ACT 129 STATEWIDE EVALUATOR PHASE II FINAL REPORT

Presented to:

Pennsylvania Public Utility Commission

FINAL REPORT

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This SWE Team Phase II Final Report presents the findings, conclusions, and recommendations of the Phase II SWE Team only and, as such, is not necessarily agreed to by the EDCs or the Commission. The Commission, while not adopting the findings, conclusions, and recommendations contained in this annual report, may consider and adopt some or all of them in appropriate proceedings, such as future updates to the Pennsylvania TRM, Total Resource Cost Test Order, and individual EDC energy efficiency and conservation plan revision proceedings.

Last, the SWE Team for Phase II would like to express its gratitude for being able to serve the PUC and the citizens of Pennsylvania for the last three years. It has been an excellent experience for our team, and we hope that energy efficiency continues to thrive and serve the customers well in Phase III of Act 129.

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ACRONYMS

AHU: Air handler unit

ARP: Appliance Recycling Program

ASHP: Air-source heat pump

CF: Coincidence Factor

C/I: Commercial and Industrial

CL: Confidence Level

Cv: Coefficient of Variation

Commission: Pennsylvania Public Utility Commission

CO: Carryover

CSP: Conservation Service Provider

CSUP: Commercial Sector Umbrella Program

DEER: Database for Energy Efficient Resources

DR: Demand Response

DSM: Demand Side Management

ECM: Electronically Commutated Motors

EDC: Electric Distribution Company

EE: Energy Efficiency

EE&C: Energy Efficiency and Conservation

EER: Energy Efficient Ratio

EISA: Energy Independence and Security Act

EFLH: Equivalent Full Load Hours

MWh: Megawatt-hour

NP: Non-Profit

NPV: Net Present Value

NTG: Net-to-Gross

NTGR: Net-to-Gross Ratio

PAPP: Public Agency Partnership Program

PA PUC or PUC: Pennsylvania Public Utility Commission

PEG: Program Evaluation Group

Phase II: Cumulative Program/Portfolio Phase II Inception to Date Reported Gross Savings

PMRS: Program Management and Reporting System

PY: Program Year

PY5: Program Year 5, from June 1, 2013 to May 31, 2014

PY6: Program Year 6, from June 1, 2014 to May 31, 2015

PY7: Program Year 7, from June 1, 2015 to May 31, 2016

PYTD: Program Year to Date

PYX QX: Program Year X, Quarter X

RARP: Residential Appliance Recycling Program

REEP: Residential Energy Efficiency Program

RG: Reported Gross Impact Savings

RHC: Residential Home Comfort Program

RR: Realization Rate

RRP: Residential Retail Program

EM&V: Evaluation, Measurement, and Verification

EMS: Energy Management System

EUL: Effective Useful Life

GNI: Government, Non-Profit, Institutional

HEEP: Healthcare Energy Efficiency Program

HID: High-Intensity Discharge Lights

HOU: Hours of Use

HPWH: Heat Pump Water Heater

HSPF: Heating Seasonal Performance Factor

HVAC: Heating, Ventilation, and Air Conditioning

IMP: Interim Measure Protocol

IPMVP: International Performance Measurement and Verification Protocol

IQ: Incremental Quarterly

ISD: In-service Date

ISR: In-service Rate

ISUP: Industrial Sector Umbrella Energy Efficiency Program

KPI: Key Performance Indicator

kW: Kilowatt

kWh: Kilowatt-hour

LED: Light-Emitting Diode

LIEEP: Low-Income Energy Efficiency Program

LILU: Low Income Low Use Program

LIWRAP: Low-Income Winter Relief Assistance Program

LLF: Line Loss Factor

SACS: Smart A/C Saver Program

SAP/SAR: Smart Appliance Recycling Program

SBR: Smart Builder Rebates Program

SBS: Smart Business Solutions Program

SCI: Smart Construction Incentives Program

SEER: Seasonal Energy Efficiency Ratio

SEI: Smart Equipment Incentives Program

SEM: Simple Engineering Model

SEP: School Energy Pledge Program

SES: Smart Energy Saver Program

SHC: Smart House Call Program

SHR: Smart Home Rebates Program

SMFS: Smart Multi-Family Solutions Program

SOS: Smart On-Site Program

SSMVP: Site Specific M&V Plan

SVG: Savings Factor

SWE: Statewide Evaluator

SWE Team: Statewide Evaluator Team

TOU: Time of Use

TRC: Total Resource Cost Test

TRM: Technical Reference Manual

TUS: Bureau of Technical Utility Services

UEC: Unit energy consumption

VFD: Variable Frequency Drive

LPD: Lighting Power Density

MMMF: Mastered Metered Multi-Family Program

M&V: Measurement and Verification

MW: Megawatt

VG: Verified Gross Impact Savings

Please see Appendix F for Glossary of Terms.

1 EXECUTIVE SUMMARY

The Phase II Statewide Evaluator (SWE) Team is providing this final report for Phase II of Pennsylvania's Act 129 energy efficiency programs. This report assesses whether the Pennsylvania electric distribution companies (EDCs) subject to Act 129 met their Phase II electric energy and demand savings targets and verifies Phase II portfolio and program Total Resource Cost (TRC) test calculations. This report also provides the detailed findings and recommendations of the Phase II SWE.

1.1 ACT 129 AND SUMMARY OF PUC ORDERS

The Pennsylvania Public Utility Commission (PA PUC, PUC, or Commission) was charged by the Pennsylvania General Assembly pursuant to Act 129 of 2008 (Act 129) to establish an energy efficiency and conservation (EE&C) program. The seven EDCs subject to Act 129[1] are Duquesne Light Company (Duquesne); the FirstEnergy companies Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), Pennsylvania Power Company (Penn Power), and West Penn Power (West Penn); PECO Energy Company (PECO); and PPL Electric Utilities (PPL). Stated below is the section of Act 129 that discusses the requirement for the Commission to conduct ongoing monitoring and verification of data collection, quality assurance, and results of each EDC's plan and program.

> 66 Pa. C.S. §§ 2806.1: "*The Commission shall, by January 15, 2009, adopt an energy efficiency and conservation program to require electric distribution companies to adopt and implement cost-effective energy efficiency and conservation plans to reduce energy demand and consumption within the service territory of each electric distribution company in this Commonwealth. The program shall include:*
>
> > *(2) "an evaluation process, including a process to monitor and verify data collection, quality assurance and results of each plan and the program."*

In order to fulfill this obligation for the Phase II Act 129 programs, the Commission entered an Implementation Order on August 3, 2012 at Docket Nos. M-2008-2069887 and M-2012-2289411. As part of the Implementation Order and Act 129, the Commission sought a SWE for Phase II to evaluate the EDCs' EE&C programs. The SWE Team, led by GDS Associates, Inc. (GDS) in partnership with Nexant,[2] Research Into Action, and Apex Analytics, was retained to fulfill requirements of the Phase II Implementation Order of Act 129. The Phase II SWE Team was contracted to monitor and verify EDC-reported program MWh and MW savings, benefit/cost (B/C) calculations, data collection and quality assurance processes, and other performance measures. The SWE Team has other contractual obligations, including reviewing and updating information and savings values found in the Pennsylvania Technical Reference Manual (TRM), developing recommendations for possible revisions and additions to the TRM, and developing best practices recommendations for program improvements and modifications.[3]

[1] EDCs in the Commonwealth of Pennsylvania with more than 100,000 customers are subject to the energy efficiency targets outlined in Act 129.
[2] Nexant withdrew from the Phase II SWE Team at the end of October 2015.
[3] For a complete list of the responsibilities of the SWE Team, see the April 2013 Phase II Statewide Evaluator Contract.

