Utilities did not collect or record the utility account numbers of classroom students who received a kit.

The ICSP also develops home energy worksheets (HEWs), which students may complete and submit online or in hard copy. The HEW asks questions to track installation rates for the kit items and collect information about participant demographics and component satisfaction. The program offers small grants as an incentive for teachers to return 25% or more of HEWs, with amounts ranging from \$10 to \$50 for response rates of 80% or more. Teachers are also requested to complete evaluation forms following their participation.

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The ICSP subcontracted with the National Energy Foundation to recruit schools and teachers, with a focus on disadvantaged communities, to create curricula aligned with Pennsylvania academic standards and to secure support for the component from the Pennsylvania Department of Education. As in prior years, AM Conservation Incorporated assembled and delivered kits to schools. The ICSP provided oversight and direction to its subcontractors.

PPL Electric Utilities collaborated with the ICSP on the SEEE component's strategic direction while maintaining oversight of Act 129 administration, program component support, evaluation, and data management.

J.1. Gross Impact Evaluation

J.1.1. Gross Impact Methodology and Sampling Approach

Cadmus conducted the PY17 impact evaluation for the SEEE component using PY17 survey data gathered through paper and online HEWs to estimate savings for all items in the kits.

The impact evaluation sampling strategy is summarized in Table J-2. Cadmus used a census approach, stratifying by education-level cohorts. The relative precision achieved for both impact evaluation verified energy and demand savings was $\pm 1\%$ with 85% confidence.

Table J-2. Student Energy Efficient Education Component Gross Impact Evaluation Sample Design

Stratum	Reported Population Size	Sampling Assumptions	Achieved Sample Size	Impact Evaluation Activity
Bright Kids 2 nd – 3 rd grades	5,402	N/A	3,788	PY17 HEWs
Take Action 5 th – 7 th grades	4,369	N/A	3,422	PY17 HEWs
Innovation 9 th – 12 th grades	10,325	N/A	7,132	PY17 HEWs
Component Total	20,096	N/A	14,342	N/A

Because the items in the kits differ across cohorts, Cadmus computed cohort-level metrics. To calculate cohort-level *ex post* savings, Cadmus applied the cohort-level realization rates to cohort-level *ex ante* savings. By summing cohort-level *ex post* savings, Cadmus estimated the component-level *ex post* savings.

J.1.2. Gross Impact Results

Table J-3 shows the SEEE component's verified gross energy savings and demand reductions.

Table J-3. Student Energy Efficient Education Component Savings

Savings	PY13 Verified	PY14 Verified	PY15 Verified	PY16 Verified	PY17 Verified	Phase IV Verified ⁽¹⁾
MWh/yr	4,797	5,037	5,221	5,160	4,929	25,145
System-Level MW/yr	0.47	0.48	0.56	0.56	0.55	2.62

⁽¹⁾ Phase IV verified savings may not match the sum of program years due to rounding.

In PY17, the SEEE component reported energy savings of 5,121 MWh/yr (Table J-4) and demand reductions of 0.51 MW/yr (Table J-5).

**Table J-4. Student Energy Efficient Education Component
Gross Impact Results for Energy**

Stratum	PYRTD MWh/yr	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Bright Kids (2 nd -3 rd grades)	805	91%	0.07	0.7%	735
Take Action (5 th -7 th grades)	2,912	93%	0.27	2.2%	2,720
Innovation (9 th -12 th grades)	1,403	105%	0.15	2.4%	1,471
Component Total⁽²⁾	5,121	96%	0.50	1.4%	4,929

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

**Table J-5. Student Energy Efficient Education Component
Gross Impact Results for Demand**

Stratum	PYRTD MW/yr	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System- Level PYVTD (MW/yr)
Bright Kids	0.07	99%	0.06	0.6%	0.07	0.08
Take Action	0.29	96%	0.26	2.0%	0.28	0.30
Innovation	0.15	103%	0.16	2.4%	0.17	0.17
Component Total⁽²⁾	0.51	98%	0.47	1.0%	0.50	0.55

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate does not accurately reflect the final verified savings. Cadmus applied realization rates are applied to verified demand reductions before application of distribution losses.

⁽²⁾ Total may not match the sum of rows due to rounding.

In PY17, verified savings were lower than reported savings for the Bright Kids and Take Action cohorts. This is primarily due to differences in the installation rates of those cohorts.

The largest cohort, Take Action, had the lowest installation rates, which reduced the overall realization rate for the component as a whole (see Table J-6). When ISRs were last calculated in PY15, the Take Action cohort had lower ISRs for kitchen aerators, nightlights, and smart strips than assumed in *ex ante* calculations:

- The *ex post* installation rate for kitchen aerators was 22%, and the *ex ante* ISR was 25%.
- The *ex post* ISR for nightlights was 60%, and the *ex ante* ISR was 65%.
- The *ex post* ISR for smart strips was 67%, and the *ex ante* ISR was 72%.

These low ISRs greatly reduced realization rates for the Take Action cohort, as these three product types accounted for nearly half of the reported savings in PY17.

The overall demand realization rates were higher than the overall energy realization rates due to differences in each product's contribution to energy and demand savings. For example, nightlights do not contribute to demand savings; therefore, they had no impact on the demand realization rates.

J.1.3. In-Service Rates

Table J-6 shows the ISRs for each product included in the kits in PY17.

Table J-6. Product-Level In-Service Rates

Cohort	Product	PY17 ISR	
		Ex Ante	Ex Post
Bright Kids			
Lighting	8W LED bulbs	92%	92%
	15 W LED Bulb	92%	92%
	LED Nightlight	85%	82%
	Second 15W LED Bulb	92%	92%
Other	Smart Strip	76%	73%
Take Action			
Lighting	8W LED bulbs	92%	92%
	15W LED bulbs	92%	92%
	Second 15W LED Bulb	92%	92%
	LED Nightlight ⁽¹⁾	65%	60%
Water Saving	Kitchen Aerator ⁽¹⁾	25%	22%
	Shower head	28%	26%
	Water Heater	28%	27%
Other	Furnace Whistle	19%	18%
	Smart Strip ⁽¹⁾	72%	67%

Cohort	Product	PY17 ISR	
		<i>Ex Ante</i>	<i>Ex Post</i>
Innovation			
Lighting	8W LED bulbs	92%	92%
	15W LED bulbs	92%	92%
	Second 15W LED Bulb	92%	92%
Water Saving	Kitchen Aerator	32%	28%
	Bathroom Aerator	35%	33%
	Shower head	36%	34%
	Water Heater	33%	33%
Other	Furnace Whistle	26%	28%
	Smart Strip	76%	76%

⁽¹⁾ These low ISRs greatly reduced realization rates for the Take Action cohort, as these three product types accounted for nearly half of the reported savings in PY17.

Net Impact Evaluation

The SEEE component is explicitly offered to schools. The program provides kits free of charge to teachers, who include them in the school's curriculum and give them to their students to take home. Cadmus did not evaluate free ridership, as there is no expectation that teachers or households will voluntarily purchase and provide the items in the kits to students in the absence of the component. Spillover is also not measured. The SEEE component is assumed to have an NTG ratio of 1.0.

J.2. Process Evaluation

Cadmus conducted a process evaluation of the SEEE component in PY17 to assess student and teacher satisfaction with both the kits and the energy efficiency presentation, and to identify what worked well and what needed improvement. The evaluation activities were consistent with the planned activities. Cadmus conducted program staff interviews via email. Table J-7 lists the process evaluation sampling strategy. Completed HEWs produced a measure of component satisfaction with $\pm 0.52\%$ precision at 85% confidence. Sample sizes noted in this report may vary by survey question because respondents could skip questions they chose not to answer; therefore, not all respondents answered every question. Cadmus included all survey respondents who answered at least one question, even if they did not complete the survey.

Table J-7. Student Energy Efficient Education Component Process Evaluation Sampling Strategy

	Stratum Boundaries	Mode	Population Size	Assumed Cv in Sample Design	Target Sample Size	Achieved Sample Size	Sample Frame	Percent Contacted ⁽¹⁾
PPL Electric Utilities Program and ICSP Staff	Key individuals from PPL Electric Utilities and CLEAResult	Email interview	2	N/A ⁽²⁾	2	2	N/A	100%
Students	Bright Kids, Take Action, Innovation	ICSP subcontractor-administered paper and online HEWs	20,096	N/A ⁽²⁾	All surveys returned	14,459 ⁽³⁾	All available	100%
Teachers	Bright Kids, Take Action, Innovation	ICSP subcontractor-administered Teacher evaluation forms	721 ⁽⁴⁾	N/A ⁽²⁾	All surveys returned	131	All available	100%
Component Total			20,817	N/A	N/A	14,592	N/A	100%

⁽¹⁾ Percent contacted means the percentage of the sample frame contacted to complete surveys and interviews.

⁽²⁾ The SEEE component evaluation did not include sampling; thus, Cv and target precision are not meaningful and are noted as N/A.

⁽³⁾ Sample size represents the number of returned HEWs, which may differ from the number of HEWs used for the impact evaluation or the number of responses received for a given HEW question in other process results.

⁽⁴⁾ Quantity reflects the number of unique teachers, where each unique teacher is identified by the participant code.

J.2.1. Participant Satisfaction

Students and teachers participated in the PY17 SEEE component by receiving kits, presentations, and curriculum. The student HEW and the evaluation form distributed to participating teachers included a satisfaction question. Both questionnaires measured overall satisfaction via a five-point rating scale (*very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, not very satisfied, or not at all satisfied*). Overall, 84% of participants were satisfied with their experience with the SEEE component in PY17, as shown in Table J-8. Though a higher proportion of teachers were satisfied than students, student experience accounted for most of the satisfaction score because the number of students who participated was much higher than the number of teachers. While teacher satisfaction remained at 100%, there was a slight decrease in overall satisfaction across participating students compared to PY16 (85% in PY16, 84% in PY17), which contributed to the decline in the overall score ($p=0.018$).

Table J-8. PY17 Satisfaction for the SEEE Component

Stratum	Overall Satisfaction ⁽¹⁾
Students (n=14,307)	84%
Teachers (n=131)	100%
Overall Satisfaction (n=14,438)	84%

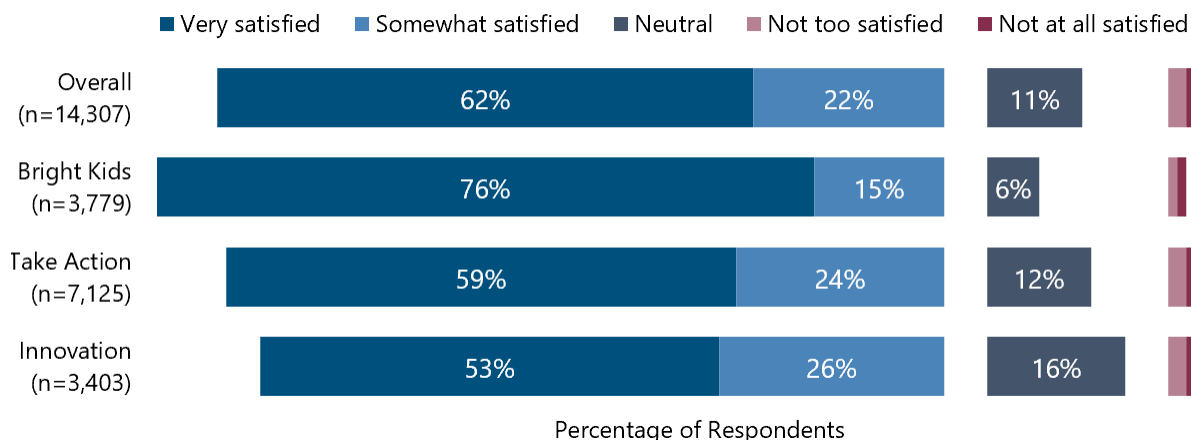
⁽¹⁾ As measured by a rating of *very* or *somewhat satisfied*

Student Satisfaction

Teachers received a HEW template they could copy and distribute, which allowed students to complete the HEW on paper or online. Of the 20,096 students in the population, 14,459 (72%) completed HEWs, and 14,307 answered the satisfaction question. Figure J-1 summarizes the results by cohort. Of the students who responded to the question, 84% said they were *very satisfied* (62%) or *somewhat satisfied* (22%) with the component overall. By cohort, satisfaction ranged from 79% *very satisfied* or *somewhat satisfied* for Innovation students to 92% for Bright Kids students.⁶³ Overall satisfaction among participating students in PY17 decreased slightly from PY16 (85% to 84%).

⁶³ The sum of *very* and *somewhat satisfied* do not match the overall percentage due to rounding.

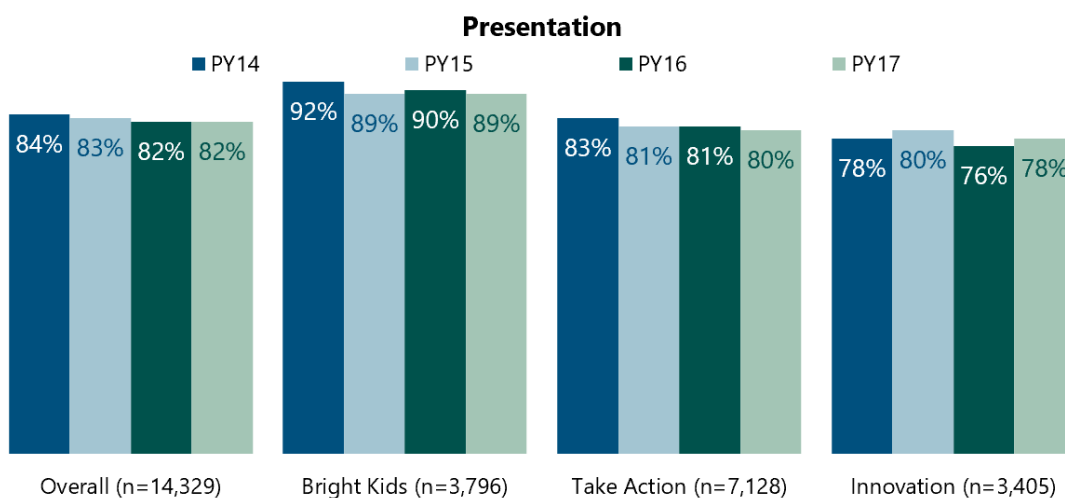
Figure J-1. PY17 Overall Student Satisfaction by Cohort

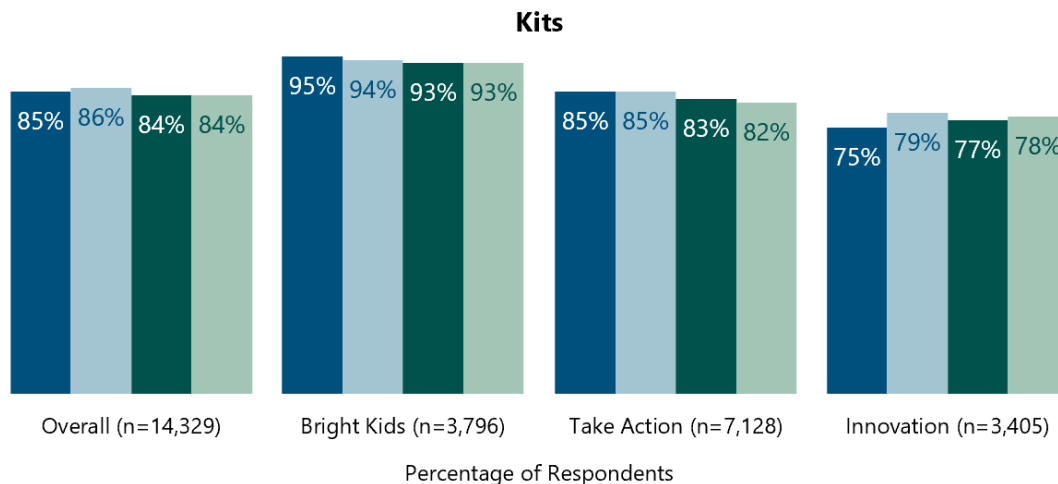


Source: Home Energy Worksheet: "Please rate your overall satisfaction with the Think! Energy program." Totals may not sum to 100% due to rounding. The sum of *very* and *somewhat satisfied* may not match the percentage reported on the infographic or in the report text due to rounding. Unlabeled segments represent 3% or less of respondents.

The HEWs included separate questions to assess student satisfaction for both the presentation and the kit. As shown in Figure J-2, overall satisfaction with the presentation remained steady in PY17 compared to PY16. Specifically, among Innovation students, satisfaction with the presentation increased by two percentage points in PY17 compared to PY16; however, this result was not statistically significant. The kits remained the same for the third straight year, and satisfaction with the kits also remained steady in PY17, with Take Action students reporting a one percentage point decrease and Innovation students reporting a one percentage point increase in the proportion who were *very* or *somewhat satisfied* with the kits. These changes in satisfaction were not statistically significant.

Figure J-2. PY17 Student Satisfaction with Presentations and Kits by Cohort



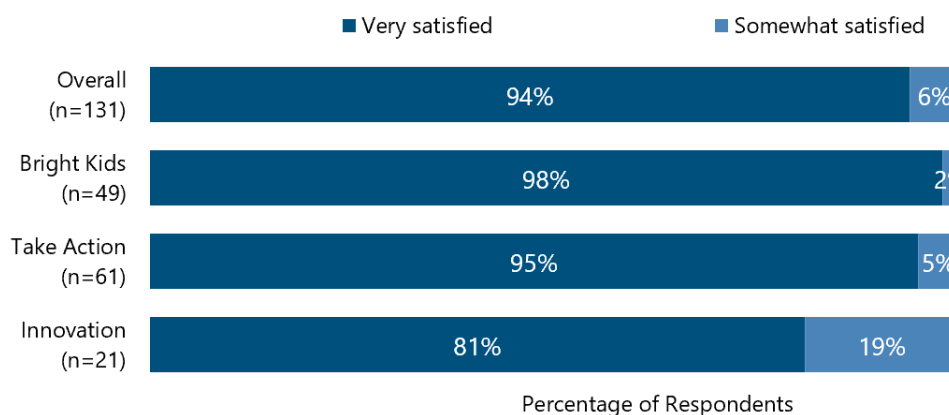


Source: Home Energy Worksheet: “How satisfied are you with the presentation?” and “How satisfied are you with the energy efficiency kit?” Not all HEW respondents answered each question.

After participating in the teacher’s classroom presentation, presenters asked teachers to rate the delivery of the SEEE component. Of the 721 participating teachers in PY17, 18% (131) completed evaluation forms, and 131 provided a rating.

Figure J-3 summarizes the results of the teacher satisfaction survey. All teachers who responded to the survey rated the component as either *very satisfied* (94%) or *somewhat satisfied* (6%; n=131). This is similar to results from PY16 (data not shown), with a slight decrease in the rate of *very satisfied* teachers (95% in PY16). Teachers in the Bright Kids cohort rated their impression of the component as *very satisfied* (98%), more often than teachers in the Innovation cohort (81%; $p < 0.05$).