1.1.1 Mandated Electricity Consumption Reductions for Phase II

Table 1-1 shows, by EDC, the electricity consumption reduction targets that the Commission adopted for Phase II of Act 129 in its August 2, 2012 Phase II Implementation Order, as well as the EDCs' three-year cumulative annual MWh figures. There were no peak demand reduction targets for Phase II.

Table 1-1: Act 129 Phase II Three-Year Energy Efficiency Reduction Compliance Targets[4]

EDC	Three-Year Program Acquisition Cost (EDC $/First-Year MWh Saved)	Three-Year % of 2009/2010 Forecast Reductions	Three-Year MWh Cumulative Annual Value of 2009/2010 Forecast Reductions
Duquesne	$211.90	2.0%	276,722
FE: Met-Ed	$220.87	2.3%	337,753
FE: Penelec	$216.19	2.2%	318,813
FE: Penn Power	$209.20	2.0%	95,502
FE: West Penn	$209.42	1.6%	337,533
PPL	$224.71	2.1%	821,072
PECO	$227.55	2.9%	1,125,851

1.1.2 Annual Reporting Requirements

This report is the seventh annual report from the SWE Team to the Commission. This report provides detailed information on the findings of the SWE Team's Program Year Seven (PY7) audit activities of the Act 129 EE&C programs implemented by seven EDCs in Pennsylvania and reports the status of EDC compliance with the Phase II MWh savings targets. PY7 started on June 1, 2015 and ended on May 31, 2016. PY7 is the third year of the three-year period covered by Phase II.[5] This report also provides information on the Act 129 Phase I and II EDC expenditures, MWh and MW savings, and the acquisition costs per first-year kWh saved by program year and EDC.

The SWE contract specifies[6] that the SWE final annual report for Phase II be completed by February 28, 2017 and must include, but is not limited to, the following:

- An analysis and reporting of program impacts (demand and energy savings) and cost-effectiveness
- An analysis and assessment of each EDC's plan and actual program expenditures
- An analysis of each EDC's compliance with Pennsylvania TRM protocols for measurement and verification (M&V) of energy and demand savings attributable to its plan, in accordance with the Commission-adopted TRM and custom measure protocols
- An analysis of the cost-effectiveness of each EDC's expenditures in accordance with the latest Commission-adopted TRC Test Order

[4] The data in this table was obtained from the Pennsylvania Public Utilities Commission, Phase II Implementation Order, Docket Nos. M-2012-2289411 & M-2008-2069887, August 2, 2012, page 24.
[5] Phase II of Act 129 covered the time period from June 1, 2013 through May 31, 2016.
[6] Pennsylvania PUC Contract for the Statewide Evaluator, April 3, 2013, p. 33.

- An analysis of TRM information and savings values, with suggestions for possible revisions and additions
- A review of the Commission's TRC Test Order, with suggestions for possible revisions and additions to the TRC test
- A review of any proposed revisions and updates to EDC plans
- Recommendations for program, EE&C plan, and evaluation plan improvements

1.1.3 EDC Cost Recovery for Act 129 EE&C Programs

Pennsylvania Act 129 allows each EDC to recover, on a full and current basis from customers, through a reconcilable adjustment clause under 66 Pa. C.S. §1307, all reasonable and prudent costs incurred in the provision or management of its EE&C plan. The Act also requires that each EDC's plan include a proposed cost-recovery tariff mechanism, in accordance with 66 Pa. C.S. §1307 (relating to sliding scale of rates; adjustments), to fund all measures and to ensure a full and current recovery of prudent and reasonable costs, including administrative costs, as approved by the Commission.

1.1.4 EE&C Program – Phase II Implementation Order

The Commission's Phase II Implementation Order established the additional incremental reductions in electricity consumption to be achieved by the end of Phase II by each of the seven EDCs subject to Act 129, established the standards that each EDC's EE&C plan for Phase II must meet, and provided guidance on the procedures to be followed for the submittal, review, and approval of all aspects of EE&C plans for Phase II of the Act 129 programs. Listed below are the key elements of the August 3, 2012 Phase II Implementation Order:

1) Established the Phase II EE&C program as outlined in this Implementation Order.

2) Tentatively adopted the EDC-specific consumption reduction targets set forth in Table 1 in Section A.2.c.1. of this Implementation Order. These consumption reduction targets were to become final for any covered EDC that did not petition the Commission for an evidentiary hearing by August 20, 2012.

3) Stated that if an EDC filed a petition for an evidentiary hearing, the matter would be referred to the Office of Administrative Law Judge for hearings, with the record being certified to the Commission by November 2, 2012. Any party seeking to intervene in any such proceeding was ordered to file a Petition for Intervention within 10 days of an EDC filing a petition for an evidentiary hearing.

4) Ordered that Pennsylvania EDCs with at least 100,000 customers must adhere to the schedule for submission and filing requirements for Phase II EE&C plans identified in this Implementation Order.

5) Ordered that the Commission staff shall have delegated authority to review and approve EDC-proposed conservation service provider (CSP) bidding processes, as set forth in Section H of this Implementation Order. Such staff determination shall be the final determination of the Commission unless appealed to the full Commission within 20 days, per 52 Pa. Code §5.44.

6) Ordered that the Commission staff shall have delegated authority to review and approve contracts between EDCs and CSPs, as set forth in Section H of this Implementation Order. Such staff determinations shall be the final determination of the Commission unless appealed to the full Commission within 20 days, per 52 Pa. Code §5.44.

7) Ordered that the Commission staff shall have delegated authority to review and approve minor EE&C plan changes in accordance with the procedures set forth in Section G of this Implementation Order and this Commission's June 10, 2011 Final Order in Docket Number M-2008-2069887.

8) Ordered that the Commission's Bureau of Consumer Services and Bureau of Technical Utility Services (TUS) initiate a working group to investigate best practices from other states and identify working models for on-bill financing and on-bill repayment that address the concerns of all interested stakeholders.

9) Ordered that the staff of the Commission's TUS coordinate with the EDCs to add a line item to their quarterly and annual reports that notes energy savings over-compliance from Phase I.

10) Ordered that any directive, requirement, disposition, or the like contained in the body of this Opinion and Order that is not the subject of an individual Ordering Paragraph, shall have the full force and effect as if fully contained in this part.

1.1.5 Statewide Evaluator

The Commission's contract for the SWE for Phase II provides the scope of work for the Phase II SWE. The scope of work for the Phase II SWE is summarized on page 25 of this contract and states the following:

> "The Commission is issuing this RFP to retain the services of a statewide contractor for Phase II EE&C Plans who will monitor and verify EDC data collection, quality assurance processes and performance of EDC's EE&C programs. This contractor will also evaluate each EDC plan results on an annual basis and the entire EE&C program as a whole. This evaluation will include an evaluation of plan impacts (energy savings) and cost effectiveness, report results and provide recommendations for plan and program improvements. The Statewide contractor will produce an accurate assessment of the future potential for energy savings through market potential assessments."

Further details pertaining to the entire scope of work and deliverables for the Phase II SWE can be located on the Commission's website, at www.puc.pa.gov/Electric/pdf/Act129/SWE_RFP_2012.pdf.