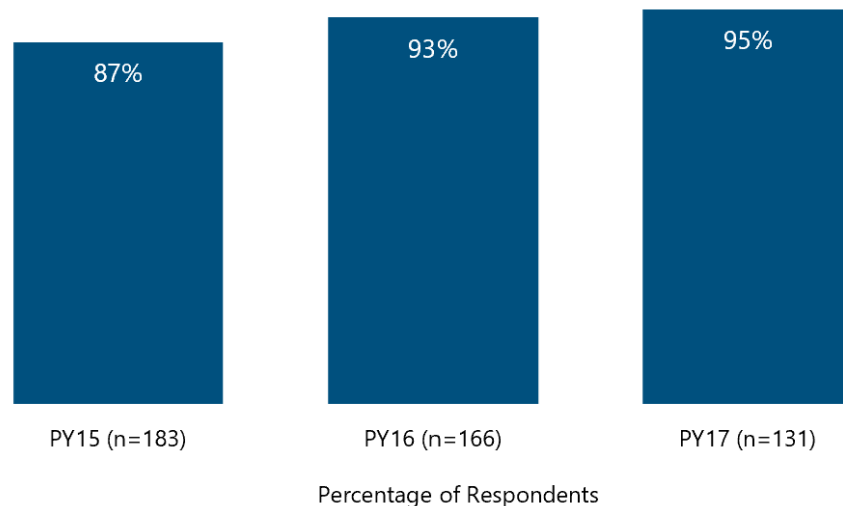
Figure J-3. PY17 Participating Teacher Satisfaction with Student Energy Efficient Education Component Overall



Source: Teacher Evaluation: “Please share your impression of Think! Energy Overall Experience.”

The teacher evaluation forms included separate satisfaction ratings questions for aspects of the program, including the presentation. As shown in Figure J-4, teacher satisfaction with the presentation was higher in PY17 compared to PY16.

Figure J-4. PY17 Teacher Satisfaction with Presentations by Program Year



Source: Teacher Evaluation: "Please share your impression of Think! Energy Presentation."

Teacher Feedback

The evaluation forms invited teachers to provide open-ended comments about their experience with the component, and they left overwhelmingly positive comments, consistent with their high satisfaction ratings for the program. In PY17, teachers continued to provide positive feedback on the quality of the presentations, specifically noting the engaging structure of the presentation, along with the value of the free kit contents:

- "Great for students and their families to not only learn about saving energy but can make changes right away with the materials in the kit." (Bright Kids)
- "Our students and families greatly benefit from receiving the energy kits—we have a number of low-income families in our area, so the kits have been fantastic for them." (Take Action)
- "This is a fabulous curriculum that gets students thinking about energy." (Take Action)
- "Students look forward to this presentation every year, and the presenters do a wonderful job with engagement during

"The PPL [Electric Utilities] Think Energy Program is a valuable educational resource that teaches students about energy conservation, electricity safety, and environmental responsibility in an engaging, age-appropriate way. The lessons align with state standards and include hands-on activities that make learning about energy both meaningful and fun. Students also receive energy efficiency kits to take home, which helps families apply what their children are learning in the classroom. It's a wonderful way to connect science concepts to real-world actions and empower students to make a difference."

--Bright Kids Teacher

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their student presentations. The supplies are very much appreciated among the students, and they are excited to receive their bags and update their homes.” (Innovation)

“Thank you so much for this program. Not only are my students excited to teach others, but they have also begun to make sure that the lights in our classroom are turned off before leaving.”
-Bright Kids Teacher

- “This is a great community resource that ties in perfectly with the environmental piece of the science curriculum.” (Innovation)
- “Thank you. Your efforts are not unnoticed. Students and families gain useful information and items in this program. I hope you continue to support this program going forward.” (Take Action)

Suggested Improvements

While comments on the PY17 presentations and kits were positive overall, two teachers had suggestions: one from the Take Action cohort and another from the Innovation cohort. Compared to PY17, 14 teachers provided suggestions in PY16. The suggestions for improvement provided by the teachers were related to the kits and the presentation:

- “Smaller groups would be more practical. Three classes at once can be a little much as far as getting them to pay attention.” (Take Action)
- “Something to think about is that a lot of our students live in multifamily homes and may not be able to install some of the items, like the shower head or the furnace whistle.” (Innovation)

Survey Participant Profile

The PY17 HEWs collected demographic information about participants in the SEEE component. Respondents had the following characteristics:

- Most lived in a single-family detached residence (78%; n=14,361).
- Sixteen percent of respondents lived in a multifamily residence.
- Had an average household size of 4.6 people (n=14,367).

Appendix K. Net Savings Impact Evaluation

K.1. Self-Report Survey Methodology

K.1.1. Free Ridership

Free ridership is a measure of the savings that participants would have achieved on their own in the absence of the program; these savings are subtracted from verified gross savings. Spillover, on the other hand, credits additional savings that participants achieved on their own, where their experience with the program was highly influential in their decision to install energy-efficient equipment without the incentive of rebates. Spillover increases net savings attributable to PPL Electric Utilities.

Following the methods defined in the Phase IV Evaluation Framework,⁶⁴ Cadmus assessed free ridership. This assessment involved two components: the *intention* to implement an energy-efficient project without a rebate and the *influence* of the program on the decision to implement the energy-efficient project. When scored, each component had a value ranging from zero to 50 and a combined total free ridership score ranging from zero to 100.

Cadmus summed the intention and influence components to estimate the total average free ridership by product or stratum. Free ridership estimates by product or stratum are weighted by *ex post* gross kWh/yr savings.

Intention Score

Cadmus assessed intention by asking questions to determine how the participant's decisions would have differed in the absence of the program. For example, the survey asked the following key questions to determine how the non-residential organization's project-related decisions would have differed in the absence of a program:

- "Which of the following would have happened if you had not received the rebate for \$[REBATE AMOUNT] from PPL Electric Utilities for the [MEASURE] project?"
- "By how much would you have reduced the size, scope, or efficiency?"
- "How likely is it that [you/your organization] would have paid the full cost to install the same quantity and efficiency of that equipment at the same time you conducted this project?"

Cadmus used the responses to determine a participant's final intention score, in accordance with the methods defined in the Phase IV Evaluation Framework, which we multiplied by the participant's respective *ex post* kWh/yr savings to calculate intention-based free rider savings.

⁶⁴ Pennsylvania Public Utility Commission. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

Influence Score

Influence was assessed by asking about how much influence—from 1 (*no influence*) to 5 (*extremely influential*)—various program elements had on the customer’s decision to purchase energy-efficient equipment. The survey asked the following influence question: “Please rate each item on how much influence it had on the decision to complete the project the way it was completed. Please use a scale from 1, meaning *no influence*, to 5, meaning the item was *extremely influential* in your decisions.”

From responses to this question, Cadmus obtained data about the influence of various program components. Cadmus assessed program influence from participants’ ratings of how important various program elements were in their decision to purchase energy-efficient equipment.

K.1.2. Spillover

Following methods defined in the Phase IV Evaluation Framework,⁶⁵ Cadmus estimated spillover. To estimate spillover, surveys included questions to determine whether participants installed specific additional high-efficiency products and, if so, whether participation in the program was important to their decision. Additional high-efficiency product purchases counted toward spillover only if the customer did not receive a rebate and the program had been important to the decision to purchase and install the products. Typically, the data collected through the non-residential surveys do not provide enough information to reliably quantify spillover; therefore, potential spillover activity is reported qualitatively.

In presenting interview and survey data in the report, the percentage or frequency of responses is followed by the sample size for the particular question. Sample size (denoted by “n”) refers to the number of respondents who answered the question. Sample sizes may vary by question because of survey logic and skipped questions. Respondents could skip questions if they did not want to answer them; not all respondents provided an answer to every question.

⁶⁵ Pennsylvania Public Utility Commission. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*. Prepared by NMR Group, Inc., Demand Side Analytics, LLC, Brightline Group, and Optimal Energy, Inc. Final version July 16, 2021.

Appendix L. Survey Bias

Surveys employ the self-report method, which can result in validity issues and biases (e.g., self-selection, recall, social desirability). Cadmus designed the surveys to minimize such issues and biases using these best practices:

- Avoided questions that are leading, ambiguous, or contain more than one topic
- Employed randomization of list-based survey items to reduce order effects
- Used consistent survey wording and response options for online and phone surveys when relevant
- Employed stratified random sampling when relevant

The SWE team and PPL Electric Utilities reviewed and approved surveys that Cadmus fielded.

L.1. Survey Contact Instructions

Cadmus coordinated with PPL Electric Utilities' contractor to screen the sample and remove the records of any customers called in the past three months (whether for a Cadmus survey or a PPL Electric Utilities survey), who had requested not to be contacted again, or had incomplete information. Cadmus also excluded inactive customers and customers who were selected for another survey. This cleaning and survey sample preparation process reduced the available sample.

For online surveys, Cadmus sent email invitations to the remaining contacts with email addresses and followed up with one reminder email invitation. For telephone surveys, Cadmus attempted each record up to five times at different times of the day and weekend, if applicable, and left messages with voicemail where possible.

For multimode surveys, Cadmus first contacted all participants with email addresses to complete an online survey, sent two reminder email invitations, and then telephoned participants who did not have a valid email address or did not respond to the online survey. Giving participants two avenues to respond to the survey increased response rates in programs with limited populations.

Appendix M. Non-Energy Benefits

Cadmus quantified non-energy benefits in accordance with the Phase IV TRC order.⁶⁶

M.1. Non-Energy Benefits of Water-Saving Measures

Non-energy benefits associated with water-saving products include the gallons of water saved. According to the recommendation in the SWE Guidance Memo of 2018, Cadmus assumed \$0.01 in avoided cost per gallon saved in TRC testing (after gross-up for distribution losses). Cadmus assumed 24.5% losses on water distribution, based on guidance. The avoided cost of water is escalated over the TRC test horizon using the same inflation/escalation assumption embedded elsewhere in the TRC model.

M.2. Non-Energy Benefits of Fossil Fuel Savings

Cadmus calculated fossil fuel benefits in accordance with the direction provided by the 2021 TRC Order. The Pennsylvania Public Utility Commission directed that EDCs should continue to include fossil fuel benefits, consistent with the 2016 TRC Test and the 2018 guidance memo.⁶⁷

M.3. Lighting Interactive Effects

Cadmus calculated lighting interactive effects according to the TRC order, which states:

"Interactive effects from efficient lighting installations in businesses with electric heat have been captured in the Pennsylvania Technical Reference Manual since the 2009 TRM and interactive effects from homes with electric heat were added in the 2014 TRM. The objective of the TRM is to capture the electric impacts of EE&C measures. The impact of EE&C measures on fossil fuel consumption is a TRC matter, ... *Phase IV Act 129 programs will utilize a simplifying approach of monetizing all fossil fuel impacts using the avoided cost of natural gas rather than requiring a separate avoided cost forecast for fuel oil and propane and tracking heating fuel distributions among EE&C plan participants with fossil fuel heat.*"

⁶⁶ 2021 TRC Test Final Order - Final order on the TRC Test for Phase IV of Act 129. From the Public Meeting of December 19, 2019, at Docket No. M-2019-3006868. Entered December 19, 2019.

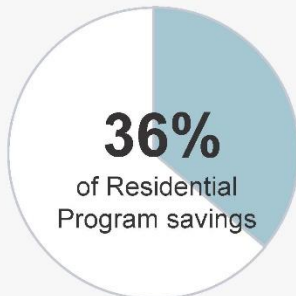
⁶⁷ SWE. *Guidance on the Inclusion of Fossil Fuel and H₂O Benefits in the TRC Test*. March 25, 2018.

HOME ENERGY REPORT

This component of the Residential Program encourages customers to save energy by sending them home energy reports or inviting them to utilize the online energy analyzer tool that provides information about their energy use, tips for saving energy, and product recommendations.

VERIFIED ENERGY SAVINGS

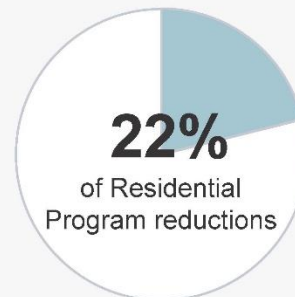
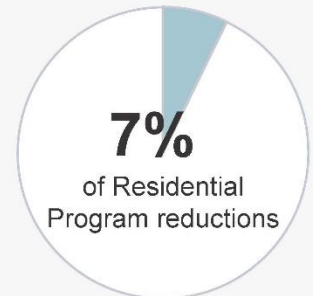
Phase IV
has saved
36,257 MWh/yr



PY17 saved
28,695 MWh/yr

VERIFIED DEMAND REDUCTIONS

Phase IV
has reductions of
2.85 MW/yr



PY17 has
reductions of
2.85 MW/yr

PY17 PARTICIPATION

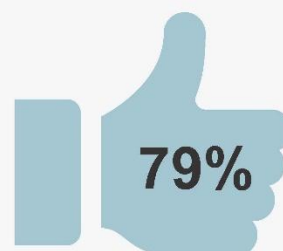
A total of **426,905**
customers received
Home Energy Reports



PARTICIPANT SATISFACTION



Satisfied with the
Home Energy
Reports



Satisfied with the
Energy Analyzer
Tool

Appendix N. Evaluation Detail - Home Energy Report

The Home Energy Report (HER) component of the Residential Program encourages customers to save energy by sending them home energy reports that provide data about their energy use, a comparison of household energy use to similar customers in the same geographic area, and tips for saving energy (e.g., turning off lights and taking short showers) and product recommendations (e.g., power strips and appliances). These reports also guide customers to PPL Electric Utilities' online energy management portal, the Energy Analyzer portal, where they can update their home profile by entering detailed information to improve the tool's accuracy.

PPL Electric Utilities' energy efficiency program staff provides overall strategic direction and program management. CLEAResult, the ICSP, manages the HERs component with the assistance of a subcontractor that is responsible for developing and distributing the program's educational offerings: the home energy reports and the energy analyzer portal.

In PY17, the component mailed home energy reports to customers. Customers with valid email addresses also received these reports electronically and could opt to receive only the electronic reports. Customers could also access the program's Energy Analyzer portal to view usage information, review energy-saving recommendations, and receive suggestions for other program offerings. The program operated as a randomized controlled trial where eligible customers were randomly assigned to a treatment group or a control group. Customers in the treatment group received the home energy reports. Treatment group customers who did not wish to receive the reports could opt out of the program at any time. Customers in the control group did not receive the reports and were not told they were part of the control group. The consumption data for the control group served as the baseline for estimating the savings from the home energy reports.

None of the customers in the treatment or control groups were carried over from Phase III. The HERs component ICSP subcontractor identified new customers for the treatment and control groups to expand the program for Phase IV, and Cadmus reviewed the random assignments of these additional customers in PY16.

N.1. Gross Impact Evaluation

N.1.1.HER Component Gross Impact Methodology and Sampling Approach Overview

Cadmus conducted the PY17 impact evaluation of the home energy reports using a randomized controlled trial with a large treatment and control group, enabling accurate intent-to-treat estimates. This involved panel regression analyses on monthly billing data, including all treatment customers regardless of opt-out status.

Because participation in Energy Analyzer is voluntary rather than randomized, Cadmus used a quasi-experimental design with propensity score matching to evaluate the Energy Analyzer portal. To ensure

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that participants were compared against similar customers, separate matching approaches were developed based on customers' home energy reports participation status. Energy Analyzer participants who also received home energy reports were matched with the home energy report treatment group customers who did not opt into Energy Analyzer. Energy Analyzer participants who are not in the home energy report treatment group were matched to customers in the home energy report control group. In PY17, because there were no overlapping customers between the home energy reports and Energy Analyzer subcomponents, all matched control customers for the Energy Analyzer subcomponent were drawn from the HERs control group. By matching participants to similar nonparticipants based on historical energy usage, Cadmus created control groups and estimated savings while minimizing selection bias, using nearest-neighbor matching with replacement.

Cadmus estimated coincident peak demand savings for both subcomponents using interval advanced metering infrastructure (AMI) data and a regression-based approach.

Additionally, Cadmus adjusted savings from the home energy reports subcomponent for uplift (i.e., additional savings from increased participation in other PPL Electric Utilities residential programs driven by the reports) by estimating and subtracting these savings to avoid double-counting. Cadmus did not conduct an uplift analysis for the Energy Analyzer subcomponent because there were no overlapping customers with home energy reports, and the evaluated savings were zero. Table N-1 summarizes the evaluation sampling strategy.

Table N-1. Home Energy Report Component Gross Impact Evaluation Sample Design

Subcomponent	Stratum	Sampling Assumptions	Planned Sample Size (population)	Achieved Sample Size	Impact Evaluation Activity
Home Energy Reports	Treatment	Census	361,829	349,954	- Implemented as a randomized controlled trial - Applied regression analysis with monthly billing data from customers in the treatment and control groups to assess energy savings' impact - Conducted regression analysis using AMI data to estimate peak demand reductions - Conducted uplift analysis to account for cross-program participation and eliminate double-counted savings
Home Energy Reports	Control	Census	94,523	91,183	
Energy Analyzer	Treatment	Census	49,686	41,336	- Used propensity score matching to create statistically equivalent control groups - Applied regression analysis with monthly billing data from customers in the treatment and control groups to assess energy savings' impact - Conducted regression analysis using AMI data to estimate peak demand reductions - Conducted uplift analysis to account for cross-program participation and eliminate double-counted savings.
Energy Analyzer	Control	Census	94,523	19,459	

The impact evaluation activities verified energy savings with $\pm 18\%$ precision and demand savings with $\pm 37\%$ precision, both at 85% confidence.⁶⁸

N.1.2. Data Preparation

Home Energy Reports

Cadmus worked with PPL Electric Utilities and the ICSP to acquire the data necessary to evaluate the home energy reports subcomponent in PY17. To prepare for the analysis, Cadmus cleaned and compiled the program-tracking, billing-consumption, and weather data. This section describes the steps Cadmus took to process the data and verify customers in the tracking and billing data.

⁶⁸ The precision values reported here apply only to the home energy reports subcomponent. For the Energy Analyzer subcomponent, the regression model produced negative savings estimates, the associated precision metrics are not applicable to the zero savings value reported in this study.

Program Tracking Data

Cadmus received HERs program tracking data from the ICSP at the close of PY17. These data included treatment-group customers who received home energy reports and control-group customers who were tracked since the program’s inception. Because the home energy reports subcomponent was implemented as a randomized controlled trial, Cadmus included all possible customers in the evaluation, adopting a “once in, always in” policy for customers originally randomized into either the treatment or control group prior to the launch of the home energy reports. As mentioned in the PY16 report, although customers receive their first home energy report at different times, Cadmus included all treatment customers in the analysis and defined December 1, 2024, as the treatment start date. For the PY17 evaluation, Cadmus estimated savings would begin on June 1, 2025, which marked the start of the evaluation year.

Table N-2 shows customer attrition in PY17, by treatment and control groups. For the home energy reports subcomponent, the first two columns show the number of customers originally randomized and active at the beginning of treatment. The attrition process identified customers whose accounts closed (became inactive) after the beginning of the program year. It removed any accounts with inactive dates before June 1, 2025, to ensure only relevant participants were included. In PY17, all customers either had no inactive date or had inactive dates that occurred within the evaluation periods.

Table N-2. PY17 Customer Attrition

	Originally Randomized		Active at the Beginning of Treatment in PY17 ⁽¹⁾	
	Treatment	Control	Treatment	Control
Home Energy Reports Subcomponent Total	361,829	94,523	349,954	91,183

⁽¹⁾ Customers active at the beginning of PY17 were not necessarily included in the billing data analysis if they had insufficient billing data.