1.2 SWE SUMMARY OF ACTIVIITIES

The evaluation activities of the Phase II SWE Team address the following topics, which are discussed in detail in this Phase II final report:

- Assessment of whether EDCs met the Act 129 Phase II three-year energy efficiency reduction compliance targets
- Determination of the accuracy of reported MWh and MW savings of Phase II EE&C programs
- Discussion of the SWE Team's methodology and approach to developing its findings and recommendations relative to processes, review of reported MWh and MW savings values, and review of reported TRC ratio values
- Key qualitative findings and recommendations related to programs and M&V processes based on observations, on-site inspections of energy efficiency project installation sites, and data review and analysis
- Findings and recommendations related to evaluation, measurement, and verification (EM&V) processes and practices by program and EDC
- Findings and recommendations relating to each EDC's program and portfolio cost-effectiveness calculations
- Quantitative findings and recommendations by program and by EDC

- Summary of findings and recommendations

1.2.1 Summary of Findings and Recommendations

Based on the SWE Team audit activities conducted from PY5 to PY7, the SWE Team makes the following key findings and recommendations to the Commission relating to the Phase II Act 129 energy efficiency and demand response programs. Additional recommendations focused on EDC-specific activities are found in Appendix A of this report.

1) All of the EDCs met their Act 129 Phase II three-year energy efficiency overall energy reduction compliance target, their low-income energy reduction compliance target, their government/non-profit/institutional (GNI) energy reduction compliance target, the percentage of measures offered to low-income program participants target, and portfolio cost-effectiveness (TRC) requirements. Table 1-2 shows the Phase II compliance report by EDC.

Table 1-2: Phase II EDC Compliance Checklist

EDC	Three-Year Overall Energy Reduction Target	Met Required Proportion of Measures Offered to Low-Income Customers	Energy Savings Achieved from Low-Income Sector	Energy Savings Achieved from GNI Sector	Total Resource Cost Test > 1
Duquesne	✓	✓	✓	✓	✓
FE: Met-Ed	✓	✓	✓	✓	✓
FE: Penelec	✓	✓	✓	✓	✓
FE: Penn Power	✓	✓	✓	✓	✓
FE: West Penn	✓	✓	✓	✓	✓
PECO	✓	✓	✓	✓	✓
PPL	✓	✓	✓	✓	✓

2) The SWE Team reviewed EDC reported and evaluated savings and generally affirms their validity. The SWE Team does, however, note a few small errors in the calculations of reported MWh and MW savings for some of the EDCs. For example, some EDCs did not use the applicable Pennsylvania TRM values or algorithms when reporting gross verified savings for some energy efficiency measures. This report identifies where such errors have been made and makes recommendations on how they should be corrected. The SWE Team recommends that any errors in reported PY5, PY6, or PY7 verified incremental or cumulative annual MWh or MW savings or reported B/C calculations for an EDC be corrected and that a revised EDC final Phase II annual report be filed with the Commission by May 31, 2017.[7]

3) For Phase II, the combined NPV lifetime net benefits (benefits – costs) of the EDC energy efficiency portfolios exceeded $900 million.

[7] In February 2015 the PUC's TUS staff instructed the Phase II SWE project manager that in the event of an error with reported savings, an "EDC make reference and amendment in their subsequent report filings unless it is the final Phase II report that is needed for compliance, in which case you will prescribe a drop dead date after which it is too late to make modifications."

4) In the PY6 audit activities, the Phase II SWE Team found instances where EDCs chose not to use values or algorithms in the applicable Phase II Pennsylvania TRM. The 2013 SWE Evaluation Framework states that if an EDC does not wish to use the values or protocols in the applicable TRM, it may use a custom method to calculate and report ex ante savings and/or ask its evaluation contractor to use a custom method to verify ex post savings, as long as the EDC:

a. Also calculates the savings using TRM protocols; and

b. Includes both sets of results in the quarterly and/or annual EDC reports.

The EDCs must justify the deviation from the TRM ex ante and ex post protocols in the quarterly and/or annual reports in which they report the deviations. EDCs should be aware that use of a custom method as an alternative to the approved TRM protocol increases the risk that the Commission may challenge their verified savings. In the EDC PY7 annual reports, the SWE did not find any instances where EDC kWh and kW savings calculations deviated from the PY7 TRM.

5) The SWE Team's initial review of EDC PY7 Annual Reports to the PUC found minor calculation inconsistencies in some EDC TRC models. The Phase II SWE coordinated with the EDCs to verify and make proper adjustments to the PY7 and Phase II TRC models. This SWE Phase II Final Report includes these TRC ratio adjustments. None of the adjustments resulted in TRC ratios that were plus or minus 1% of EDC reported numbers. As noted above, the Phase II SWE Team only recommends that an EDC file a revised report with the Pennsylvania PUC if there are errors in reported total EDC program costs, EDC portfolio gross or net MWh savings, or any other key items (such as TRC B/C ratios) greater than plus or minus 1% of reported numbers in any program year of Phase II.

6) In the SWE's PY6 report, the SWE recommended that net-to-gross (NTG) research be conducted for all market segments[8] where an EDC offers Act 129 programs, including the residential low-income sector.[9] During PY7, six of the seven EDCs followed this recommendation. These six EDCs determined that the NTG ratios (NTGRs) for their low-income programs ranged from 81% to 90%. This research conclusively shows that the NTGR for low-income programs is not 100%. Going forward, the Phase II SWE Team recommends that NTG market research for residential low-income programs be conducted at least once in every Act 129 Phase. The Phase II SWE Team also recommends that the Commission consider setting the default NTGR for Phase III for residential low-income programs in the range of 81% to 90% given the results determined from the Phase II NTGR research.

7) The SWE Team finds that all seven Pennsylvania EDCs subject to the Phase II electricity savings requirements of Act 129 have met the Phase II kWh savings targets listed in the Phase II Implementation Order for Act 129. On a statewide basis, the EDCs achieved 133% of the Phase II MWh/yr savings goal for all of Phase II, based on the numbers verified by the EDCs' evaluation contractors.

8) The overall TRC test B/C ratio, as reported by the EDCs and consolidated across each EDC for PY7, is 1.8. The net present value (NPV) savings to Pennsylvania ratepayers reported by the EDCs for PY7 is

[8] In its August 2, 2012 Act 129 Phase II Implementation Order, the Commission mandated "that the EDCs calculate the NTG ratio as they did for Phase I. The EDCs will continue to use net verified savings in their TRC test for program planning purposes and compliance in Phase II will be determined using gross verified savings". See Phase II Implementation Order, page 82.

[9] Research conducted by SWE Team members in other jurisdictions indicates that the NTGR for low-income programs is often significantly different than 1.0. The Phase II SWE recommends that, going forward, NTG research be conducted for the low-income sector in order to determine the net savings of programs targeted at this sector and to collect information to help in future planning and program design for Act 129 low-income programs.

$443 million (~$1 billion in benefits minus ~$560 million in costs). In those instances, where calculation errors caused the NPV savings for an EDC's PY7 program portfolio to change by 1% or more, the SWE Team recommends that the EDC cost-effectiveness calculations be corrected and a revised EDC PY7 report be filed with the Commission by May 31, 2017.

9) Based on the SWE Team audit activities conducted from PY5 to PY7, there still is evidence of high free-ridership for several EDC programs. For purposes of this report, the Phase II SWE defines high free-ridership as a rate above 50%. In the residential sector, free-ridership was highest for appliance and heating, ventilating, and air-conditioning (HVAC) rebate and upstream lighting programs; it varied from moderate to high for appliance recycling; it was lowest for home performance and kit distribution programs. In the non-residential sector, free-ridership was highest in programs targeting small businesses, custom projects, and the GNI sector. When high free-ridership exists, the SWE Team recommends that EDCs should reexamine program design elements to determine whether free-ridership can be reduced in the future. All EDCs should continue to consider actions to reduce free-ridership in Phase III. In the non-residential sector, if any EDCs still allow customers to submit rebate applications after equipment purchase (and do not specify an eligibility time period), they should consider implementing a 90-day rebate eligibility clause for such purchases.[10]

10) The EDC process evaluations identified that retailers and contractors are an important source of program information.[11] One EDC process evaluation found that contractors prefer direct, personal program contact, and another evaluation found a decrease in sales staffs' enthusiasm for selling energy efficient appliances. These findings point to the need for programs to engage with retailers and contractors directly and personally to encourage sales, which may help increase program participation.