Billing Data

Cadmus collected customer monthly billing data from PPL Electric Utilities and cleaned the billing data following these steps:

1. Dropped observations where both billing days and kWh were negative
2. Dropped observations where the first or last record by account had zero usage
3. Trued up bills of estimated consumption values with corrected values based on actual reads
4. Cleaned and calendarized bills, corrected mismatched ZIP codes, and removed duplicated billing cycles
5. Removed outliers, defined as average daily consumption greater than 300 kWh or less than -30 kWh, as well as an average daily consumption outside three standard deviations of the seasonal average consumption
6. Dropped customers with less than 12 months of pre-treatment bills

Table N-3 summarizes the attrition in the PY17 analysis sample from data-cleaning steps for the home energy reports subcomponent. The final modeling sample included customers in the ICSP program-

tracking dataset who successfully matched to customers in the billing data. Cadmus used this sample in the final billing analysis.

Table N-3. Summary of PY17 Sample Attrition from Data Cleaning

Step in Attrition	Treatment Group	Control Group
Originally randomized customers	361,829	94,523
Included in billing data	361,689	94,490
Non-missing ZIP code	361,689	94,490
At least one post-treatment month	341,669	89,038
At least 12 pre-treatment months	341,602	89,024
Final Modeling Sample	341,602	89,024

Weather Data

Cadmus collected weather data from the NOAA Global Historical Climatology Network hourly by identifying the weather station closest to each home and estimated missing temperature observations during a three-day NOAA outage, August 30 through September 1, 2025, by linearly interpolating temperatures between the adjacent days for each weather station. Cadmus then estimated Heating degree days (HDDs) and cooling degree days (CDDs) for each customer billing cycle, merged the weather and billing data, and allocated the billing-cycle electricity consumption, HDDs, and CDDs to calendar months.

Energy Analyzer

To prepare the Energy Analyzer data for analysis (similar to the home energy reports analysis), Cadmus cleaned and compiled the program tracking data, billing consumption data, and weather data. This section describes the steps Cadmus took to process the data and verify customers in the tracking and billing data.

Program Tracking Data

Cadmus received two batches of Energy Analyzer subcomponent tracking data from the ICSP. The first batch was received in March 2026 and included participants through the end of February 2026. The second batch was received at the close of PY17, in June 2026, and included participants through May 31, 2026. These data included customers with and without a first-click date. For the Energy Analyzer subcomponent, treatment customers were defined as those who had a “first-click date,” i.e., those who opted in. Due to this opt-in structure, Cadmus filtered the tracking data to treatment customers only and pooled potential control group customers from the home energy reports subcomponent. The Energy Analyzer and home energy reports subcomponents participant pools had no overlap; the eligible control group customers are defined as home energy reports subcomponent control group customers.

Table N-4 shows customer attrition in PY17, by treatment and control groups. The column for “control” shows the total number of eligible control-group customers. The attrition process identified customers whose accounts closed (became inactive) after the beginning of the program year. It removed any accounts with inactive dates prior to June 2025 to ensure only relevant participants were included. In

PY17, all Energy Analyzer subcomponent participants either did not have an inactive date or had inactive dates that occurred within the evaluation periods.

Table N-4. PY17 Customer Attrition for Energy Analyzer Subcomponent

	Originally Randomized		Active at the Beginning of Treatment in PY17 ⁽¹⁾	
	Treatment	Eligible Control	Treatment	Eligible Control
Energy Analyzer Program Total	49,686	94,523	49,683	91,208

⁽¹⁾ Customers active at the beginning of PY17 were not necessarily included in the billing data analysis if they had insufficient billing data.

Billing Data

Cadmus collected customer monthly billing data from PPL Electric Utilities and cleaned the billing data following these steps:

1. Dropped observations where both billing days and kWh were negative
2. Dropped observations where the first or last record by account had zero usage
3. Trued up bills of estimated consumption values with corrected values based on actual reads
4. Cleaned and calendarized bills, corrected mismatched ZIP codes, and removed duplicated billing cycles
5. Removed outliers, defined as average daily consumption greater than 300 kWh or less than -30 kWh, as well as an average daily consumption outside three standard deviations of the seasonal average consumption
6. Dropped customers with less than 12 months of pre-treatment bills

Table N-5 summarizes the attrition in the PY17 analysis sample from data-cleaning steps for the Energy Analyzer subcomponent. The final modeling sample included customers in the ICSP program tracking dataset who successfully matched to customers in the billing data. Cadmus used this sample in the final billing analysis.

Table N-5. Summary of PY17 Sample Attrition from Data Cleaning

Step in Attrition	Treatment Group	Control Group
Original customer count	49, 686	94, 523
Cleaned billing data	49, 507	91,182
Outliers	49,421	91,182
Removed early treatment months	49,286	-
At least 12 pre-treatment months	41,549	83,834
Matched after propensity score matching	41,463	19,618
Final Modeling Sample	41,336	19,459

Matching

Cadmus conducted nearest-neighbor propensity score matching with replacement to find adequate control customers. Since there is no overlap between Energy Analyzer treatment customers and home energy reports participants in PY17, the eligible control-group customers are the entire home energy reports control-group customers. Energy Analyzer treatment customers had different first-click dates. Matching used 12 individual monthly pre-treatment average daily consumption. Treatment dates, or first-click dates, were set to the first of the month to calculate each treatment customer's monthly pre-average daily consumption across 12 months; Energy Analyzer treatment customers had to have complete data for the period to be included. Preliminary matching diagnostics indicated small sample sizes and poor matching performance for treatment customers with first-click dates falling in December 2024, January 2025, and February 2025, which Cadmus excluded from the matching process.

Cadmus assigned all possible control dates to each control customer and calculated 12-month pre-average daily consumption for each treatment date, excluding home energy reports control customers without sufficient billing data for a given treatment date. Cadmus matched Energy Analyzer participants using Energy Analyzer treatment pre-average daily consumption to home energy reports control customers with replacement, allowing home energy reports control customers to be assigned to multiple Energy Analyzer treatment customers.

Weather Data

Cadmus collected weather data from NOAA and calculated HDDs and CDDs using the weather station closest to each zip code to estimate for each customer billing cycle. After merging the weather and billing data, Cadmus allocated the billing cycle electricity consumption, HDDs, and CDDs to calendar months. The weather data collected included complete data for the evaluation and pre-treatment periods. The weather data did not map to some Energy Analyzer treatment customers because of missing or invalid ZIP codes. As this only accounted for 0.1% of treatment customers, Cadmus retained these customers and set the HDDs and CDDs to zero.

N.1.3. Verification of Balanced Treatment and Control Groups

Home Energy Reports

The ICSP conducted the randomization for the home energy reports subcomponent. Cadmus verified the randomization by comparing the cleaned billing data with the pre-program average annual and monthly consumption.

Table N-6 summarizes the test results for monthly differences between the treatment and control groups' pre-treatment consumption. While the differences in daily consumption between the treatment and control groups remained below 0.4 kWh throughout the 12-month pre-treatment period, the differences were statistically significant at the 10% level in most months, except in April, October, and November. Compared to PY16, where the treatment and control groups appeared more balanced across pre-treatment months, the PY17 equivalency results show greater variation. One potential contributor to the change in equivalency results is the attrition of customers who became inactive prior to the start of the PY17 evaluation period. Because these inactive customers were excluded after the initial randomization,

the resulting analysis population may differ from the originally randomized population and could have affected the balance between the treatment and control groups.

At the annual average level, however, the difference in energy consumption between the treatment and control groups was not statistically significant (p-value of 0.106). This result indicates that the average difference across the 12-month pre-treatment period was not statistically significant at the 10% level. Therefore, despite some month-to-month variation, the treatment and control groups remained reasonably balanced overall during the pre-treatment period.

Table N-6. PY17 Tests for Differences in Pre-Period Electricity Use between Treatment and Control

Pre-Period Month	Average Daily Electricity Use per Customer (kWh)			p-value
	Treatment Group	Control Group	Difference	
December 2023	41.2756	41.4873	(0.2117)	0.0008
January 2024	44.1288	44.4854	(0.3566)	0.0000
February 2024	39.9607	40.2584	(0.2976)	0.0000
March 2024	34.8214	34.9938	(0.1724)	0.0064
April 2024	29.9985	30.0116	(0.0131)	0.8365
May 2024	29.6775	29.5100	0.1675	0.0081
June 2024	37.5892	37.2642	0.3249	0.0000
July 2024	42.3727	42.0197	0.3530	0.0000
August 2024	35.8132	35.5278	0.2854	0.0000
September 2024	29.1109	28.8885	0.2225	0.0005
October 2024	27.0904	26.9859	0.1045	0.1008
November 2024	33.8970	33.9565	(0.0594)	0.3523

Energy Analyzer

Cadmus assessed the quality of the propensity score matching using three complementary approaches:

- Applying covariate balance diagnostics to evaluate standardized mean differences and variance ratios for the matching variables
- Visually assessing pre-treatment equivalency by plotting average daily consumption (ADC) for the treatment and control groups across each month in the pre-treatment period
- Conducting monthly pre-period equivalency tests to statistically compare treatment and control group consumption prior to program participation

Cadmus used these diagnostics together to determine whether the matched control group provided a reasonable counterfactual for the treatment group.

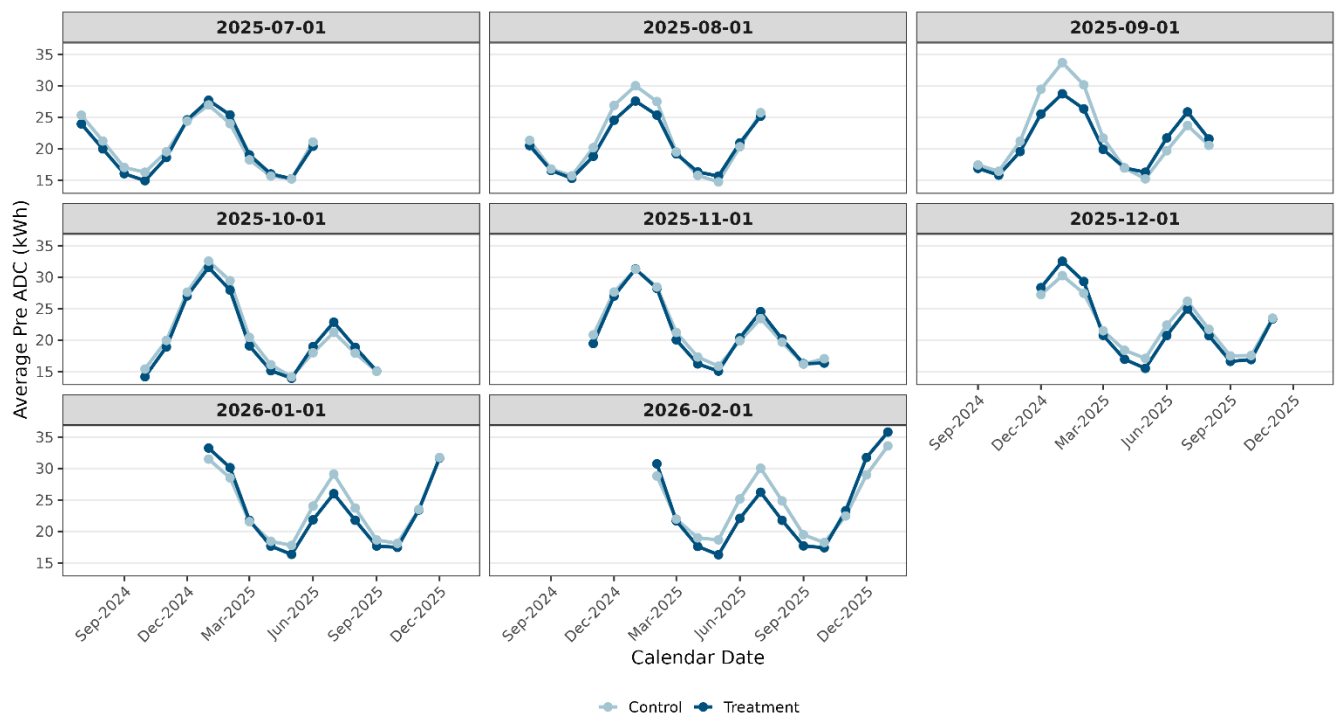
Cadmus first evaluated the distribution of matching variables between the Energy Analyzer treatment and the matched home energy reports control group using standardized mean differences for each of the 12 monthly pre-period average daily consumption used in matching. Standardized mean differences below an absolute value of 0.10 and variance ratios near 1.0 were considered good balance. All monthly pre-period ADC had acceptable standardized mean differences, except for month eight. Cadmus also reviewed the balance within each first-click month cohort, assessing lustered standardized mean differences and variance ratios for each matching variable. The balance diagnostics showed that the

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matched treatment and control groups were generally similar across the observed pre-treatment energy consumption.

As a second diagnostic, Cadmus visually assessed the similarity of the matched treatment and control groups by comparing their pre-treatment electricity consumption patterns. Using the matched treatment-control pairs, Cadmus merged the pairs back into the monthly billing data and plotted monthly ADC for treatment and control customers within each first-click month cohort. This visual review identified systematic differences in consumption patterns prior to treatment. As shown in Figure N-1, pre-treatment consumption trends were generally comparable between the treatment and control groups, with a few exceptions, including December 2024 for two 2025 first-click cohorts and July 2025 for two 2026 first-click cohorts.

Figure N-1. Pre ADC by First Click Date



Lastly, Cadmus conducted monthly statistical equivalency tests. The equivalency test results are presented in Table N-7. Although the differences in ADC were statistically significant for most months, the magnitude of the differences was generally small, remaining at or below approximately 1 kWh per day.

Table N-7. Pre-Period Usage Equivalency Tests by Month

Pre-Period Month	Average Daily Electricity Use per Customer (kWh)			
	Treatment Group	Control Group	Difference	P-Value
July 2024	23.9603	25.3487	-1.3884	0.0000
August 2024	20.3013	21.3077	-1.0064	0.0000
September 2024	16.4724	17.0184	-0.5460	0.0003
October 2024	15.1101	15.9473	-0.8372	0.0000

Pre-Period Month	Average Daily Electricity Use per Customer (kWh)			
	Treatment Group	Control Group	Difference	P-Value
November 2024	18.9733	20.2234	-1.2501	0.0000
December 2024	25.5467	26.9267	-1.3800	0.0000
January 2025	29.4406	30.5119	-1.0713	0.0000
February 2025	26.9346	27.6461	-0.7115	0.0000
March 2025	19.7365	20.2078	-0.4713	0.0001
April 2025	16.3973	16.5925	-0.1951	0.0977
May 2025	15.4765	15.4803	-0.0037	0.9746
June 2025	20.7542	20.6951	0.0590	0.6163
July 2025	24.9796	25.0664	-0.0868	0.5089
August 2025	20.6513	20.7561	-0.1049	0.5170
September 2025	16.3908	16.8903	-0.4995	0.0076
October 2025	17.0164	17.7013	-0.6849	0.0028
November 2025	23.3682	23.2677	0.1005	0.7134
December 2025	31.6912	30.8638	0.8274	0.0112
January 2026	35.7875	33.5913	2.1962	0.0001

Given the acceptable covariate balance indicated by the standardized mean differences, the visual similarity of pre-treatment consumption patterns across first-click month cohorts, and extensive testing of alternative matching specifications that did not produce meaningful improvements in balance,⁶⁹ Cadmus concluded that the selected propensity score matching approach produced reasonable matched pairs and an appropriate comparison group for estimating program impacts.

N.1.4.HER Component Ex Post Verified Savings Methodology

Energy Savings Model Specification

The following section describes Cadmus' approach for the lagged dependent variable (LDV) and differences-in-differences (D-in-D) fixed effects model. The SWE confirmed they followed the same methodology.

Cadmus conducted regression analyses of monthly billing data from customers in the treatment and control groups to estimate energy savings for the home energy reports subcomponent. The billing

⁶⁹ Cadmus evaluated different caliper specifications to determine whether the pre-treatment equivalency test would improve. The caliper defines the maximum allowable distance between treatment and control customers on the matching metric. A smaller caliper was tested in order to try to produce more similar matches and improve pre-period equivalency. Resulting balance and equivalency diagnostics produced no improvement. Cadmus also tested the addition of seasonal average pre-treatment consumption, and pre-treatment average annual consumption to the nearest-neighbor propensity score matching. These additions also failed to produce meaningful improvement; thus, Cadmus concluded the matching with the original specification.

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analysis conformed to IPMVP Option C, whole facility,⁷⁰ and the approach described in the Uniform Methods Project.^{71,72} Cadmus also followed the methods included in the Phase IV Evaluation Framework for behavioral programs.⁷³

Specifically, Cadmus used a multivariate regression to analyze the energy use of customers who had been randomly assigned to treatment and control groups, employing LDV or D-in-D model specifications to ensure the robustness of savings results.

The LDV (post-only) model regresses customer average daily consumption on a treatment indicator variable and includes as regressors the customers' pre-treatment energy use, month-by-year fixed effects, and weather.⁷⁴ The model is estimated only with post-treatment customer bills. Cadmus clustered the standard errors on customers to account for arbitrary correlation in customer consumption over the analysis period. Cadmus used a weather-independent LDV model and a D-in-D model to check sensitivity and robustness. The weather-independent LDV model follows the same LDV model specification but excludes the weather covariates. The D-in-D model regresses average daily consumption on a treatment indicator variable, month-by-year fixed effects, customer fixed effects, and weather. The model was estimated with pre-treatment and post-treatment customer bills.

Cadmus used the results from the LDV model as the final evaluated results, consistent with what was proposed in the evaluation plan.

The following sections provide additional details about the modeling approaches.

Lagged Dependent Variable Model

The LDV model was specified assuming the average daily consumption (ADC_{it}) of electricity of the customer 'i' in month 't' as given by Equation N-1.

⁷⁰ Efficiency Valuation Organization. January 2012. *International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume 1*. p. 25. (EVO 10000 – 1:2012). <http://www.evo-world.org/>

⁷¹ Agnew, K., and M. Goldberg. April 2013. *Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*. U.S. Department of Energy, National Renewable Energy Laboratory. (NREL/SR-7A30-53827). http://www1.eere.energy.gov/office_eere/de_ump_protocols.html

⁷² Stewart, Jim, and A. Todd. 2020. *The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures*. "Chapter 17: Residential Behavior Protocol." Prepared for National Renewable Energy Laboratory, Golden, Colorado. NREL/SR-7A40-77435. <https://www.nrel.gov/docs/fy21osti/77435.pdf>

⁷³ Pennsylvania Public Utility Commission. July 16, 2021. *Evaluation Framework for Pennsylvania Act 129 Phase IV Energy Efficiency and Conservation Programs*.

⁷⁴ Allcott, H., and T. Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review* 104 (10), 3003-3037.

Equation N-1

$$ADC_{it} = \beta_1 part_i + \sum_{m=1}^{12} \delta_m pre_adc_{im} \times M_m + W'\gamma + \tau_t + \varepsilon_{it}$$

Where:

β_1	=	Coefficient representing the conditional average treatment effect of the program on electricity use (kWh per customer per day).
$part_i$	=	Indicator variable for program participation (which equals 1 if customer 'i' was in the treatment group and 0 otherwise).
β_2	=	Coefficient representing the conditional average effect of pre-treatment electricity use on post-treatment average daily consumption (kWh per customer per day).
pre_usage_i	=	Mean household energy consumption of customer 'i' across all pre-treatment months.
M_m	=	Variable indicating the month of the calendar year for months $m=1, 2, \dots, 12$
W	=	Vector using both HDD and CDD variables to control for the impacts of weather on energy use.
γ	=	Vector of coefficients representing the average impact of weather variables on energy use.
τ_t	=	The month-by-year fixed effects, which reflect unobservable factors that affect the consumption of all households during the month 't'.
ε_{it}	=	Error term for customer 'i' in month 't.'