11) EDC process evaluations of home audit programs continued to show opportunities for greater conversion of audit participants to program participants. The SWE Team recommends that EDCs conduct research to track over time the percentage of home energy audits that result in purchases and installations of energy efficiency measures. Then the SWE can develop a comparison of these percentages across EDC audit programs. Having such comparative information across EDCs will help the SWE develop findings, best practices, and recommendations on program strategies that lead to the highest conversion rates from audit participants to program participants.

12) During Phase III, EDC database tracking systems should continue to adjust as necessary to capture sufficient measure detail so that the applicable TRM algorithms can be used to verify reported savings values and assumptions. The SWE Team found some instances in which the PY7 EDC tracking systems lacked the ability to capture these details. The SWE Team's specific recommendations for each EDC's data-tracking and reporting system are provided in Appendix A of this report.

[10] Focusing on reducing program free-ridership rates, the SWE made this recommendation to the EDCs during several Phase II Program Evaluation Group (PEG) meetings. A 90-day rebate eligibility clause is recommended by the SWE to significantly reduce the possibility of granting rebates to program participants who have already installed qualifying measures without a rebate. The 90-day window of opportunity would be measured from the date of equipment purchase. Some of the EDCs already have implemented such eligibility requirements. Furthermore, the SWE recommends that additional research be conducted to determine the extent to which program participants who apply for a rebate two to three months after equipment purchase are free-riders. The SWE recommends that participant surveys ask how long the interval was between the purchase of the appliance and the submittal of the rebate application (if these data are not already in the EDC's program tracking system), and that analysis be done to determine the free-ridership rate for such participants as compared with participants who applied more quickly for a rebate. The SWE recommends that this research recommendation be discussed with PEG participants at a future meeting during Phase III. This research is necessary in order to provide Pennsylvania-specific information on whether the free-ridership rate increases as the length of time a participant takes to apply for a rebate (after a measure is installed) increases.

[11] The Phase II SWE Team recommendations in this section draw from SWE Team audit activities conducted across all three years of Phase II, not just from the last year of Phase II.

13) During Phase II the percentage of participants in EDC residential low-income programs receiving either a telephone or on-site inspection varied significantly among EDCs. Going forward, the Phase II SWE Team recommends that the TUS staff and Phase III SWE consider establishing clearer guidelines for the number of telephone and on-site inspections that need to be performed for residential low-income programs. The design of these guidelines will need to take into account differences in EDC low-income programs. These guidelines should establish minimum requirements for the number and types of telephone and/or on-site inspections that need to be performed for low-income programs.

14) The SWE Team found that 9% of the verified savings in the non-residential sector in PY7 came from residential upstream lighting programs. This is a significant reduction from the 21% reported in PY5, as all EDCs except for the FirstEnergy companies reported substantial drops in the cross-sector savings associated with these upstream bulb programs. For Duquesne for PY7, the amount verified in this category was actually 0%. For PECO and PPL, the percentages verified were 14% and 12%, respectively, with those for the FirstEnergy companies ranging from 0.5% for Penn Power to 4.7% for Penelec and West Penn. The SWE Team recommends continued cross-sector sales analysis, as the findings show there are important shifts in the MWh and MW savings being reported in this category.

15) For all four EDCs under the FirstEnergy umbrella in Pennsylvania, the SWE found that kWh and kW savings calculations for PY7 for commercial and industrial (C/I) lighting projects were performed using a modified version of the 2015 Pennsylvania TRM Appendix C calculator. Use of the modified calculator makes it much more difficult for the SWE Team to review and verify the kWh and kW savings calculations for these types of energy efficiency projects. The Phase II SWE recommends that going forward the original Appendix C calculator be used.

16) SWE audit activities revealed that the EDCs that conducted process evaluations generally did so consistent with the Phase II Act 129 Evaluation Framework but in some cases could have provided greater detail about methods and findings to support their conclusions. The SWE Team makes the following recommendations for improving process evaluations in the future:

- **a.** EDC process evaluation reports should identify analysis methods, including level of analysis, and types of statistical tests performed.
- **b.** When reporting response differences among subgroups, indicate whether the differences were statistically significant, and by what test.
- **c.** Provide additional insights, when possible, into causes for programs struggling to meet participation and kWh/yr and kW savings targets.
- **d.** Where possible, connect process evaluation recommendations to general conclusions based on multiple findings rather than to single findings.
- **e.** Restrict the number of recommended actions identified in each process evaluation recommendation.

17) The SWE process evaluation audit activities for the PY7 programs found that the evaluation contractors made 175 Phase II process evaluation recommendations to the EDCs. Of this total, the EDCs' annual reports indicated that 103 (59%) were implemented (or accepted for planned implementation) by the EDCs, 53 (30%) were still being considered for implementation, and 19 (11%) were rejected by the EDCs. The 59% acceptance rate is considerably higher than that from PY5 (32%) and PY6 (36%). The 11% rejection rate also was higher than that from PY5 and PY6 (2% and 3%, respectively). In the PY6 SWE annual report, the SWE Team noted the high percentage of

recommendations still under consideration, attributing it to the short interval between the dates that the evaluation contractors submitted their recommendations to the EDCs and the deadline for submitting the EDC annual reports. The SWE recommended that the EDCs establish priorities for the process evaluation recommendations so that the most important recommendations are resolved quickly. Additional information obtained for this Phase II SWE Final Report sheds more light on this issue. The SWE Team observed that in every program year of Phase II, the annual report for one EDC showed that no recommendations were yet accepted. Concerns about committing resources during a major information technology (IT) implementation that occurred throughout Phase II reportedly prevented the EDC from identifying recommendations as accepted or implemented in time for the annual report. This only partly explains the high overall percentage of recommendations that remained under consideration at the time of the annual reports, however. While that EDC had the highest percentage of Phase II recommendations under consideration, it also had the fewest recommendations to consider. Dropping that EDC out of the analysis had a minimal effect on the overall percentage of recommendations still under consideration. The purpose of having EDCs indicate the status of recommendations in their annual reports is to show whether the evaluation contractors have provided clear and actionable recommendations and whether the EDCs have given them due consideration. Therefore, the SWE Team recommends that instead of identifying each recommendation as implemented, under consideration, or rejected, the EDCs identify them as implemented, high priority for implementation, medium priority for implementation, low priority for implementation, or rejected.

18) For PY7, the SWE identified instances where EDCs did not use the correct in-service rate (ISR) from the applicable Pennsylvania TRM for residential lighting measures. All EDCs must use the ISR for residential lighting measures provided in the TRM applicable for PY7, unless the EDC has conducted research in its service area to document the actual ISR achieved during PY7.

19) The SWE Team completed 61 ride-along site inspection reports (RASIRs) of randomly selected PY7 C/I energy efficiency measure installations. Through these rigorous ride-along site inspections, the SWE Team found that the EDC site inspection evaluation process has improved from PY6 and that installed projects were far more likely to match the application in terms of equipment type and quantity across all EDCs. Also of note for PY7 is the difficulty that some EDC evaluation teams had in securing the first choice for a project on-site inspection; in many cases they had to use project participants from the list of alternate sites.

20) The EDC PY5, PY6, and PY7 annual reports to the PUC show different participation rates across EDCs for similar types of programs. The SWE recommends that the TUS staff and the Phase III SWE conduct a study to examine this issue more thoroughly in order to understand the factors causing these different levels of participation, including whether the EDCs are calculating and reporting participation rates on the same basis. The results of this analysis can be used for two purposes:

- **a.** To clarify how program participation levels and participation rates should be calculated and reported to the PUC; and
- **b.** To identify whether any EDC should consider modifying the design attributes (marketing strategy, delivery channels, incentive levels, education and outreach efforts, etc.) of a program in order to improve program efficiency and effectiveness. Such modifications or enhancements to these aspects of program design are very important when trying to improve participation rates.

21) Evaluations of home energy audit programs may show opportunities for greater conversion from audits to incented projects, with some evaluations identifying specific market barriers. Conversion of an energy audit participant to a program participant may not occur within the same program

year. Going forward, the SWE recommends that EDC evaluation contractors should investigate whether customers who had energy audits in a given program are more likely than customers who did not receive an audit to carry out incented projects in later program years. Currently such data or information are not available for the EDC home energy audit programs. EDCs also should investigate ways to overcome identified barriers and in general increase follow-up outreach to audit participants to encourage conversion.

22) The process evaluation of PPL's residential lighting program (which offered only discounted light-emitting diodes [LEDs] throughout Phase II) found that compact fluorescent light (CFL) bulbs disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of there being more recycling bins in diverse locations. The SWE recommends that if this is not already addressed by the EDCs, that the EDCs work together during Phase III to modify the education and outreach portion of residential lighting programs, in order to increase significantly the percentage of customers who dispose of CFLs in recycling bins.

23) The SWE Team found a few instances where EDCs did not use measure lives listed in the TRM in their calculations of the TRC test. The SWE recommends that the TRM be used as the primary source for measure life values when they are available and listed in the Pennsylvania TRM. In addition, the SWE recommends that errors in the use of measure lives be corrected in each EDC's final report for Phase II, if these corrections will cause the overall EDC portfolio TRC ratio for PY7 to change by more than plus or minus 1%.

24) The SWE Team recommends that EDCs provide additional documentation of the methodology and data used to calculate cross-sector residential lighting and low-income sales. In order to provide more foundation for the calculations of cross-sector sales estimates, the SWE recommends that each EDC should report the sample sizes used for the evaluation research, the distribution of intercept stores (name of store, size of store, etc.), distribution of weekend versus weekday intercept surveys, and time of year the intercept surveys were administered. This information would allow the SWE Team to understand whether there may have been any changes over time in the methodology used by EDCs to estimate cross-sector sales. Changing the methodology over time can affect the research results. The SWE wants to ensure that changes in estimates of such cross-sector sales of lighting products are driven entirely by changes to program design rather than changes in research methods and sampling techniques. Given the upstream residential lighting programs' significant contribution to each EDC's portfolio savings, the SWE Team recommends that the EDC evaluation contractors include additional details regarding the research methods in future annual reports as well as a discussion related to differences in parameter estimates. The Phase II SWE also recommends that the Phase III SWE consider developing guidelines or protocols for research methods to be used for determining cross-sector sales.

25) The SWE recommends that thorough auditing of program applications for C/I measures be continued by EDCs, to ensure clarity of the project files for the subsequent SWE review.

26) The SWE Team found that all EDCs either used the approved common NTG research methods or used them with acceptable modifications. Some EDCs also used other acceptable methods where the SWE Team did not establish a common method. The SWE Team continues to recommend that, where applicable, the EDC evaluation contractor's report explicitly state how a given survey instrument differs from the common NTG method approved by the SWE and TUS, and why the EDC survey instrument, if different than the common method, would not produce a systematically different result from the result that would be achieved if the common method were used.

As of May 31, 2016 (the end of PY7), the seven EDCs collectively saved 4,400,578 MWh/yr (i.e., on a cumulative annual basis) and 524 MW during Phase II.[12] Table 1-3 provides a status report on each EDC's progress toward reaching its Phase II savings targets as of the end of PY7. These savings are attributable to more than 80 EE&C programs implemented by the seven EDCs. All of the EDCs met their overall energy savings targets for Phase II. Table 1-3 also provides the EDCs' progress toward their Phase II low-income and GNI carve-out goals. All of the EDCs achieved their low-income and GNI carve-out goals for Phase II.

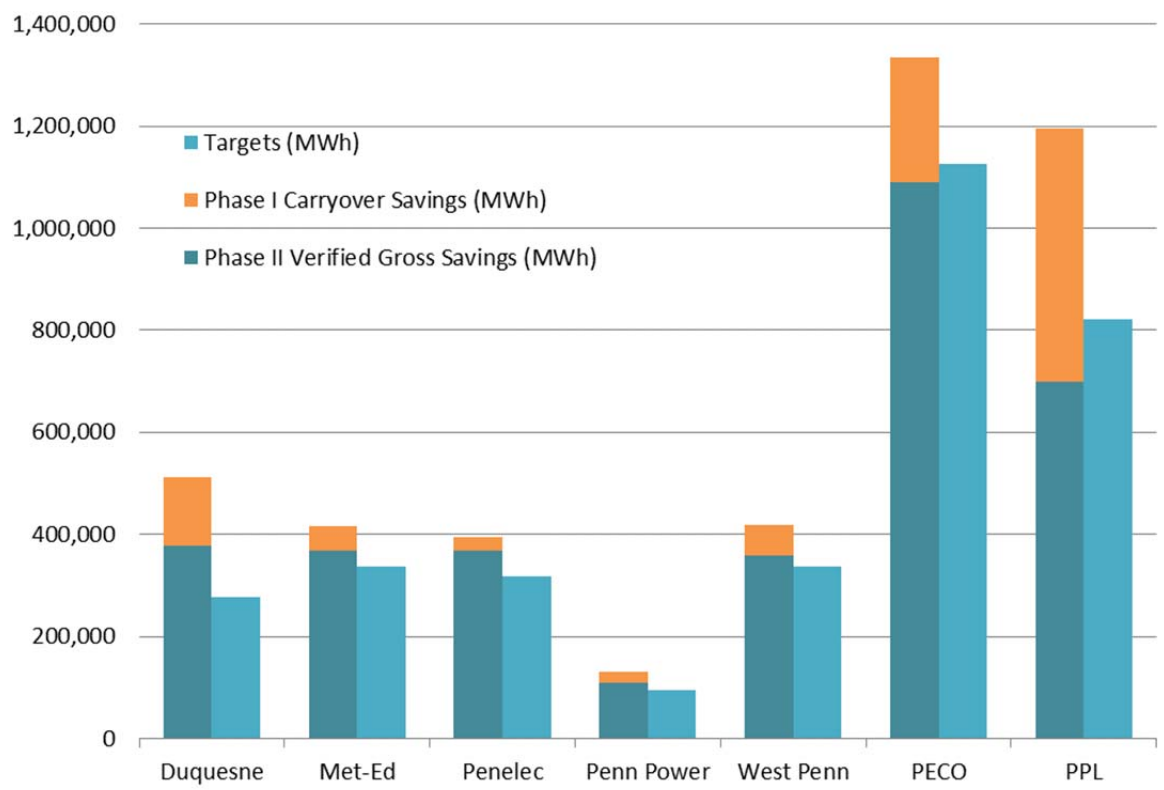
Table 1-3: Summary of Progress Toward Achieving Phase II Energy Savings Compliance as of the End of PY7

% of Target Achieved	Statewide	Duquesne	FE: Met-Ed	FE: Penelec	FE: Penn Power	FE: West Penn	PECO	PPL
% of Phase II Energy Savings Target	**133%**	185%	123%	124%	138%	124%	118%	146%
% of Phase II Low-Income Carve-Out Goal	**218%**	186%	302%	385%	296%	247%	181%	159%
% of Phase II GNI Carve-Out Goal	**216%**	108%	119%	134%	179%	277%	272%	226%
[a] Statewide percentages based on sum of each EDCs savings, targets and goals								

Figure 1-1 compares Phase II cumulative annual savings—consisting of Phase II savings achieved during PY5, PY6, and PY7 plus carryover savings from Phase I—and the cumulative annual savings target to be achieved by the end of PY7.