Difference-in-Difference Fixed Effects Model

The D-in-D fixed effects model was specified assuming the average daily consumption (ADC_{it}) of electricity of customer 'i' in month 't' as given by Equation N-2:

Equation N-2

$$ADC_{im} = \alpha_i + \tau_m + W'\gamma + \beta_1 part_i \times post_m + \epsilon_{im}$$

Where:

α_i	=	Average energy use for customer i reflecting unobservable, non-weather-sensitive, and time-invariant factors specific to the customer; the analysis controlled for these effects with customer fixed effects
τ_m	=	Average energy use in month and year m reflecting unobservable factors specific to the month and year; the analysis controlled for these effects with month-by-year fixed effects
W	=	Vector using HDD and CDD variables to control for weather impacts on energy use
γ	=	Vector of coefficients representing the average impact of weather variables on energy use

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- β_1 = Coefficient representing the product's conditional average treatment effect on electricity use (kilowatt-hours per customer per day)
- $part_i$ = Indicator variable for product participation (which equals 1 if customer i was in the treatment group and 0 otherwise)
- $post_m$ = Indicator variable for whether month m is pre- or post-treatment (which equals 1 if month m was in the treatment period and 0 otherwise)
- ϵ_{it} = Error term for customer i in month and year m

Annual Program Energy Savings

Cadmus estimated program savings in PY17 for treated customers as the product of average daily savings per participant and the number of days these customers were treated in PY17, shown in Equation N-3.

Equation N-3

$$Savings_h = -\hat{\beta}_1 * \sum_{i=1}^N Treatment\ Days_i$$

Where:

$\hat{\beta}_1$ = Average daily savings (kWh) per treatment group customer, estimated from Equation N-1.

$Treatment\ Days_i$ = The number of days customer ' i ' was treated in PY17.

Cadmus estimated realization rates as the ratio of verified program savings to reported program savings (estimated by the ICSP).

Table N-8 shows the LDV (post-only) model estimate of average daily savings per customer and the total savings in PY17. The estimated average daily savings per customer are 0.2271 kWh based on the LDV model and 0.2303 kWh based on the weather-independent LDV model. The estimated average daily savings per customer are 0.2437 kWh based on the D-in-D fixed effects model. All three models produced similar savings, and each one is within the standard error of the other models. The close alignment among these three models demonstrates the robustness of the estimated treatment effects.

For the Energy Analyzer subcomponent, the LDV model estimates an average daily savings per customer of -6.06 kWh. Although the estimated effect is statistically significant, negative savings are not considered program-attributable energy savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 kWh and reports zero net savings for the component.

Table N-8. PY17 Home Energy Report Component Savings by Subcomponent

Subcomponent	Savings Estimate (kWh/day)	Standard Error of Savings Estimate	Treatment Days	Total Evaluated MWh	85% Confidence Interval (Lower Bound)	85% Confidence Interval (Upper Bound)
Home energy reports (LDV model)	0.2271	0.0290	125,377,682	28,472.24	23,240.56	33,703.93
Home energy reports (D-in-D model)	0.2437	0.0292	125,377,682	30,554.33	25,280.50	35,828.16
Home energy reports (LDV weather independent model)	0.2303	0.0290	125,377,682	28,871.92	23,642.37	34,101.47
Energy Analyzer (LDV model)	(6.0644)	0.6015	12,461,775	(75,573,194 ⁽¹⁾)	(86,363.57)	(64,782.81)

⁽¹⁾ Negative savings are not considered program-attributable energy savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 kWh and reports zero net savings for the component.

Ex Post Verified Savings Across Time

Cadmus also estimated monthly savings. The treatment variable, $part_i$, in equation N-1 was interacted with the month indicator binary variables to produce a monthly estimate of the average daily savings per customer. Because Cadmus included only the current program year and pre-treatment period billings in the regressions, the estimated treatment effect reflects the monthly average treatment effect in the current treatment year, PY17. The average daily savings per customer are the negative of the treatment effect and can be used to estimate total monthly savings in each month.

Home Energy Report

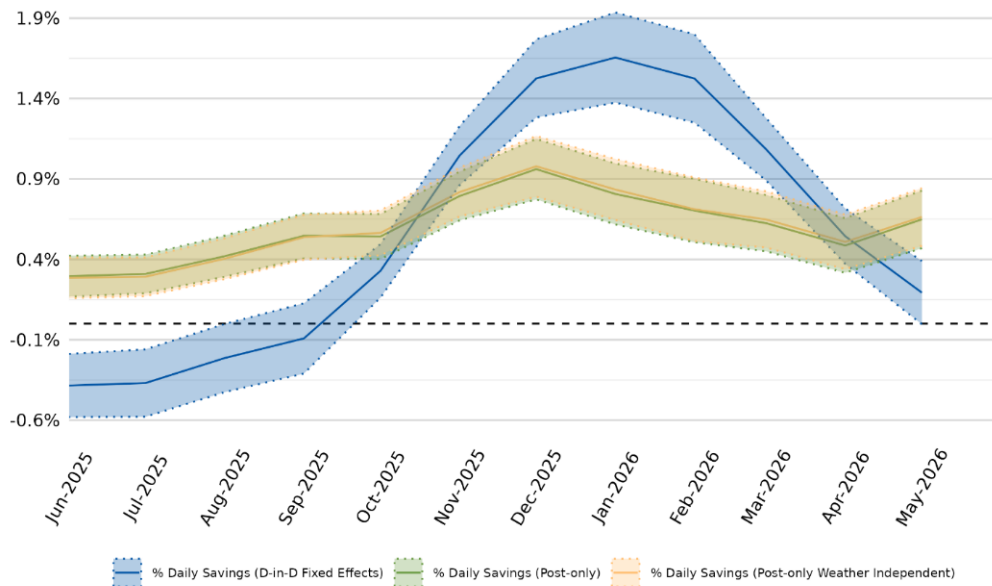
LDV model monthly regression results show statistically significant savings throughout the evaluation year (p value less than 0.001). Estimated savings increased during the summer months following treatment initiation, declined through the winter, and increased again in May 2026. This pattern is consistent with a ramp-up period and seasonal variation in responsiveness.

D-in-D fixed effects model results showed significant savings for all months except for August and September 2025 and May 2026. Unlike the LDV model, Figure N-2 shows the D-in-D estimates increased from December 2025 through January 2026 and declined from April through May 2026. The D-in-D model exhibited a seasonal pattern similar to that of the LDV model, but with larger fluctuations in the estimated savings and varying confidence interval widths across the evaluation period. This pattern may reflect the imbalances of the treatment and control groups during pre-treatment period, the D-in-D fixed model relies on the assumption that the two groups would have followed similar trends in the absence of treatment. Departures from pre-treatment equivalency can affect the estimated treatment effect. The post-only (LDV) model instead adjusts for baseline consumption using pre-treatment usage, making it less sensitive to violations of the parallel trends assumption.

Similar to the LDV model, the weather-independent LDV model's monthly regression results show statistically significant savings. Both the post-only (LDV) and weather-independent post-only (LDV)

models produce close estimates and confidence intervals that are of proximity. The close alignment between these two models demonstrates the robustness of the estimated treatment effects.

Figure N-2. HER: Percentage of Monthly Savings Across Time

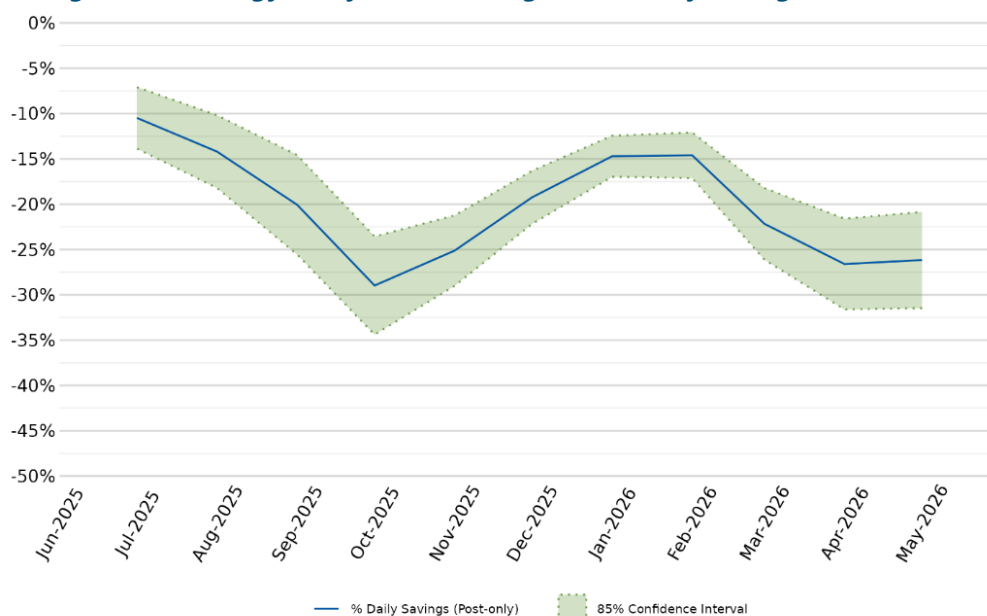


Energy Analyzer

LDV model monthly regression results show statistically significant negative savings across all months in the evaluation period. Figure N-3 provides the percentage daily savings across time for each month in PY17. Cadmus calculated the percentage daily savings as the ratio of average daily savings to the monthly average control group consumption.

The blue line in Figure N-3 shows monthly savings resulting from the LDV (post-only) with the surrounding shaded area representing the range of statistical uncertainty. The estimated Energy Analyzer savings were consistently negative throughout PY17.

Figure N-3. Energy Analyzer: Percentage of Monthly Savings Across Time



Demand Reduction Evaluation Methodology

The Pennsylvania TRM defines peak demand impacts as the average reduction in electric consumption from 2:00 p.m. to 6:00 p.m. Eastern Daylight Time on non-holiday weekdays during June, July, and August. Since the home energy reports subcomponent launched after September 2024 and the evaluation period ends before June 2025, the PY16 evaluation did not verify peak demand savings since no treatment occurred during the peak period as defined in the Pennsylvania TRM. In PY17, Cadmus applied a regression-based approach to estimate the program's effect on electricity use during peak hours in June, July, and August 2025 as described in the approved evaluation plan.

Cadmus calculated coincident peak demand reduction for the home energy reports subcomponent using 15-minute interval AMI data. Interval AMI data were aggregated to hourly usage during the peak period and matched across pre- and post-treatment periods at the customer level prior to modeling. Cadmus cleaned the AMI data with the following steps:

- Remove duplicated observations, with priority for keeping non-estimated meter readings
- Aggregate 15-minute interval AMI to the customer ID, date, and hour level by summing meter usage
- Remove customers with only zero-kWh meter readings
- Filter the data for the non-holiday weekday peak demand hours of 2:00 p.m. to 6:00 p.m.

Cadmus conducted a regression model to estimate the average difference in demand for households between the pre- and post-treatment periods during the peak period:

$$\Delta \overline{kW}_i = \beta_{part_i} + \varepsilon_i$$

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Where:

$\Delta \overline{kW}_i$ = Average difference in demand for household i between the pre- and post-treatment periods during the PPL Electric Utilities peak demand period.

$part_i$ = Indicator variable for component participation (which equals 1 if customer 'i' was in the treatment group and 0 otherwise).

β = Average peak demand reduction due to the HERs component.

ε_i = Error term for customer 'i'

Cadmus estimated total peak demand savings by multiplying the estimated treatment effect from the primary model above by the number of active treatment customers in the evaluation period and calculated the standard error and 85% confidence interval for the peak demand savings estimate.

In addition to the primary model, Cadmus also estimated the average treatment effect on demand reduction using the standard D-in-D and LDV models described above as robustness checks.

Table N-9 and Table N-10 present the hourly average coincident peak demand savings from all three models for the home energy reports and Energy Analyzer subcomponents, respectively. The results are consistent across models, supporting the robustness of the findings.

Table N-9. PY17 Home Energy Reports Subcomponent Peak Demand Savings

Metric	Primary Model	D-in-D Model	LDV Model
Hourly Peak Demand Savings per Household (kW)	0.007	0.007	0.004
85% Confidence Interval (kW)	(0.0047, 0.0102)	(0.0042, 0.0101)	(0.0016, 0.0069)
Total Peak Demand Reduction (kW)	2,608	2,504	1,482

Table N-10. PY17 Energy Analyzer Subcomponent Peak Demand Savings

Metric	Primary Model	D-in-D Model	LDV Model
Hourly Peak Demand Savings per Household (kW)	(0.124)	(0.129)	(0.045)
85% Confidence Interval	(-0.1306, -0.1169)	(-0.1360, -0.1220)	(-0.5210, -0.0389)
Total Peak Demand Reduction (kW) ⁽¹⁾	(6,161)	(6,409)	(2,236)

⁽¹⁾ Negative savings are not considered program-attributable demand savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 kW and reports zero net savings for the component.

N.1.5. Home Energy Reports Uplift Analysis Methodology

Savings from the home energy reports subcomponent can be attributed to behavioral changes, such as turning off lights in unoccupied rooms and adjusting thermostat settings, and investments in energy-efficient products, such as high-efficiency furnaces and water-saving equipment. In PY17, some customers who installed efficient products because of the home energy report may have received rebates from PPL

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Electric Utilities through other Act 129 programs. As a result, these savings could be counted in both the home energy reports subcomponent and PPL Electric Utilities' other efficiency programs.

To avoid double-counting savings from other programs in which customers participated as a result of the home energy reports, Cadmus subtracted cross-participation savings from the subcomponent's savings. To do this, Cadmus conducted an uplift analysis to estimate the impacts of the home energy reports subcomponent on customer participation in PPL Electric Utilities' residential and low-income efficiency programs, as well as the energy savings resulting from that participation. Cadmus refers to any difference in the rate of participation and savings as "participation uplift" and "savings uplift," respectively.

Cadmus did not perform an uplift analysis for the Energy Analyzer subcomponent in PY17, as no customers participated in both the Energy Analyzer and home energy reports subcomponents. Cadmus determined the evaluated Energy Analyzer savings were zero, as presented in the previous sections.

The following sections provide details on uplift results for the home energy reports subcomponent.

Cross-Participation in Downstream Residential Rebate Programs

For products and services promoted by utility programs and tracked at the customer level (downstream programs), Cadmus estimated the participation and savings uplift by matching home energy reports subcomponent treatment and control customers in each wave to the energy efficiency program participation tracking data in PPL Electric Utilities' tracking database, starting in the month when treatment began through to the end of PY17. Home energy reports treatment and control customers could also participate in PPL Electric Utilities' downstream programs in PY17, which include the Appliance Recycling and Energy Efficient Homes components and the Low-Income Program.

Participation Uplift

After matching tracking data to home energy reports customers, Cadmus calculated participation uplift, defined as the difference in the percentage of treatment group customers participating in at least one rebate program and the percentage of control group customers participating in at least one rebate program.

The control group's participation rate captured the business-as-usual effect of marketing and word-of-mouth impacts on customers' participation in other PPL Electric Utilities' Act 129 programs. This baseline participation rate is defined as the number of control group customers who participated in at least one other Act 129 program in PY17, divided by the total number of control group customers. If the cross-program participation rate was greater for treatment customers than it was for control customers, the home energy reports subcomponent had an additive effect on participation in those other programs.

Table N-11 shows the PY17 participation rate uplift results for the home energy reports subcomponent, broken out by program. The table shows the differences in cross-participation rates between treatment and control groups (uplift participation), and the percentage uplift participation relative to control group participation. The Energy Efficient Homes program component had the highest cross-program participation in PY17.

**Table N-11. Home Energy Reports: Participation Uplift
by Program or Component (Per 1,000 Customers)**

Program/Component	Participation Uplift per 1,000 Customers	Percentage Participation Uplift
Appliance Recycling Component	16.56	31.10%
Energy Efficient Homes Component	23.15	3.53%
Low-Income Program	11.60	2.22%

Savings Uplift

The savings uplift analysis followed a simple differences approach. Cadmus followed these steps to estimate uplift savings from downstream programs:

1. Matched the program tracking data for each program year to the treatment and control customers by a unique identifier.
2. Assigned each transaction to a month based on the participation date field in the tracking data.
3. Excluded any installations that occurred prior to the customer being assigned to the treatment or control group.
4. Calculated the average monthly electricity savings of each efficient product installed by a home energy reports customer, proportioned across months by the accrued heating and cooling degree days in each month for products sensitive to weather (Cadmus proportioned annual savings across months equally for products not sensitive to weather). Cadmus used the *ex post* gross verified savings for each product in PPL Electric Utilities' tracking database.
5. Summed the monthly average savings, by customer, for all products installed prior to a given month through the end of PY17. Cadmus incorporated customer inactive dates and measure lives of products when aggregating monthly savings.
6. Calculated the average annual savings accrued per customer for the treatment and control groups during PY17.
7. Calculated the incremental average annual savings per customer from other programs by taking the difference in annual per-customer savings for the treatment group and control group.

Multiplying the incremental average annual savings per customer by the number of program customers treated in PY17 yielded an estimate of the total home energy reports subcomponent savings from participation in other PPL Electric Utilities energy efficiency programs, as counted by those programs.

The uplift analysis excluded upstream components, in which participation is not tracked at the customer level. Since there were no upstream lighting installations after the launch of the home energy reports subcomponent, the default upstream reduction factor from the Phase IV Evaluation Framework does not apply. Given the expected small treatment effect, conducting a large-scale customer survey to capture small uplift savings is not worthwhile.

Table N-12 shows the home energy reports subcomponent energy savings uplift results for PY17, resulting from PPL Electric Utilities' downstream programs. The negative uplift savings indicate that the subcomponent did not lead to additional energy savings in these downstream programs. Per SWE's feedback, in calculating verified adjusted savings, Cadmus netted out the negative uplift values.

Table N-12. Home Energy Reports Uplift Energy Savings Summary

	Average Cross-Program Savings per Customer (kWh/yr)			Total Uplift Savings (MWh/yr)
	Treatment Group	Control Group	Difference	
Program Total	8.310	8.954	(0.644)	(222.475)

Although uplift savings were negative, participation uplift (presented in an earlier section) was positive. This suggests that the home energy reports subcomponent encouraged customers to participate in other efficiency programs, but those participants did not generate the expected incremental savings. It is likely that treatment customers adopted additional energy efficiency measures through downstream programs; however, the measured savings attributable to these actions were relatively low.

N.1.6. Energy Analyzer Cross-Program Engagement

While Energy Analyzer did not result in energy savings, the evaluation found cross-program engagement.

Cross-program engagement is defined as the difference between the percentage of treatment-group customers participating in at least one PPL Electric Utilities residential Act 129 program and the percentage of control-group customers participating in at least one PPL Electric Utilities residential Act 129 program. Participation is defined as having participated in other programs on or after an Energy Analyzer's first-click date.

The control group's participation rate captured the business-as-usual effect of marketing and word-of-mouth impacts on customers' participation in other PPL Electric Utilities' Act 129 programs. This baseline participation rate is defined as the number of control group customers who participated in at least one other Act 129 program in PY17, divided by the total number of control group customers. If the cross-program participation rate was greater for treatment customers than it was for control customers, the Energy Analyzer subcomponent had an additive effect on participation in those other programs.

Table N-13 shows the PY17 cross-program engagement for the Energy Analyzer subcomponent. The table shows the differences in cross-participation rates between treatment and control groups, and the percentage of participation relative to control group participation. The Appliance Recycling program component had the highest cross-program participation in PY17.

Table N-13. Energy Analyzer Cross-Program Engagement by Program or Component (Per 1,000 Customers)

Program/Component	Participation per 1,000 Customers	Percentage Participation
Appliance Recycling Component	6.50	21.24%
Energy Efficient Homes Component	6.04	2.04%
Low-Income Program	5.64	1.51%
Overall	17.18	2.46%

Overall, Energy Analyzer participants participated in other programs 2.46% more often than control customers, and 17.18 extra participants per 1,000. The cross-program engagement results indicate that the Energy Analyzer subcomponent can encourage participation in other programs.

N.2.Gross Impact Results

Table N-14 shows the verified gross energy savings, adjusted by uplift savings, for the HER component by subcomponent. As mentioned earlier, Cadmus did not evaluate peak demand in PY16 because no treatment occurred during the peak period as defined in the Pennsylvania TRM.

Table N-14. Home Energy Report Component Savings

	Savings	PY16 Verified ⁽¹⁾	PY17 Verified ⁽¹⁾	Phase IV Verified ⁽¹⁾
Home Energy Report	MWh/yr	7,562	28,695	36,257
	System-Level MW/yr	0	2.85	2.85
Energy Analyzer	MWh/yr	0	0 ⁽²⁾	0
	System-Level MW/yr	0	0 ⁽²⁾	0

⁽¹⁾Verified savings in this table reflect the removal of energy-savings uplift (double-counting) in the component.

⁽²⁾ Negative savings are not considered program-attributable savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 MWh/yr and 0 MW/yr and reports zero net savings for the component.

In PY17, the HER component reported energy savings of 27,290 MWh/yr, as shown in Table N-15. Cadmus verified 104% of the reported savings. The evaluated savings confidence interval (85%) ranged from 23,240.56 MWh/yr to 33,703.93 MWh/yr, which does encompass the reported savings estimate. The variance is likely attributable to the low statistical significance of results and limited precision in the underlying calculations. Many treatment customers received their first report earlier than the planned treatment start date. Using the planned date as a universal proxy for treatment introduced measurement error in treatment timing.

Table N-15. Home Energy Report Component Gross Impact Results for Energy

Stratum	PYRTD (MWh/yr)	Energy Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MWh/yr)
Home Energy Report	27,290	104%	0.13	18.40%	28,472
Energy Analyzer ⁽⁴⁾	0	N/A	N/A	N/A	0
Total (Verified)⁽²⁾	27,290	104%	0.13	18.40%	28,472
Adjustment for Double-Counted Savings (uplift)	N/A	N/A	N/A	N/A	(222) ⁽³⁾
Adjusted Savings⁽²⁾	27,290	105%	0.13	18.40%	28,695

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

⁽³⁾ Per SWE guidance, negative uplift savings are still applied as a subtraction from the unadjusted savings. When there are differences in energy efficiency program participation between the treatment and control groups, the incremental savings from that differential uptake are already captured in the regression-based estimate. In this case, applying the correction increases the PY17 verified savings by 222 MWh/yr.

⁽⁴⁾ Negative savings are not considered program-attributable energy savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 MWh/yr and reports zero net savings for the component.

In PY17, the HER component reported demand savings of 3.11 MW/yr, as shown in Table N-16. Cadmus verified 84% of the reported demand savings, totaling 2.61 MW/yr. The demand savings estimate had a sample Cv of 0.25 and achieved $\pm 34.52\%$ relative precision at the 85% confidence level, indicating high uncertainty around the estimated demand impacts. For the Energy Analyzer subcomponent, the estimated demand savings were negative; Cadmus reported 0 MW/yr of verified demand savings. After subtracting the negative uplift adjustment, the final adjusted demand savings are 2.62 MW/yr.

Table N-16. Home Energy Report Component Gross Impact Results for Demand

Stratum	PYRTD (MW/yr)	Demand Realization Rate ⁽¹⁾	Sample Cv or Error Ratio	Relative Precision at 85% C.L.	PYVTD (MW/yr)	System Level PYVTD (MW/yr)
Home Energy Report	3.11	84%	0.25	34.5%	2.61	2.846
Energy Analyzer ⁽⁴⁾	0	N/A	N/A	N/A	0	0
Total (Verified)⁽²⁾	3.11	84%	0.25	34.5%	2.61	2.846
Adjustment for Double- Counted Savings (uplift)	N/A	N/A	N/A	N/A	(0.015) ⁽³⁾	(0.016)
Adjusted Savings⁽²⁾	3.11	84%	0.25	34.5%	2.62	2.85

⁽¹⁾ Due to rounding, multiplying the PYRTD savings by the realization rate will not accurately reflect the final verified savings.

⁽²⁾ Total may not match the sum of rows due to rounding.

⁽³⁾ Per SWE guidance, negative uplift savings are still applied as a subtraction from the unadjusted savings. When there are differences in energy efficiency program participation between the treatment and control groups, the incremental savings from that differential uptake are already captured in the regression-based estimate. In this case, applying the -0.015 MW/yr uplift adjustment increases the PY17 adjusted demand savings from 2.61 MW/yr to 2.62 MW/yr.

⁽⁴⁾ Negative savings are not considered program-attributable demand savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 MW/yr and reports zero net savings for the component.

N.3.Net Impact Evaluation

The HER component evaluation resulted in an estimate of net savings. The estimate included any spillover that may have occurred within treated customer homes. No free ridership was anticipated because customers did not choose to receive the home energy reports, and no incentives were provided.

For the Energy Analyzer subcomponent, Cadmus used propensity score matching to address potential self-selection and free ridership concerns by constructing a comparison group of nonparticipating customers who closely resemble Energy Analyzer participants based on observable pre-treatment characteristics.

Cadmus also calculated incremental first-year savings and lifetime savings from the HER component following the formulas in the Phase IV TRM and Evaluation Framework. Because PY17 is the second treatment year, incremental first-year savings were equal to the estimated average treatment effect. Cadmus calculated lifetime savings by applying a factor of 2.44 to incremental first-year savings (Table N-17). This factor is based on the default assumptions for savings persistence (decay) and customer churn outlined in the TRM. For the Energy Analyzer subcomponent, Cadmus applied a measure life of one year since the TRM did not provide guidance on savings persistence for this program.

Table N-17. Incremental First-year Net Savings and Lifetime Net Savings

Stratum	Net Savings (MWh/yr)		Net Savings (MW/yr)	
	Incremental First-year	Lifetime	Incremental First-year	Lifetime
Home Energy Report	28,695	70,014	2.62	6.40
Energy Analyzer ⁽¹⁾	0	0	0	0
Total Net	28,695	70,014	2.62	6.40

⁽¹⁾ Negative savings are not considered program-attributable savings; therefore, Cadmus evaluated Energy Analyzer savings as 0 MWh/yr and 0 MW/yr and reports zero net savings for the component.

N.4. Process Evaluation

Cadmus conducted a process evaluation of the home energy reports and Energy Analyzer subcomponents using data collected through an online participant survey and interviews with staff from PPL Electric Utilities, the ICSP, and the ICSP's subcontractor. The research objectives for the process evaluation were to assess participant satisfaction, review component changes and performance, assess component design and customer experience, and make recommendations for improvement. Table N-18 shows the sampling strategy for the process evaluation. The results from the participant survey produced a measure of component satisfaction with $\pm 10\%$ precision at 90% confidence.

A total of 1,042 customers responded to the online survey from May 11 through June 3, 2026. Of those, 806 passed screening questions and were eligible to complete the survey. In total, 644 respondents (425 who accessed the Energy Analyzer tool but did not receive home energy reports, 213 who received home energy reports but did not access the Energy Analyzer tool, and six customers with the same email but different billing account numbers who accessed the tool and received the reports) completed the survey,

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defined as providing an answer for at least one demographic question at the end of the survey. The evaluation was consistent with the approved evaluation plan.

Sample sizes noted in this report may vary by survey or interview question because respondents could skip questions they chose not to answer; therefore, not all respondents answered every question. Cadmus included all survey and interview respondents who answered at least one question, even if they did not complete the survey or interview.

Table N-18. Home Energy Report Component Process Evaluation Sampling Strategy

Stratum	Stratum Boundaries	Mode	Population Size	Assumed Cv in Sample Design	Target Sample Size	Achieved Sample Size	Sample Frame ⁽¹⁾	Percent Contacted ⁽²⁾
PPL Electric Utilities Program and ICSP Staff	Key individuals from PPL Electric Utilities, ICSP, and the ICSP's subcontractors	Telephone in-depth interview	2	N/A	2	2	2	100%
Customers	Home energy reports participants	Online survey	456,352	0.50	240	213 ⁽³⁾	23,779	1%
	Energy Analyzer participants	Online survey	652,447	0.50	240	425 ⁽³⁾	23,827	2%
	Home energy reports and Energy Analyzer participants	Online survey	56,669	0.50	AMAP	6	291	2%
Component Total			1,165,470	-	-	646	47,899	-

⁽¹⁾ The sample frame is a list of participants and program staff with contact information who had a chance to complete the survey or interview. The final sample frame includes unique records in the PPL Electric Utilities database at the time of the surveys. After selecting all unique records, Cadmus removed any records from the population that did not have valid contact information (email or telephone number), were on the do not call list or opted out of the online survey.

⁽²⁾ Percent contacted means the percentage of the sample frame contacted via telephone or email to complete surveys/interviews.

⁽³⁾ Achieved sample size shows the number of respondents who completed the survey. When reporting, Cadmus included all responses in the analysis, even if the respondent did not complete the survey. The number of respondents used in the process evaluation differs from the numbers used in the gross impact analysis.

⁽⁴⁾ See Appendix L for details on Cadmus' approach to reduce survey bias and contact instructions.

N.4.1. Home Energy Reports and Energy Analyzer Subcomponents Survey

Cadmus administered the survey to PPL Electric Utilities' customers who had either accessed the Energy Analyzer tool but had not received home energy reports or had not accessed the Energy Analyzer tool but had received home energy reports.

Cadmus initially attempted to also survey customers who received home energy reports and accessed the Energy Analyzer tool. However, participation from this group was extremely limited, with only six completed responses. Because this sample size was insufficient to support statistically reliable analyses or meaningful comparisons with other respondent groups, Cadmus excluded these responses from the analysis.

The survey's general purpose was to assess customer experiences with the Energy Analyzer tool and home energy reports. The primary focus, however, was to evaluate how the Energy Analyzer tool influenced customers' energy-saving behaviors, awareness of PPL Electric Utilities' programs and offerings, perceptions of barriers to energy efficiency, confidence in their ability to overcome those barriers, and overall perceptions of the tool. Where appropriate, Cadmus compared survey responses between customers who accessed the Energy Analyzer tool and customers who received home energy reports but did not access the tool.⁷⁵ This comparison examined differences in energy-saving behaviors, program awareness, and perceived barriers to taking energy-saving actions.

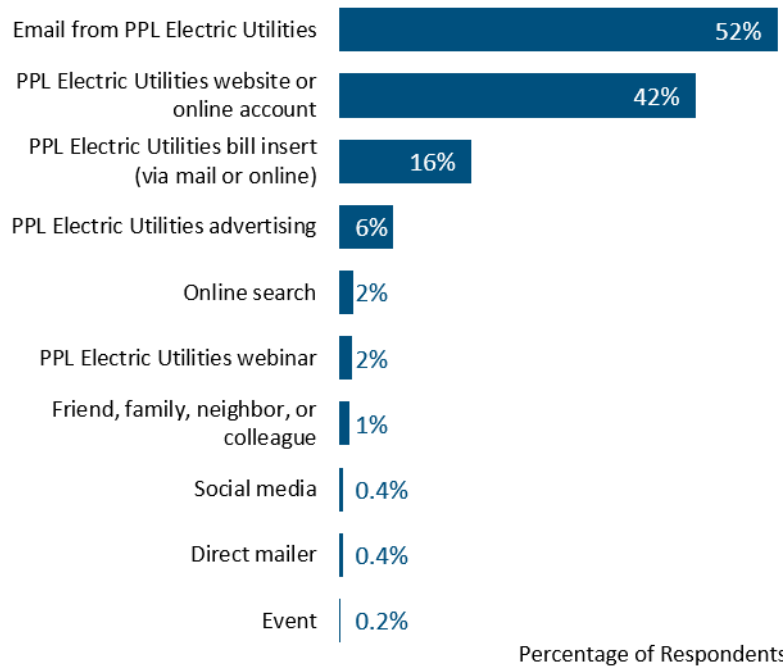
These comparisons should be interpreted with caution because the two groups engaged with the offerings in fundamentally different ways. Because Energy Analyzer users self-selected into using the tool, whereas recipients of home energy reports were assigned through a randomized design, the two groups may differ in their underlying motivation and engagement. Consequently, differences observed between the groups should be interpreted descriptively and not attributed solely to the effects of either offering.

⁷⁵ Customers either accessed the Energy Analyzer tool or received home energy reports. There was no overlap between the two subcomponents.

Initial Awareness of and Motivation to Access the Energy Analyzer Tool

The survey asked respondents how they first heard about the Energy Analyzer tool and what motivated them to access the tool. The most frequently reported channels through which respondents first became aware of the tool were PPL Electric Utilities mediums, including email (52%), website or online accounts (42%), and bill inserts (16%; see Figure N-4).

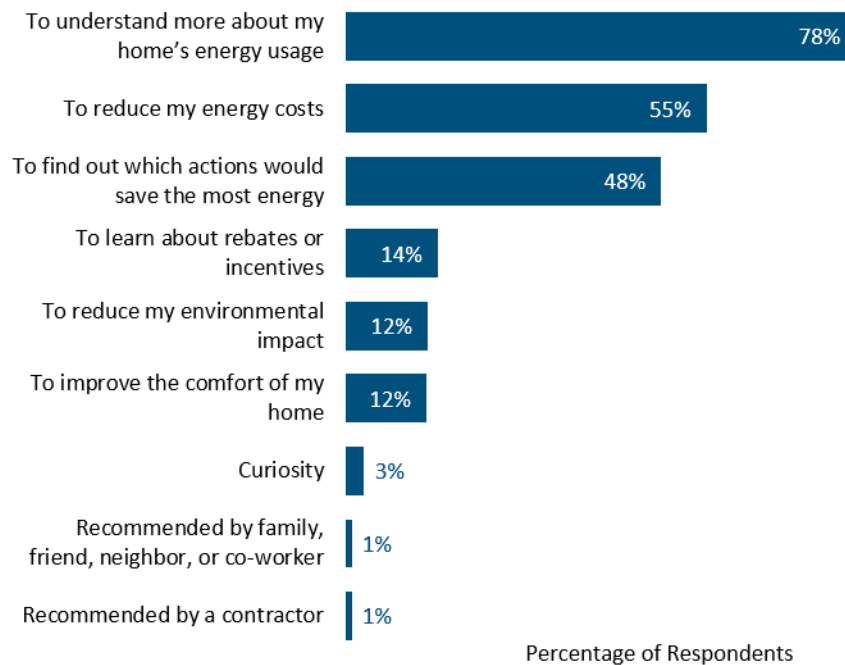
Figure N-4. Source of Awareness for Energy Analyzer Tool



Source: Participant survey, "How do you recall first hearing about the Energy Analyzer online tool? Select all that apply." (n=511)

As shown in Figure N-5, the most frequently reported reasons for accessing the tool were to understand more about their home's energy use (78%), to reduce energy costs (55%), and to find out which actions would save the most energy (48%).

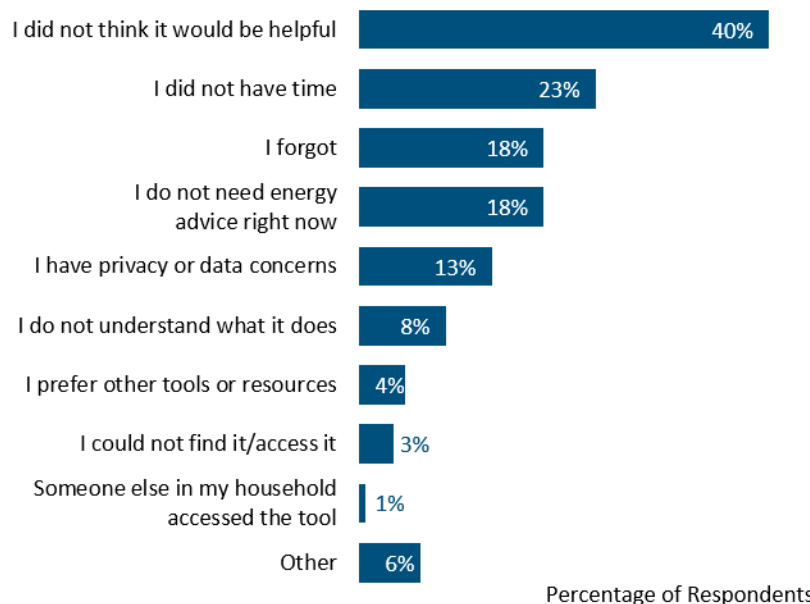
Figure N-5. Motivations for Accessing the Energy Analyzer Tool



Source: Participant survey, "What motivated you to access the Energy Analyzer online tool? Select all that apply." (n=500)

The survey also asked home energy reports recipients whether they had recalled seeing online or hearing anything about the Energy Analyzer tool. Nearly 86% (n=238) said that they had indeed seen or heard about the tool. As shown in Figure N-6, when asked why they had not accessed the tool even though they were aware of its existence, 40% said that they did not believe it would be helpful, 23% said they did not have time, and 18% said they simply forgot.