Figure 1-1: Phase II Verified Energy Savings (plus Phase I Carryover) by EDC versus EDC Phase II Savings Targets

[12] Savings represent verified gross energy (including carryover) and demand savings. It is important to note the provision in the Commission's June 11, 2015 Phase III Implementation Order relating to the methodology to be used to calculate any carry over savings to Phase III. The Phase III Implementation Order states the following: "the EDCs are allowed to bank only those savings obtained in Phase II in excess of their targets for application towards Phase III targets. These carryover savings may only be savings actually obtained in Phase II. This directive applies to excess savings in the G/E/NP sector, as well. With regard to low-income carryover savings to be applied toward the low-income carve-out, the EDCs will only be allowed to carry over excess low-income savings into Phase III, based on an allocation factor determined by the ratio of savings from low-income specific programs." See pages 84 to 86 of the Phase III Implementation Order for more information on this topic.



2 ENERGY SAVINGS – PY7 AND PHASE II

This section of the report discusses the mandated consumption reduction goals under Act 129, and the EDCs' compliance with the goals in Phase II. This section also presents the results of consumption reductions realized in PY7.

2.1 REVIEW OF PHASE II TARGETS UNDER ACT 129

The Commission established the EE&C program as directed by the Pennsylvania General Assembly. The EE&C program requires each electric distribution company (EDC) that serves at least 100,000 customers to implement a plan to reduce energy and demand consumption within its service territory.[13] Based on findings from the Phase I Market Potential Study dated May 10, 2012, the PUC determined that the benefits of a Phase II Act 129 program would exceed its costs, and therefore adopted additional required incremental reductions in consumption for another EE&C program term.

Table 2-1 presents the Phase II energy efficiency compliance targets for each EDC. Table 2-2 provides the low-income and GNI energy efficiency reduction targets by each EDC for Phase II.

[13] 66 Pa. C.S. § 2806.1

Table 2-1: Act 129 Phase II Three-Year Energy Efficiency Reduction Compliance Targets

EDC	Three-Year Program Acquisition Cost ($/First-Year MWh Saved)	Three-Year % of 2009/2010 Forecast Reductions	Three-Year MWh/yr Cumulative Annual Value of 2009/2010 Forecast Reductions
Duquesne	$211.90	2.0%	276,722
FE: Met-Ed	$220.87	2.3%	337,753
FE: Penelec	$216.19	2.2%	318,813
FE: Penn Power	$209.20	2.0%	95,502
FE: West Penn	$209.42	1.6%	337,533
PPL	$224.71	2.1%	821,072
PECO	$227.55	2.9%	1,125,851

Table 2-2: Act 129 Phase II Three-Year Low-Income and GNI Energy Efficiency Reduction Targets

EDC	Low-Income Target (MWh/yr)	GNI Target (MWh/yr)
Duquesne	12,452	27,672
FE: Met-Ed	15,199	33,775
FE: Penelec	14,347	31,881
FE: Penn Power	4,298	9,550
FE: West Penn	15,189	33,753
PECO	50,663	112,585
PPL	36,948	82,107

The remainder of the chapter discusses EDC compliance with these targets and carve-out goals, and provides statewide and EDC-specific results.

2.2 COMPLIANCE SUMMARY BY EDC

All seven EDC's met their compliance targets. Table 2-3 below shows the Phase II verified energy savings and these achievements as a percentage of the Phase II targets. The Phase II verified energy savings include carryover savings from Phase I. The Phase III carryover savings in the final column equal the PY5-PY7 verified energy savings minus the Phase II energy savings targets.

Table 2-3: Phase II Compliance Summary by EDC

EDC	Phase I Carryover MWh/yr Savings	Phase II Verified MWh/yr Savings	Phase II Verified MWh/yr Savings (including CO)	Phase II Energy Savings Targets	Savings Achieved % of Target	Phase III Carryover MWh/yr Savings
Duquesne	133,717	377,248	510,965	276,722	185%	100,526
FE: Met-Ed	47,187	368,235	415,422	337,753	123%	30,482
FE: Penelec	26,805	368,508	395,313	318,813	124%	49,695
FE: Penn Power	22,580	109,368	131,948	95,502	138%	13,866
FE: West Penn	59,929	358,073	418,002	337,533	124%	20,540
PECO	242,793	1,090,505	1,333,298	1,125,851	118%	0

PPL	495,636	698,736	1,194,372	821,072	146%	0

All EDCs achieved their respective GNI and low-income carve-out goals. Table 2-4 shows EDC achievements compared with low-income carve-out goals. The SWE's low-income carve-out carryover calculation is based upon the ratio of low-income specific program savings (including savings from both low-income specific and non-low-income specific programs) multiplied by the total amount of low-income savings in excess of the Phase II low-income savings targets that were paid for with Phase II funds. Therefore, it was possible for each EDC to accumulate Phase III carryover savings towards the low-income carve out, even though PECO and PPL do not carryover any savings towards the portfolio level targets.

The savings presented in Table 2-4 were calculated by the SWE using the calculation method described above and do not match the carryover savings listed in the PY7 Annual Reports for DLC, PECO, and PPL. For DLC and PPL, the EDC's used the prescribed calculation methodology, but relied on a slightly different value for the verified gross low-income savings, resulting in minor differences between the EDC-reported values and those calculated by the SWE. Additionally, PECO's calculation method for low-income carryover only allowed for savings from low-income specific programs that exceeded the Phase II low-income target to be counted towards Phase III carryover. Using a consistent calculation methodology across all EDC's, the SWE calculated significantly greater Phase III low-income carryover savings for PECO.

Table 2-5 shows the EDC achievements compared with GNI carve-out goals. The Phase II energy savings include carryover savings from Phase I. While each EDC met their Phase II GNI carve out goals, only four EDCs exceeded their Phase II target as a direct result of Phase II program spending and have GNI carryover savings into Phase III. Similar to the low-income carve out, PECO and PPL accumulated Phase III carryover savings towards the GNI carve out, but do not carry over savings that contribute to their portfolio level targets.

Table 2-4: Low-Income Carve-out Goal Performance, Summary by EDC

EDC	Phase II Low-Income MWh/yr Carve-Out Goal	PY5-PY7 Verified MWh/yr Savings	Savings Achieved % of Targets	Phase III Carryover MWh/yr Savings
Duquesne	12,452	23,173	186%	2,542
FE: Met-Ed	15,199	45,839	302%	5,025
FE: Penelec	14,347	55,255	385%	7,872
FE: Penn Power	4,298	12,713	296%	1,805
FE: West Penn	15,189	37,513	247%	3,354
PECO	50,663	91,673	181%	24,332
PPL	36,948	58,703	159%	10,520

Table 2-5: GNI Carve-out Goal Performance, Summary by EDC

EDC	Phase II GNI MWh/yr Carve-Out Goal	Carryover from Phase I (MWh/yr)	PY5-PY7 Verified MWh/yr Savings	Phase II Verified MWh/yr GNI Savings	Savings Achieved % of Targets	Phase III Carryover MWh/yr Savings
Duquesne	27,672	7,722	22,135	29,857	108%	0
FE: Met-Ed	33,775	6,430	33,657	40,087	119%	0

EDC	Phase II GNI MWh/yr Carve-Out Goal	Carryover from Phase I (MWh/yr)	PY5-PY7 Verified MWh/yr Savings	Phase II Verified MWh/yr GNI Savings	Savings Achieved % of Targets	Phase III Carryover MWh/yr Savings
FE: Penelec	31,881	10,721	31,964	42,685	134%	83
FE: Penn Power	9,550	258	16,866	17,124	179%	7,316
FE: West Penn	33,753	59,929	33,726	93,655	277%	0
PECO	112,585	77,961	227,985	305,946	272%	115,400
PPL	82,107	92,143	93,248	185,391	226%	11,141

Table 2-6 shows each EDC's minimum percentage of low-income measures requirement and the percentage of low-income measures offered in PY5-PY7. Every EDC complied with the Act 129 low-income requirements all three years of Phase II.