Figure N-6. Reasons for Not Accessing the Energy Analyzer Tool



Source: Participant survey, "Our records show that you have not accessed the Energy Analyzer online tool. What is the reason for that? Select all that apply." (n=178)

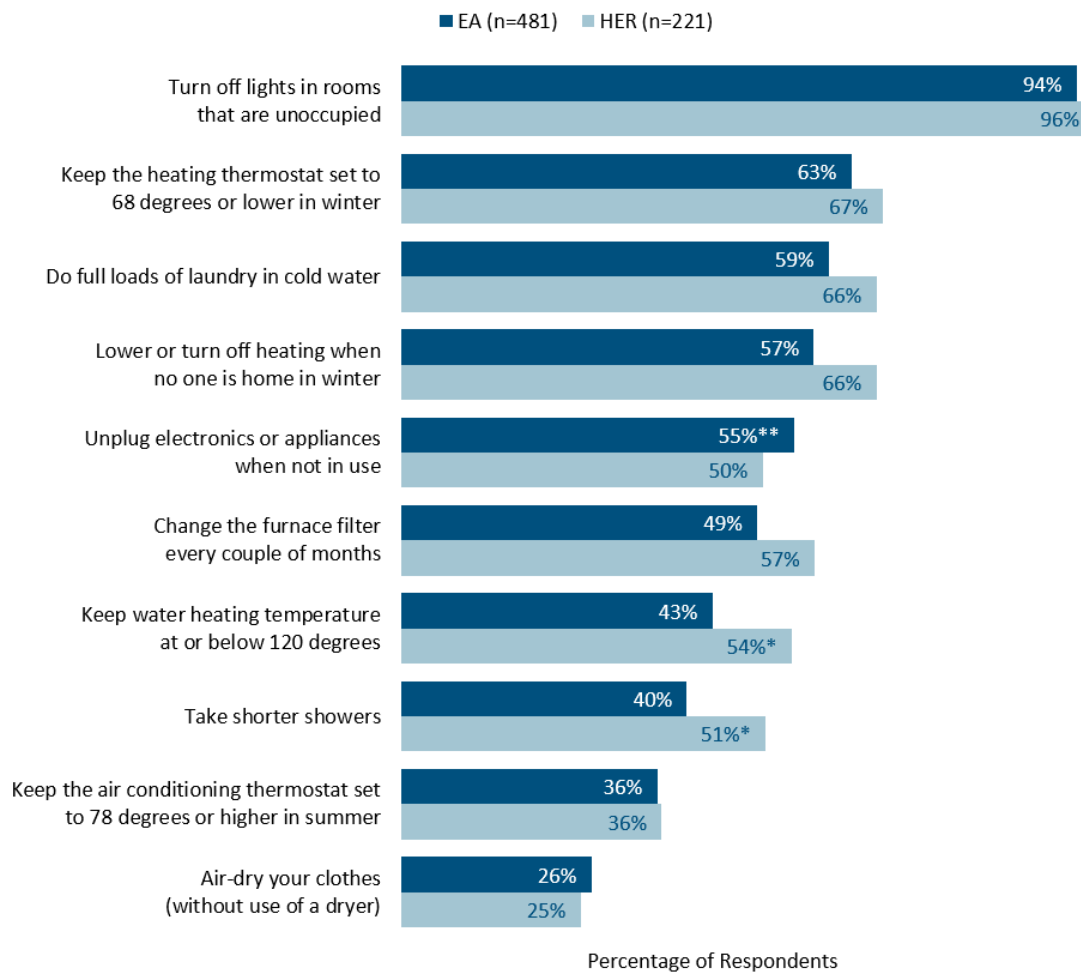
Energy Saving Behavioral Practices and Home Improvements

The evaluation research objectives included understanding the energy-saving practices and home improvements that customers engaged in and assessing the importance of the Energy Analyzer tool and home energy reports in influencing action.

Respondents reported high adoption of several basic energy-saving behaviors, although less intensive conservation practices were less common. Overall, the most frequently cited energy-saving practices were turning off lights in unoccupied rooms (90%), keeping the heating thermostat set to 68°F or lower in winter (60%), and doing full loads of laundry in cold water (59%). Conversely, the practices that were the least cited included air-drying clothes (25%), keeping the air conditioning thermostat set to 78°F or higher in the summer (34%), and taking shorter showers (41%).

Differences between groups were modest, with Energy Analyzer respondents more likely to report unplugging electronics and home energy reports recipients more likely to report water-heating and water-conservation behaviors. Those who accessed the tool reported unplugging electronics and appliances when not in use (55%) at a statistically significantly higher rate than report recipients (50%; $p < .10$). Report recipients were statistically significantly more likely to keep water heating temperatures at or below 120°F (54% vs. 43%; $p < .05$) and to take shorter showers (51% vs. 40%; $p < .05$; see Figure N-7).

Figure N-7. Energy-Saving Behaviors



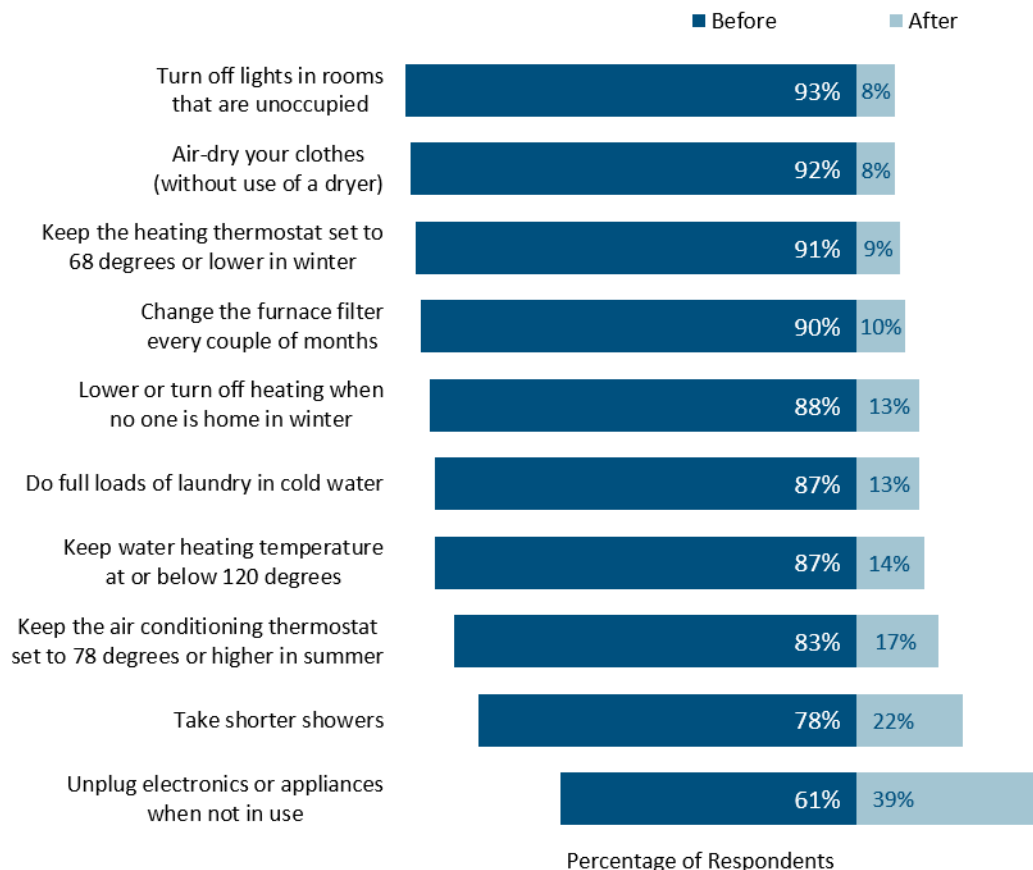
Source: Participant survey, "Below is a list of everyday habits that can save energy. Please check all the items your household tries to make a habit of."

One asterisk (*) indicates statistical significance at the 95% confidence level.

Two asterisks (**) indicate statistical significance at the 90% confidence level.

In terms of the tool's influence on energy-saving practices, Cadmus asked respondents whether they had developed each habit they said they engaged in prior to or after accessing the tool. For all reported behaviors, the majority of respondents said they had engaged in such habits prior to accessing the tool; however, the tool appeared to influence behaviors to varying degrees. For instance, 39% (n=245) of respondents said they unplugged unused appliances when not in use, and 22% (n=171) said they took shorter showers *after* accessing the tool (see Figure N-8).

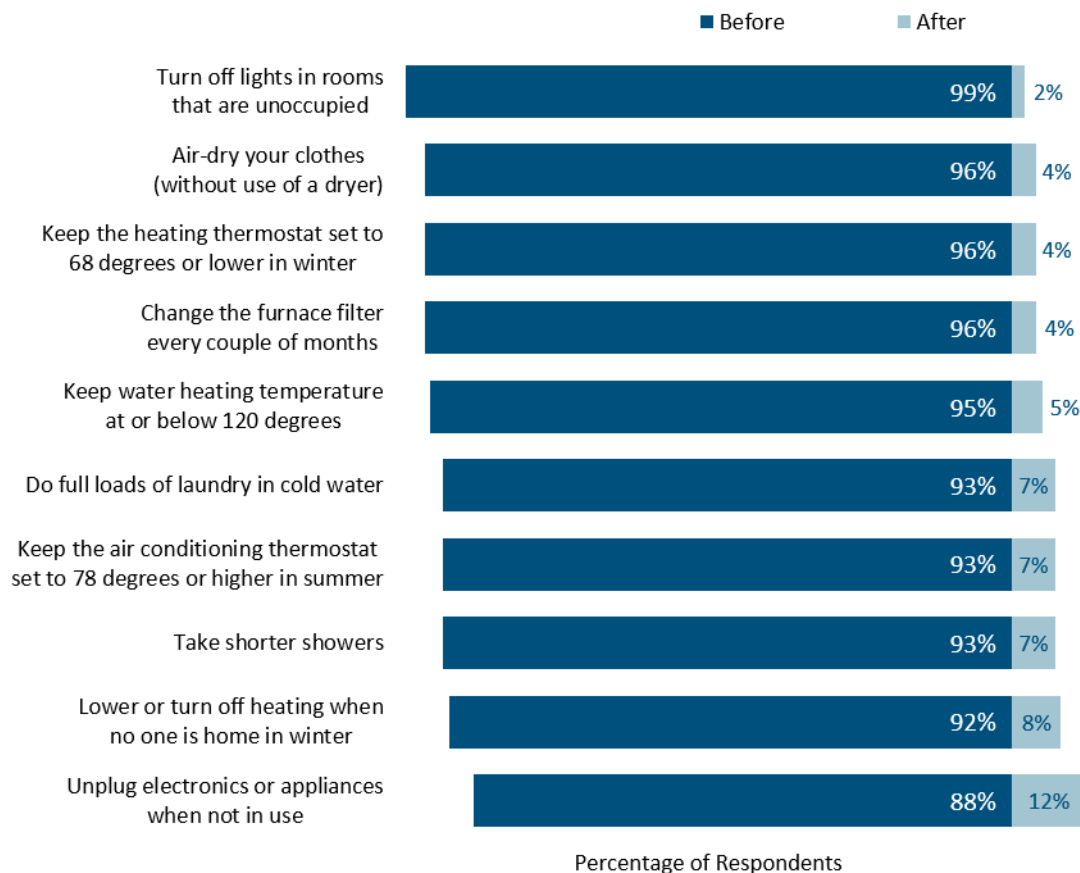
Figure N-8. Energy Analyzer Tool's Influence on Energy-Saving Behaviors



Source: Participant survey, "For each of the habits that you selected, please use the dropdown menu to indicate whether you started doing this before or after you first explored the online Energy Analyzer tool." (n=460)

Home energy reports appeared to have less impact on the adoption of energy-saving behaviors than the Energy Analyzer tool. The reports did not appear to have much impact on behaviors, with only unplugging electronics when not in use exceeding 10% in terms of respondents who started performing the behavior *after* receiving their first report (see Figure N-9).

Figure N-9. Home Energy Reports' Influence on Energy-Saving Behaviors

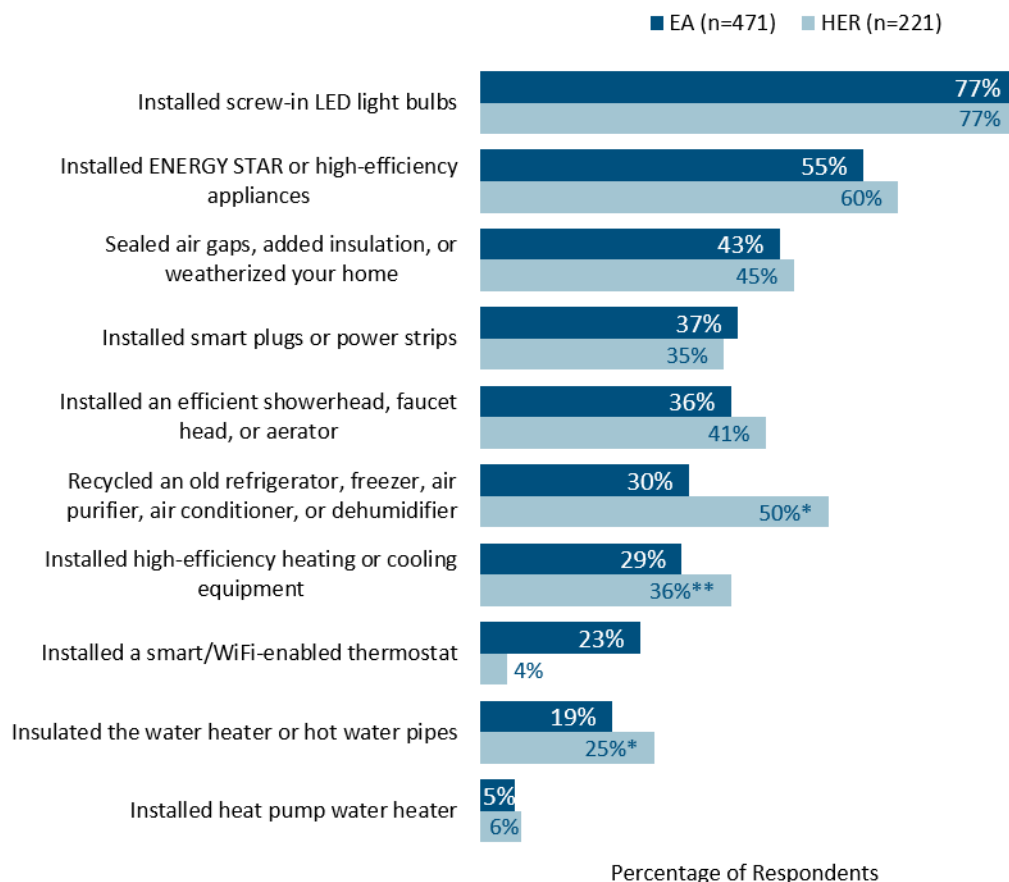


Source: Participant survey, "For each of the habits that you selected, please use the dropdown menu to indicate whether you started doing this before or after you received your first home energy report." (n=217)

Home energy reports had a greater impact than the Energy Analyzer tool regarding the percentage of respondents who completed energy-saving home improvements within the past five years. Those who received home energy reports were statistically significantly more likely than Energy Analyzer tool users to have installed high-efficiency heating or cooling equipment (36% vs. 29%, $p < .10$); recycle an old refrigerator, freezer, air purifier, air conditioners, or aerators (50% vs. 30%, $p < .05$); and insulate the water heater or hot water pipes in their homes (25% vs. 19%; $p < .05$; see Figure N-10). Overall, the most common home improvements were installing screw-in light bulbs or installing ENERGY STAR or high-efficiency appliances.

These results should be interpreted with caution, as they may reflect differences in the amount of time respondents had to adopt energy-saving behaviors or complete home improvement projects. For example, a respondent who received their first home energy report several years ago would have had substantially more time to complete a home improvement than one who only recently accessed the Energy Analyzer tool. As a result, observed differences between the two groups may be influenced not only by the offerings themselves but also by differences in exposure duration.

Figure N-10. Energy-Saving Home Improvements Completed in the Past Five Years



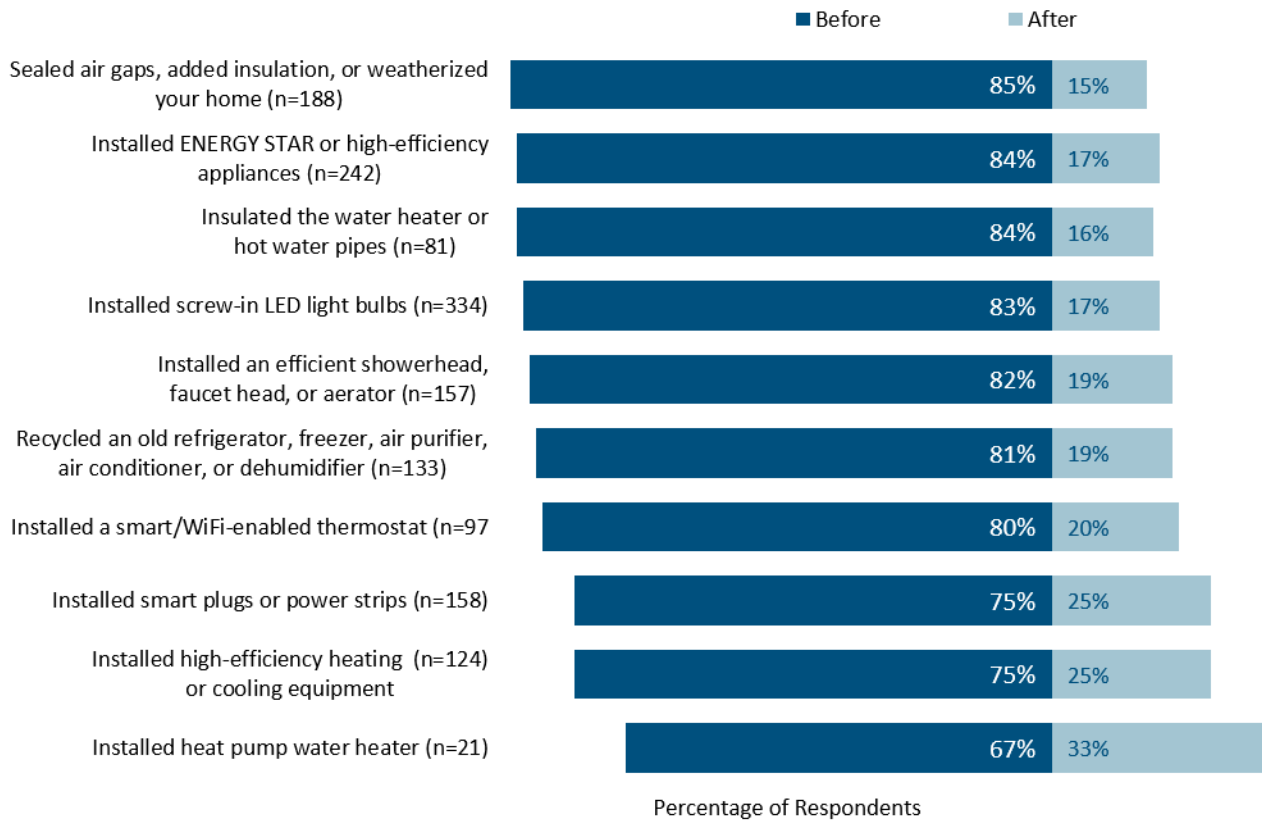
Source: Participant survey, "Below is a list of energy-saving home improvements. Please check all the items your household has completed in the past five years."

One asterisk (*) indicates statistical significance at the 95% confidence level.

Two asterisks (**) indicate statistical significance at the 90% confidence level.

As noted, the findings presented in Figure N-11 regarding home improvements within the past five years should be interpreted with caution, as the observed relationship may not reflect a direct influence of the program on respondent behavior. In contrast, the Energy Analyzer tool appears to be more strongly associated with subsequent energy-saving actions. As shown in Figure N-11, a substantial share of respondents reported completing energy efficiency improvements after first accessing the tool, including installing a heat pump water heater (33%) and installing high-efficiency HVAC equipment (25%).