Table 2-6: EDC Achievement of Act 129 Low-Income Requirements in PY7

EDC	% Low-Income Measures Requirement	% Low-Income Measures Offered in PY5	% Low-Income Measures Offered in PY6	% Low-Income Measures Offered in PY7
Duquesne	8.402%	13%	15%	14%
FE: Met-Ed	8.787%	15%	15%	15%
FE: Penelec	10.231%	15%	15%	15%
FE: Penn Power	10.639%	15%	15%	15%
FE: West Penn	8.794%	15%	15%	15%
PECO	8.799%	16%	16%	17%
PPL	9.950%	30%[14]	45%[15]	46%

2.3 RESULTS FOR PROGRAM YEAR 7 (2015–2016)

This section summarizes the energy savings reported by the EDCs for PY7. Savings are provided by EDC and by sector. A detailed review of low-income program performance is also provided.

2.3.1 Summary of Energy Savings Statewide and by EDC

Table 2-7 summarizes the reported and verified energy savings in PY7 for each EDC.

Table 2-7: Summary of PY7 Reported and Verified Energy Savings by EDC

EDC	PY7 Reported Energy Savings (MWh/yr)	PY7 Verified Energy Savings (MWh/yr)	Realization Rate
Duquesne	144,200	142,187	99%

[14] This number is based on the SWE's interpretation of guidance found in the Evaluation Framework related to the designation of low income measure types and general measure types, and is lower than the reported number in PPL's PY5 Annual Report. PPL reported 52% of measures were available at no cost to low-income customers. Both instances far exceed the established goal of 8.4% for PPL,

[15] This number is the approximate percentage calculated by the SWE based on the SWE's interpretation of guidance found in the Evaluation Framework related to the designation of low income measure types and general measure types, and is lower than the reported number in PPL's PY5 Annual Report. PPL reported 54% of measures were available at no cost to low-income customers. Both instances far exceed the established goal of 10.0% for PPL.

FE: Met-Ed	170,583	171,420	100%
FE: Penelec	160,046	164,398	103%
FE: Penn Power	28,653	27,280	95%
FE: West Penn	161,266	158,760	98%
PECO	507,165	528,301	104%
PPL	321,234	313,976	98%
Statewide	**1,493,147**	**1,509,707**	**101%**

Statewide, the verified gross savings were greater than the reported gross savings, which yields a realization rate across all EDCs of 101%. Realization rates were strong for all EDCs, being 95% or higher.

2.3.2 Summary of Energy Savings by Sector

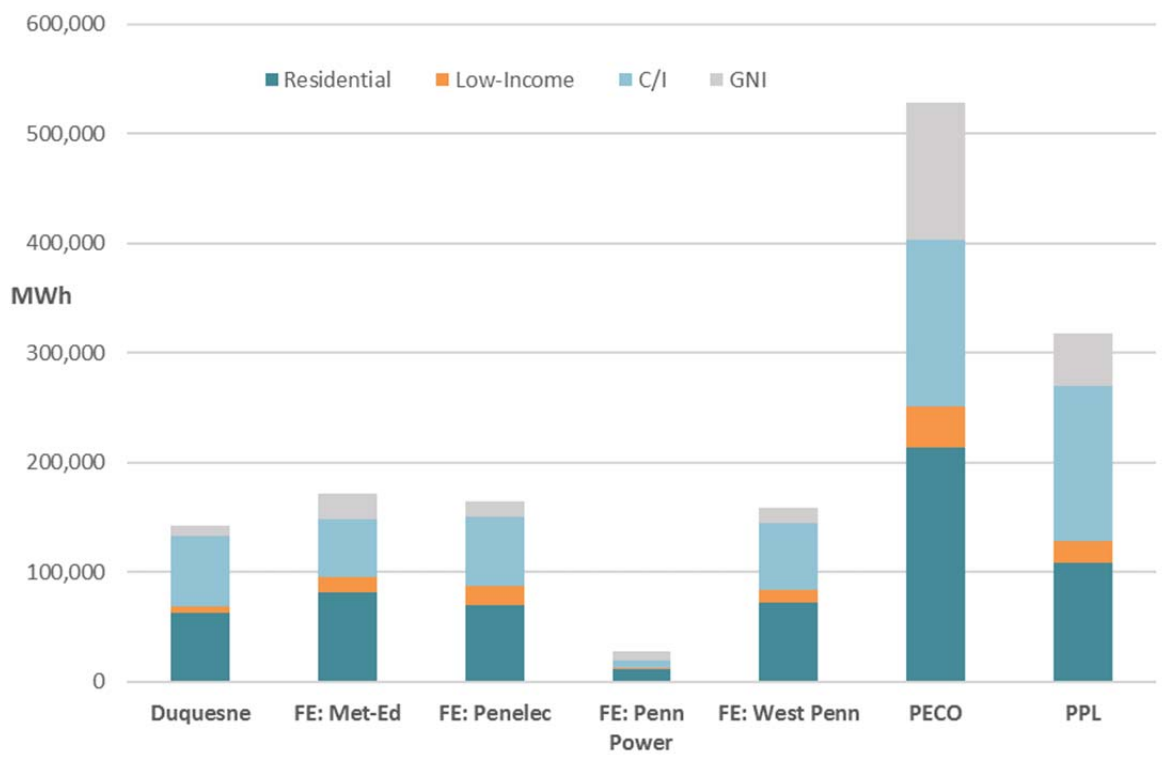
Table 2-8 shows the seven EDCs' PY7 energy savings by sector: residential, low-income, C/I, and GNI.

Table 2-8: PY7 Verified Energy Savings by EDC and Sector

EDC	PY7 Residential Energy Savings (MWh/yr)	PY7 Low-Income Energy Savings (MWh/yr)	PY7 C/I Energy Savings (MWh/yr)	PY7 GNI Energy Savings (MWh/yr)
Duquesne	62,571	6,070	64,368	9,178
FE: Met-Ed	81,240	14,391	52,941	22,848
FE: Penelec	69,285	18,368	62,923	13,821
FE: Penn Power	11,773	1,180	7,045	7,283
FE: West Penn	72,338	11,346	61,391	13,685
PECO	213,367	37,329	152,203	125,402
PPL	106,633	18,400	141,900	47,044
Statewide	**617,207**	**107,084**	**542,771**	**239,261**

Figure 2-1 provides a graphical representation of the above data.

Figure 2-1: PY7 Verified Energy Savings by EDC and Sector



The residential sector accounted for the highest proportion of savings across the four sectors during PY7. The C/I sector accounted for the highest savings for two EDCs. The low-income sector accounted for 7% of total savings and the GNI sector for 16% of total savings during PY7.