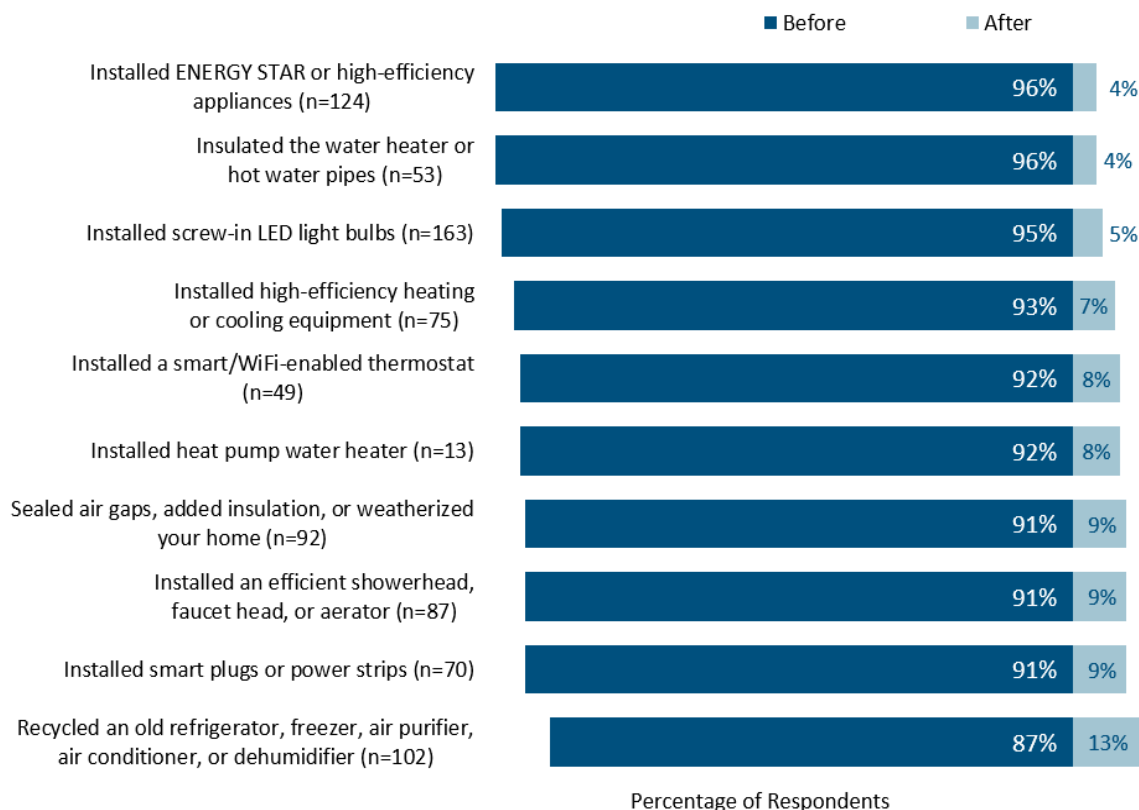
Figure N-11. Energy Analyzer Tool Influence on Energy-Saving Home Improvements



Source: Participant survey, "For each of the energy-saving home improvements you have completed in the past five years, please use the dropdown menu to indicate whether you completed the task before or after you first explored the online Energy Analyzer tool."

Figure N-12 indicates that the proportion of respondents who completed home improvements after receiving their first home energy report was lower than the corresponding proportion among Energy Analyzer users.

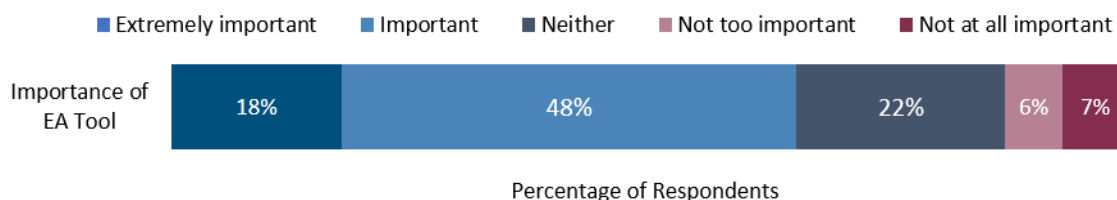
Figure N-12. Home Energy Reports Influence on Energy-Saving Home Improvements



Source: Participant survey, "For each of the energy-saving home improvements you have completed in the past five years, please use the dropdown menu to indicate whether you completed the task before or after you received your first Home Energy Report."

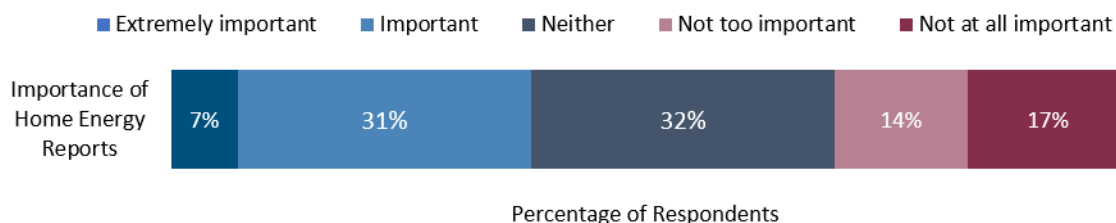
Consistent with previous findings, the Energy Analyzer appears to have had a stronger perceived influence on motivating respondents to take energy-saving actions. Among respondents who accessed the Energy Analyzer tool, 18% reported that the tool was *extremely important*, and 48% reported that it was *important* in motivating their energy-saving actions or improvements (see Figure N-13). In comparison, among report recipients, 7% indicated that the reports were *extremely important*, and 31% indicated they were *important* in influencing their energy saving actions or improvements (see Figure N-14).

Figure N-13. Importance of Energy Analyzer Tool on Energy-Saving Improvements



Source: Participant survey, "How important was the Energy Analyzer online tool in your energy-saving actions or improvements?" (n=432)

Figure N-14. Importance of Home Energy Reports on Energy-Saving Improvements



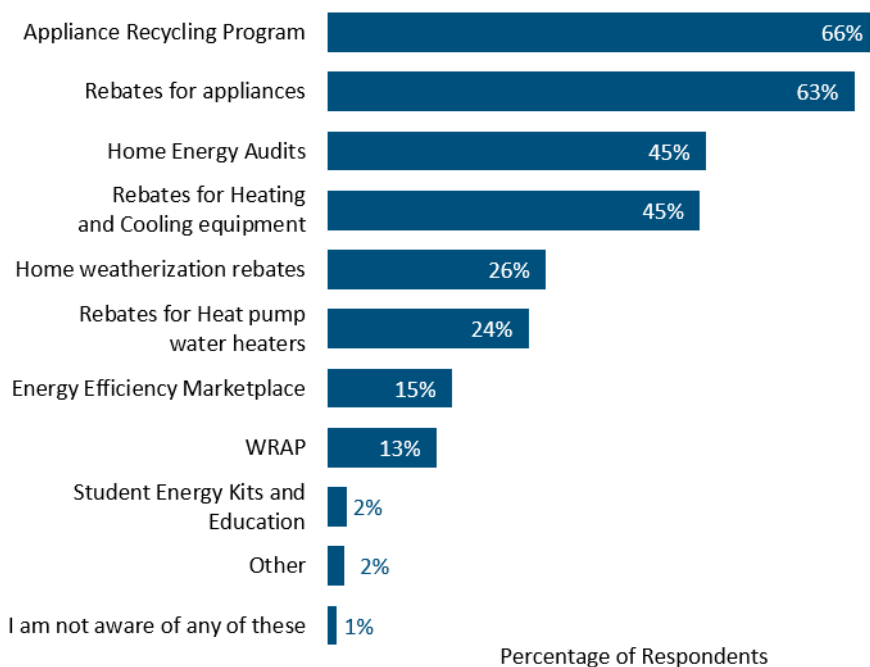
Source: Participant survey, "How important were the Home Energy Reports in your energy-saving actions or improvements?" (n=199)

Awareness of PPL Electric Utilities Programs and Offerings

PPL Electric Utilities offers several programs to residential customers, including rebate offerings and home energy audits. To assess customer engagement with these programs and offerings, Cadmus asked respondents who accessed the Energy Analyzer tool which programs they had heard of in the past six months, the extent of their familiarity with these programs, and the importance of the tool for increasing their awareness of the programs.

Sixty-eight percent of respondents who accessed the tool (n=428) said that they had heard something about PPL Electric Utilities programs that provide rebates on the purchase of energy-efficient equipment or that help save energy and money on energy bills in other ways. As shown in Figure N-15, of those respondents who said they had heard of at least one PPL Electric Utilities program in the past six months, appliance recycling (66%), rebates for appliances (63%), and home energy audits (45%) were the most frequently cited.

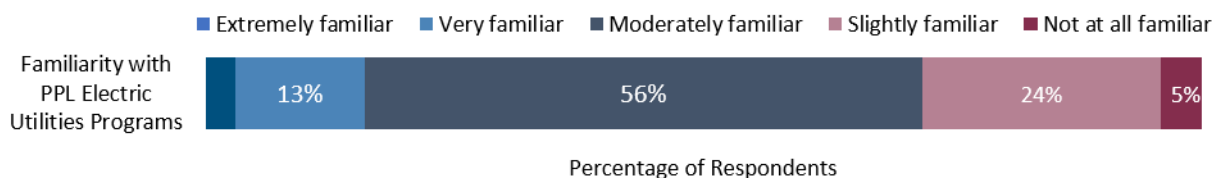
Figure N-15. PPL Electric Utilities Program Awareness



Source: Participant survey, "Which PPL Electric Utilities rebate or energy efficiency programs for residential customers have you heard about over the past 6 months? Select all that apply." (n=272)

Cadmus then asked respondents about the extent of their familiarity with the programs they said they had heard of and the importance of the tool in increasing their awareness of these programs. Respondent familiarity with PPL Electric Utilities Program offerings was modest, with 4% being *extremely familiar* and 13% being *very familiar*. The majority of respondents said they were *moderately familiar* with the programs (56%; see Figure N-16).

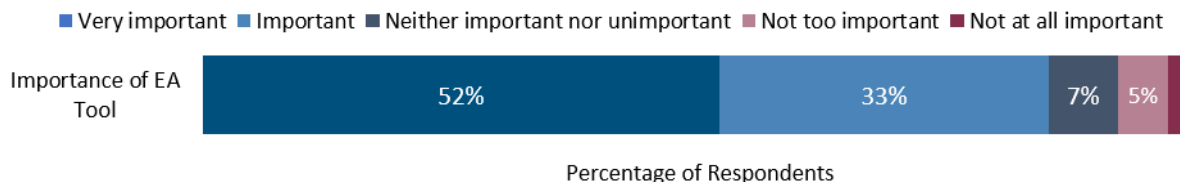
Figure N-16. Familiarity with PPL Electric Utilities Programs



Source: Participant survey, "How familiar are you with the PPL Electric Utilities energy efficiency programs mentioned above?" (n=259)

Among respondents who reported being *extremely familiar* or *very familiar* with the Energy Analyzer tool, most indicated that it was either *very important* (52%) or *important* (33%) in motivating their energy-saving actions or improvements (Figure N-17). These findings suggest that the perceived importance of the tool increased with familiarity and engagement.

Figure N-17. Importance of the Energy Analyzer Tool in Increasing Program Awareness



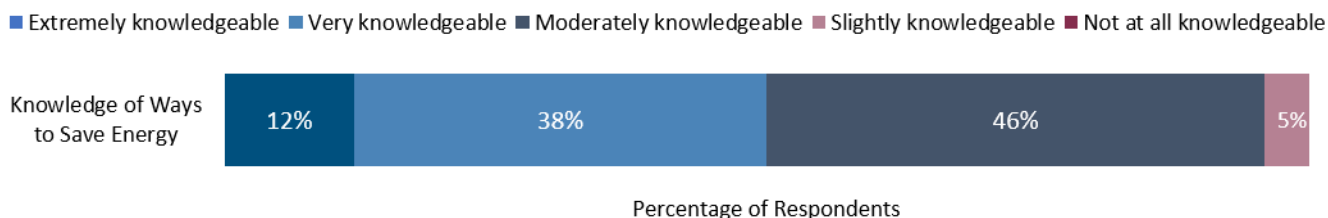
Source: Participant survey, "How important was the Energy Analyzer online tool in helping increase your awareness of the PPL Electric Utilities programs you mentioned?" (n=42)

Barriers to Energy Efficiency and Self-Efficacy to Overcome

Consistent with the evaluation research objectives, this section examines the factors that influence customers' energy-saving behaviors, including barriers to adopting energy-saving practices, confidence in overcoming those barriers, and knowledge of opportunities to reduce energy consumption. The evaluation also assessed the extent to which the Energy Analyzer tool and home energy reports increased customer awareness and understanding of energy-saving actions and opportunities.

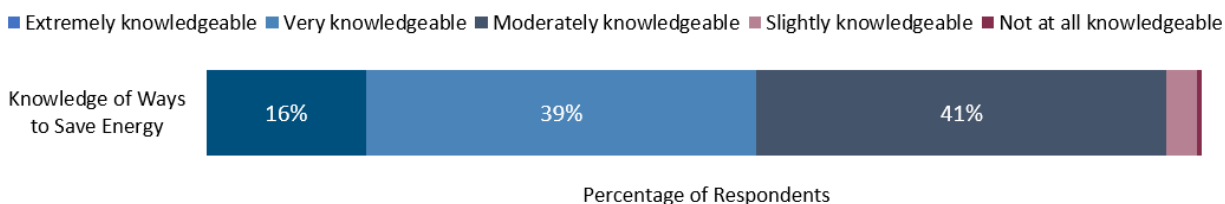
In terms of self-reported knowledge of ways to save energy in the home, most respondents who accessed the tool (Figure N-18) or received Home Energy Reports (Figure N-19) said they were either *moderately knowledgeable* (46% vs. 41%) or *very knowledgeable* (38% vs. 39%).

Figure N-18. Energy Analyzer Tool Users' Knowledge of Energy-Saving Behaviors



Source: Participant survey, "How would you rate your knowledge of the different ways you can save energy in your home?" (n=472)

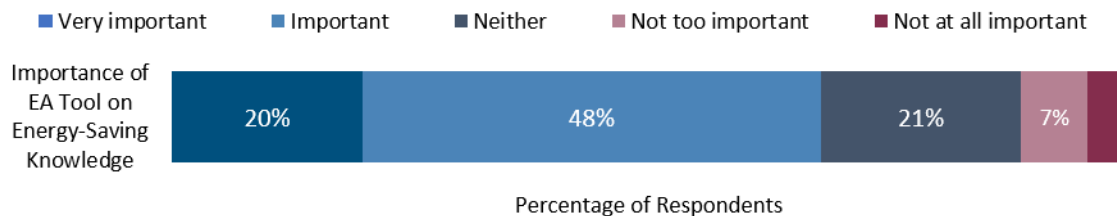
Figure N-19. HER Respondents' Knowledge of Energy-Saving Behaviors



Source: Participant survey, "How would you rate your knowledge of the different ways you can save energy in your home?" (n=221)

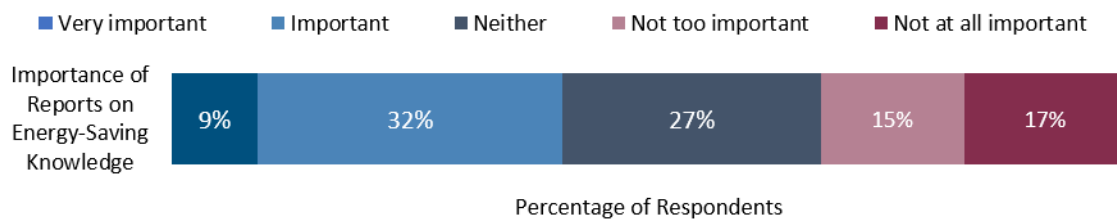
The Energy Analyzer tool played some importance in helping increase respondents' knowledge of different ways to save, with 48% and 20% of respondents reporting that the tool was *important* or *very important*, respectively (Figure N-20). Home Energy Reports appeared to have a more limited influence on increasing customer knowledge of energy-saving opportunities and practices, as 32% and 9% of respondents reported the reports were *important* or *very important*, respectively (Figure N-21).

Figure N-20. Importance of the Energy Analyzer Tool for Increasing Energy-Saving Knowledge



Source: Participant survey, "How important was the Energy Analyzer online tool in helping to increase your knowledge of different ways you can save energy in your home?" (n=436)

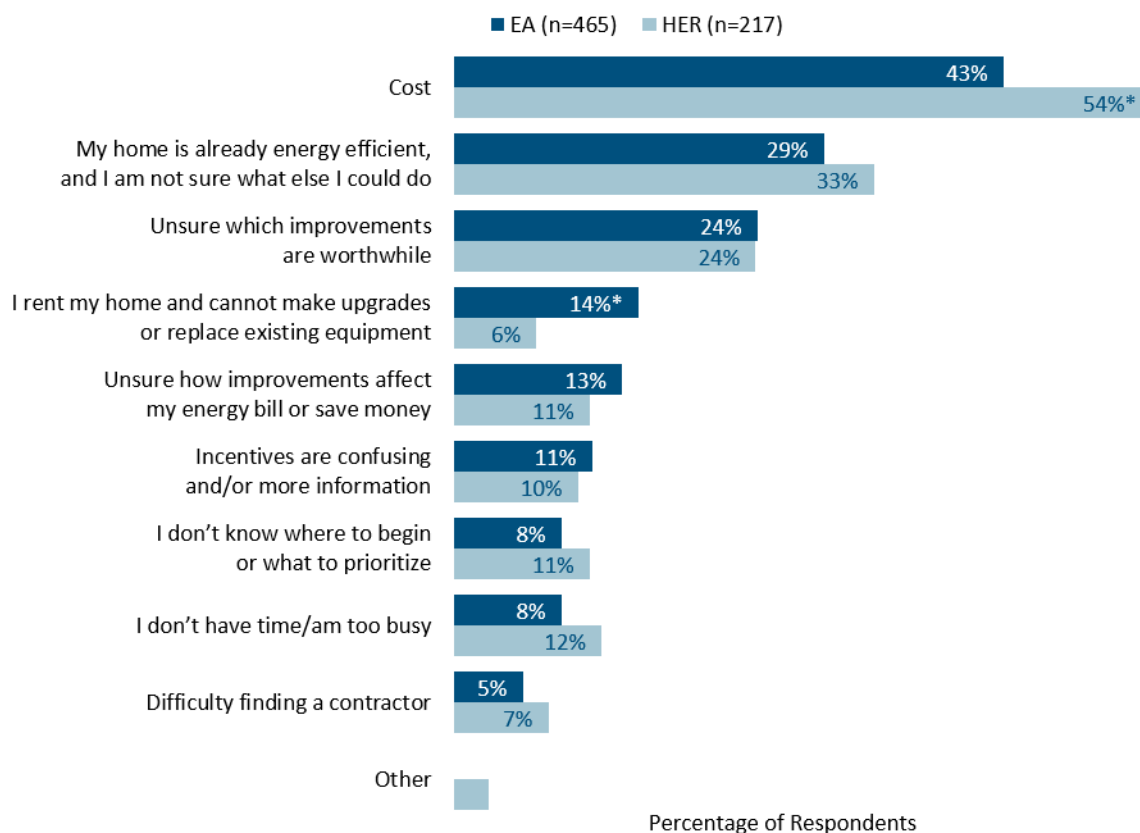
Figure N-21. Importance of Home Energy Reports on Increasing Energy-Saving Knowledge



Source: Participant survey, "How important were the Home Energy Reports in helping to increase your knowledge of different ways you can save energy in your home?" (n=205)

With respect to barriers to completing energy-saving improvements, the most frequently cited reasons for both respondents who accessed the tool and those who received home energy reports were related to the upfront cost of improvements, competing household priorities, and uncertainty about the potential benefits of the investment. The difference in cost as a barrier was statistically significantly higher for report recipients (54%) compared to those who accessed the tool (43%; $p < .05$; Figure N-22). These findings suggest that financial and informational barriers continue to be important factors limiting the adoption of energy-saving measures, regardless of the engagement channel.

Figure N-22. Barriers to Completing Energy-Saving Improvements



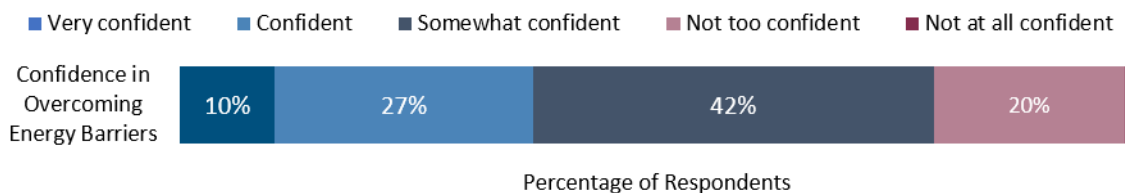
Source: Participant survey, "What makes it difficult for you to complete energy-saving improvements? Please check all the items that you think apply to your household."

One asterisk (*) indicates statistical significance at the 95% confidence level.

Two asterisks (**) indicate statistical significance at the 90% confidence level.

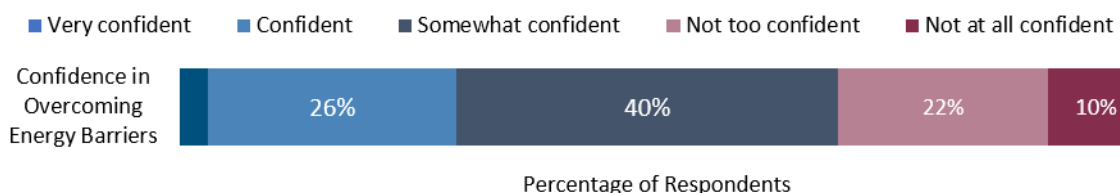
Respondents who accessed the tool had greater confidence than home energy reports recipients that they could make changes to overcome challenges and reduce their home's energy use. In fact, only 2% of tool accessors were *not at all confident* compared to 10% of report recipients ($p < .05$; Figure N-23). Conversely, 10% of tool accessors were *very confident* compared to 3% of report recipients ($p < .05$; Figure N-24).

Figure N-23. Energy Analyzer Tool Users' Confidence in Overcoming Energy Barriers



Source: Participant survey, "How confident are you that you could make changes to overcome those challenges and reduce your home's energy use?" (n=308)

Figure N-24. HER Respondent Confidence in Overcoming Energy Barriers



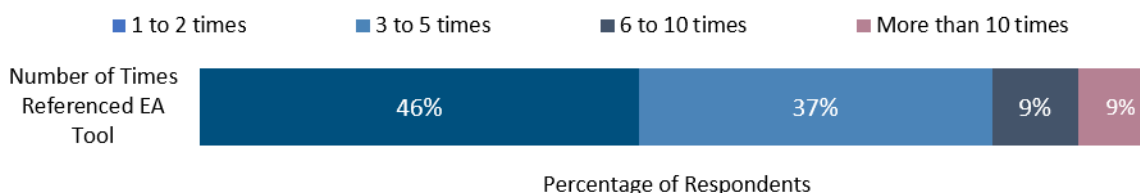
Source: Participant survey, "How confident are you that you could make changes to overcome those challenges and reduce your home's energy use?" (n=149)

Perceptions of the Energy Analyzer Tool

The survey asked respondents who accessed the tool to evaluate their experience, including frequency of use, perceived helpfulness, ease of use, and the aspects of the tool they found most useful.

In terms of the frequency with which respondents referenced the tool, most respondents said they had referenced the tool one or two times (46%), while 37% of respondents had referenced it three to five times, 9% six to 10 times, and 9% referenced it 10 or more times (n=402; see Figure N-25).

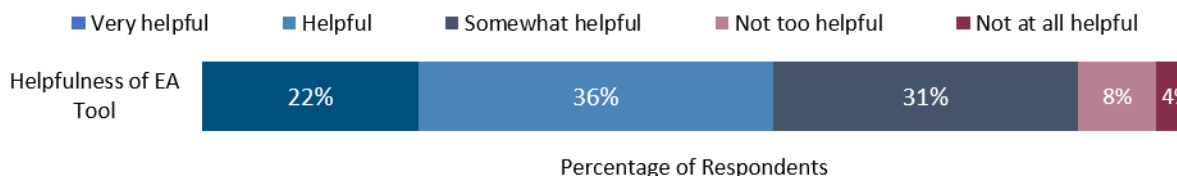
Figure N-25. Number of Times Respondents Referenced Energy Analyzer Tool



Source: Participant survey, "About how many times have you referenced the Energy Analyzer online tool?" (n=402)

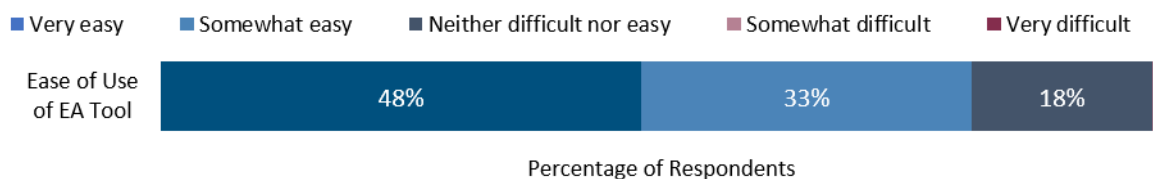
Respondents found the tool to be *very helpful* (22%) or *helpful* (36%; see Figure N-26) and either *very easy* (48%) or *somewhat easy* to use (33%; see Figure N-27).

Figure N-26. Helpfulness of Energy Analyzer Tool



Source: Participant survey, "How helpful did you find the Energy Analyzer?" (n=452)

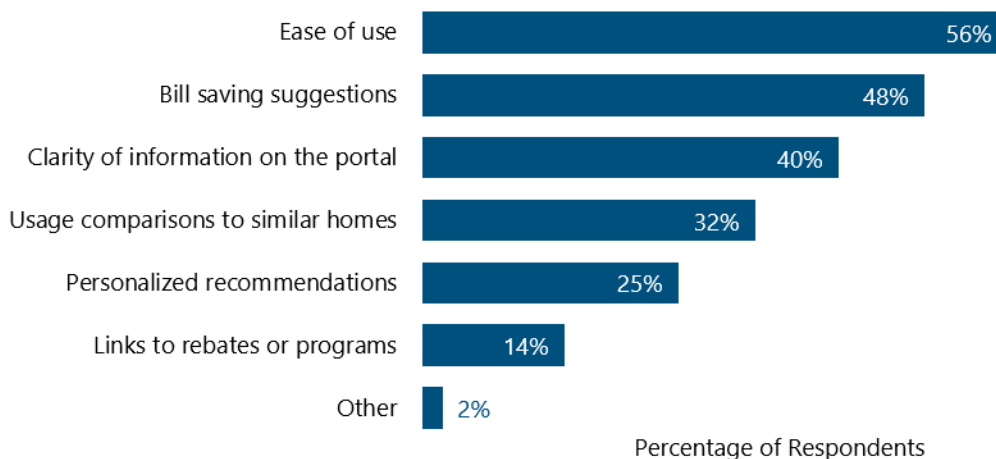
Figure N-27. Ease of Use of Energy Analyzer Tool



Source: Participant survey, "How easy was the Energy Analyzer to use?" (n=437)

Respondents reported that the ease of use (56%), bill savings suggestions (48%), and the clarity of information in the portal (40%) were the most useful parts of the tool (see Figure N-28).

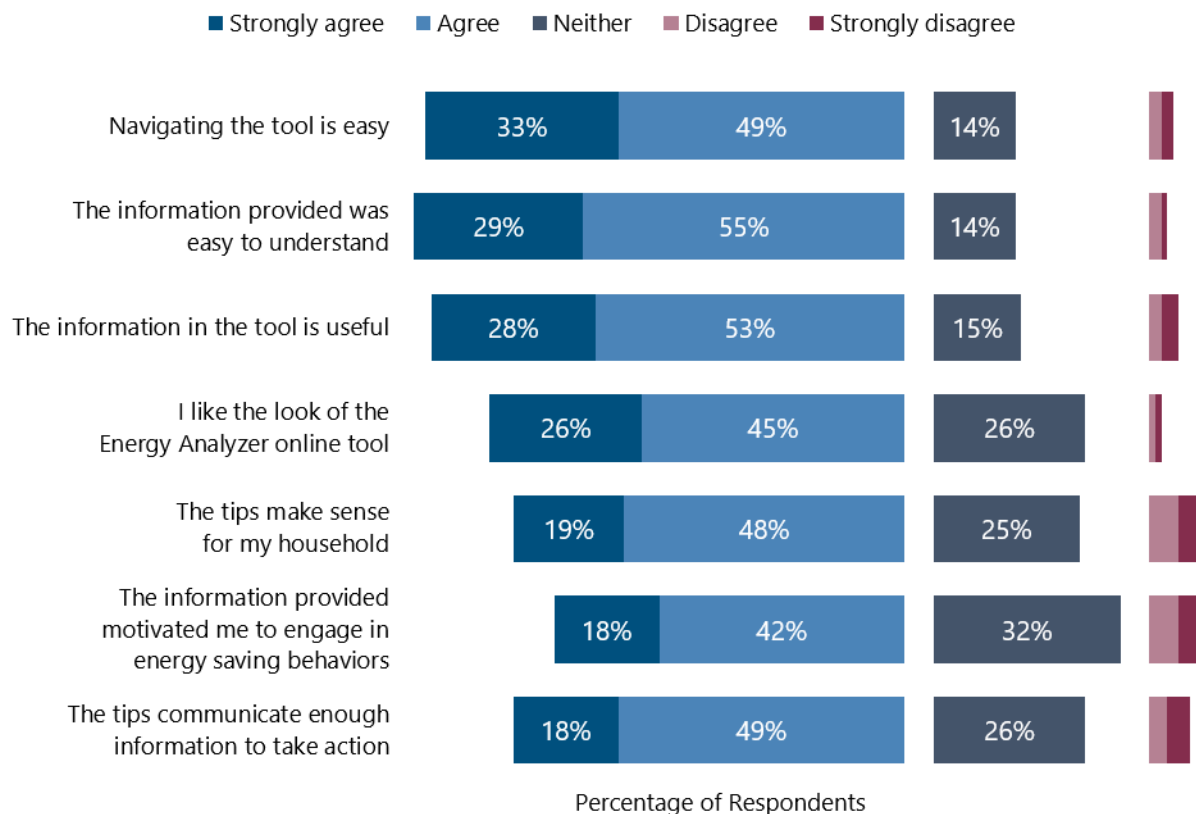
Figure N-28. Useful Components of the Energy Analyzer Tool



Source: Participant survey, "Which parts of the Energy Analyzer were most useful? (Select all that apply)." (n=397)

Cadmus also asked respondents to rate the extent to which they disagreed or agreed with several statements about the tool, including the tips provided, the design of the tool, and ease of navigation. For all seven statements shown in Figure N-29, the majority of respondents answered affirmatively (that is, they were in positive agreement with each statement).

Figure N-29. Perceptions of the Energy Analyzer Tool



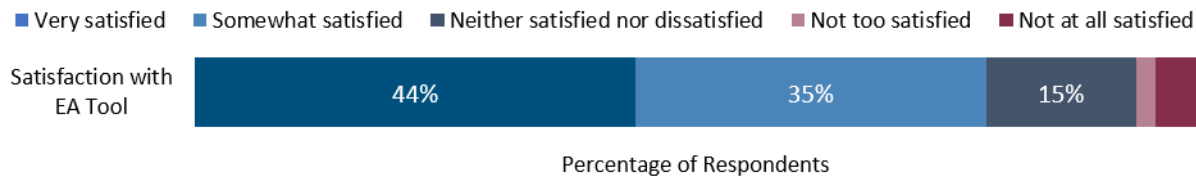
Source: Participant survey, "On a scale from 1 to 5, where 1 means strongly disagree and 5 means strongly agree, to what extent do you disagree or agree with the following statements about the Energy Analyzer online tool?" (n=423)

Satisfaction with the Energy Analyzer Tool and Home Energy Reports

The final set of survey questions asked respondents about their overall satisfaction with the Energy Analyzer tool or the home energy reports, as well as their suggestions for improving the tool and the reasons they were less than satisfied with the reports.

For the Energy Analyzer tool, most respondents were either *very satisfied* (44%) or *somewhat satisfied* (35%) with the tool (see Figure N-30).

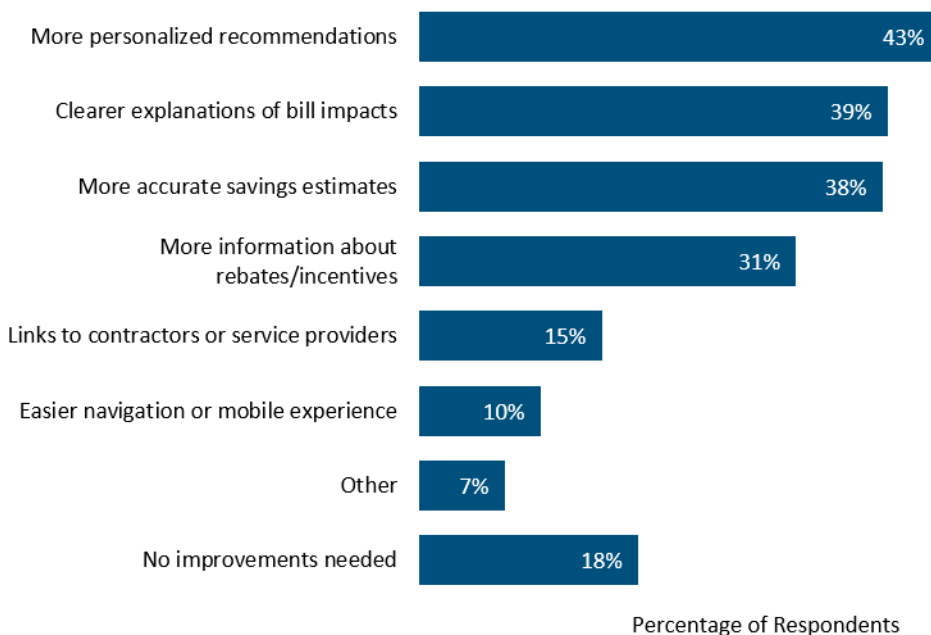
Figure N-30. Satisfaction with Energy Analyzer Tool



Source: Participant survey, "Overall, how satisfied are you with the Energy Analyzer online tool?" (n=422)

Cadmus asked all respondents who reported being less than very satisfied with the tool to provide suggestions to improve the tool to make it more useful. The most frequently cited improvement suggestions were to provide more accurate savings estimates (38%), provide a clearer explanation of bill impacts (39%), and provide more personalized recommendations (43%; see Figure N-31).

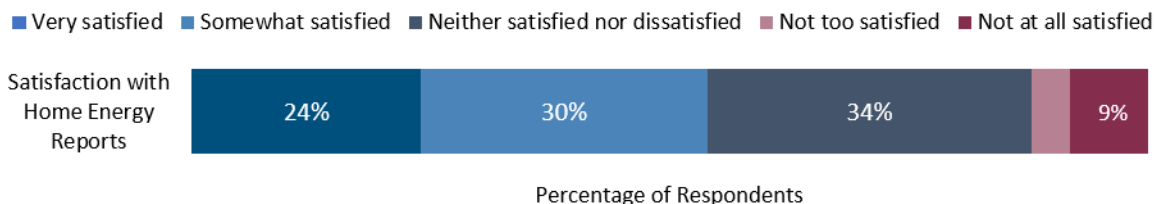
Figure N-31. Suggested Improvements to the Energy Analyzer Tool



Source: Participant survey, "What improvements would make the Energy Analyzer more useful? Select all that apply." (n=226)

Among respondents who received home energy reports, satisfaction levels were mixed. While 24% reported being *very satisfied* and 30% reported being *somewhat satisfied* with the reports, the most common response was *neither satisfied nor dissatisfied* (34%; Figure N-32). These findings suggest that many respondents viewed the reports neutrally, despite the majority expressing at least some level of satisfaction.

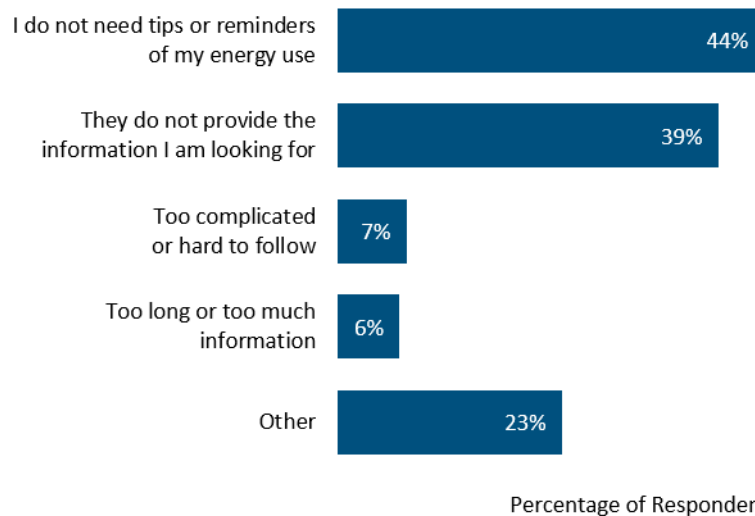
Figure N-32. Satisfaction with the Home Energy Reports



Source: Participant survey, "Overall, how satisfied are you with the Home Energy Reports?" (n=213)

For those who reported being less than satisfied with the home energy reports, 44% said they did not need tips or reminders of their energy use, and 39% said the reports did not provide them with information they were interested in (see Figure N-33).

Figure N-33. Reasons for Dissatisfaction with the Home Energy Reports



Source: Participant survey, "Why are you less than satisfied with the Home Energy Reports? Select all that apply." (n=126)

N.4.2. Participant Profile and Survey Sample Attrition

The PY17 survey collected demographic information about the Energy Analyzer and home energy reports survey respondents (Table N-19).

Table N-19. Home Energy Reports Participant Profile

Attribute	HERs Participants	Energy Analyzer Participants
Housing type – percentage living in a single-family detached home	82%	63%
Average age	67 years	70 years
Completed some college education or more	72%	73%

Table N-20 lists the total number of records contacted via online survey and the outcome (final disposition) of each record. Additional details on the survey methodology are in [Appendix L](#).

Table N-20. Home Energy Reports Online Participant Survey Sample Attrition

Description of Outcomes of Online Participant Survey	Number of Records ⁽¹⁾		
	HER	Energy Analyzer	HER/Energy Analyzer
Population (number of selected households)	456,352	652,447	56,669
Removed: Not active, opted out, invalid or missing contact information, duplicate email, selected for a different survey	51,232	159,519	14,192
Removed: Not eligible (no first click date or did not receive HER)	170,893	454,388	42,186
Removed: Not selected for the sample frame	210,448	14,713	0
Survey Sample Frame (records attempted)	23,779	23,827	291
Not reached or non-working: Opted out, email returned (bounce back), did not respond	23,426	23,195	281
Ineligible for survey (disqualified)	87	98	1
Partially completed survey	53	109	3
Completed Surveys (online)	213	425	6
Overall Response Rate	1%	2%	2%
⁽¹⁾ The sampling unit for the survey was a unique email address and does not match the counts used for impact analysis.			