2.3.3 Comparison of PY7 Expenditures with Approved EE&C Plan Budget Estimates

The EDCs provided information about their spending on a portfolio and by-program basis. Table 2-9 summarizes the EDCs' spending on incentives and program overhead costs in PY7. The table also shows that the EDCs' portfolios collectively generated more than $1 billion in NPV benefits in PY7. This compares with total TRC costs of approximately $565 million. The total EDC incentives were about $107 million, and net participant costs accounted for nearly $337 million. The total EDC program overhead costs were nearly $121 million. The total TRC B/C ratio of all EDC programs was 1.7, which means that as a group, the EDCs continued to operate their programs in a cost-effective manner in PY7.

Table 2-9: Summary of Statewide Portfolio Finances for PY7

Element	PY7 ($000)
Incremental Measure Costs	$444,312
EDC Incentives to Participants	$107,071
EDC Incentives to Trade Allies	$348
Participant Costs (net of incentives/rebates paid by utilities) [a]	$336,893
Program Overhead Costs	$121,035
Design and Development	$469
Administration, Management, and Technical Assistance [b]	$88,593

Element	PY7 ($000)
Marketing [c]	$16,744
EDC Evaluation Costs	$14,554
SWE Audit Costs	$675
Total TRC Costs [d]	$583,298
Total NPV Lifetime Energy Benefits	$884,641
Total NPV Lifetime Capacity Benefits	$93,027
Total NPV Benefits [e]	$1,009,106
TRC B/C Ratio [f]	1.73

NOTES:
[a] Per the 2013 Total Resource Cost Test Order – Net participant costs; in PA, the costs of the end-use customer.
[b] Includes the administrative CSP (rebate processing), tracking system, general administration and clerical costs, EDC program management, CSP program management, general management oversight major accounts, and technical assistance.
[c] Includes the marketing CSP and marketing costs by program CSPs.
[d] Total TRC Costs = Incremental Measure Costs + Program Overhead Costs, plus increase in cost of natural gas (not individually shown)
[e] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits, plus operations and maintenance (O&M) savings from avoided bulb purchases (not shown in table). Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[f] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

Table 2-10 compares each EDC's actual PY7 energy efficiency program expenditures with the estimated expenditures in the EDC's Phase II EE&C plan. The PY7 overall energy efficiency program budget for all seven EDCs was $254 million, whereas actual spending was $225 million. Thus, actual spending in PY7 on a statewide basis was 11% lower than the approved budget. Actual spending in PY7 was lower than the EE&C plan PY7 budget for five EDCs. Only PECO, by the slimmest of margins, exceeded planned expenditures for PY7.

Table 2-10: Comparison of EDC PY7 Actual and Planned Expenditures in Each EDC's EE&C Plan

EDC	PY7 Actual Expenditures ($)	PY7 Budget Estimate ($)	Difference between Actual and EE&C Plan ($)	Percent Change from Plan
Duquesne	$16,033,000	$19,497,797	-$3,464,797	-17.8%
FE: Met-Ed	$18,906,855	$25,519,550	-$6,612,695	-25.9%
FE: Penelec	$16,422,862	$24,096,572	-$7,673,710	-31.8%
FE: Penn Power	$3,901,655	$6,821,749	-$2,920,094	-42.8%
FE: West Penn	$17,054,581	$24,207,741	-$7,153,160	-29.5%
PECO	$91,147,823	$91,081,490	$66,333	0.1%
PPL	$64,716,000	$75,824,000	-$11,108,000	-14.6%

EDC	PY7 Actual Expenditures ($)	PY7 Budget Estimate ($)	Difference between Actual and EE&C Plan ($)	Percent Change from Plan
Total	**$228,182,776**	**$267,048,899**	**-$38,866,123**	**-14.6%**

Table 2-11 compares the PY7 planned acquisition cost and actual acquisition cost (per first-year kWh saved) for each EDC and for all EDCs combined.

Table 2-11: Planned Acquisition Costs versus Actual Acquisition Costs in PY7

EDC	PY7 Verified MWh/yr Savings (not including CO)	Forecasted PY7 Acquisition Cost per First-Year kWh Saved	Actual PY7 Acquisition Cost per First-Year kWh Saved	Percent Change from Planned Acquisition Costs
Duquesne	142,187	$0.137	$0.113	-17.8%
FE: Met-Ed	171,420	$0.149	$0.110	-25.9%
FE: Penelec	164,398	$0.147	$0.100	-31.8%
FE: Penn Power	27,280	$0.250	$0.143	-42.8%
FE: West Penn	158,760	$0.152	$0.107	-29.5%
PECO	528,301	$0.172	$0.173	0.1%
PPL	313,976	$0.241	$0.206	-14.6%
Total	**1,506,322**	**$0.177**	**$0.151**	**-14.6%**

Overall, the seven EDCs saved 1,506,322 MWh/yr during PY7 and spent a total of $228,182,776. This yields an acquisition cost per first-year kWh saved of $0.151 per kWh, which is 15.7% less than the planned acquisition cost for PY7 of $0.177 per first-year kWh saved.

2.3.4 Comparison of PY7 Per-Participant Costs and Savings for EDC Low-Income Programs

This section provides an overview of the methods used by the Phase II SWE Team to audit the reported kWh/yr and kW savings of the EDCs' PY7 residential low-income programs. It also provides a comparison across EDCs of the PY7 costs and electricity savings for these programs. While the seven Pennsylvania EDCs subject to Act 129 did not have identical low-income program offerings in PY7, it is useful to compare costs and savings across the seven EDCs, in order to understand trends as well as differences among the programs.[16]

The SWE Team used various approaches to audit the methods used by EDC evaluation contractors to determine low-income program kWh and kW savings for PY7. The SWE Team's audit approaches included the following:

1) Reviewing savings calculations to ensure that the Pennsylvania 2015 TRM algorithms were applied correctly by each EDC

[16] Low-Income Programs addressed in this section are the programs dedicated to low-income customers. Low-income customer participation in other programs also contributes to achievement of required low-income savings targets established by the PUC for Phase II.

2) Reviewing statistical billing analyses, where undertaken, to ensure that multivariate analyses had acceptable goodness-of-fit statistics and were conducted according to the applicable U.S. Department of Energy (DOE) Uniform Methods Project (UMP) protocol
3) Confirming that all verified per-measure annual kWh/yr and kW savings and participant counts were consistent with the 2015 TRM
4) Confirming all calculations of total low-income-program kWh/yr and kW savings for programs that relied on 2015 TRM data for calculating and reporting savings
5) Confirming the correct use of ISRs from the 2015 TRM

In addition, if EDCs reported "off-TRM" savings, the Phase II SWE Team audited those alternative savings calculations as well.

For each EDC low-income program, the SWE Team verified the kWh and kW savings for all measure types, at the measure level, by comparing EDC supporting calculations to kWh and kW savings for low-income measures listed in the 2015 TRM. For each measure type, the SWE Team verified 10 individual projects. Where EDCs performed statistical billing analyses, the SWE Team reviewed the statistical billing analysis regression goodness-of-fit statistics, equations, and regression output to confirm that the statistical approach was sound and the billing analysis followed the U.S. DOE UMP protocol for such statistical analyses. When individual energy efficiency measures (e.g., CFLs, faucet aerators, low-flow showerheads) were bundled into a single offering and the EDC used a deemed savings approach to calculate savings, the SWE Team verified the savings for each individual energy efficiency measure by comparing the EDC's supporting calculations and data to the per-measure data in the 2015 TRM.

Based on the audit work completed, the SWE Team concludes that each EDC's evaluation contractor followed the appropriate protocols to calculate kWh/yr and kW savings for each residential low-income program. Overall the EDCs' evaluation contractors followed the approved evaluation framework to calculate and report electricity savings for PY7 residential low-income programs. The SWE Team also notes that the EDC evaluation contractors used the Pennsylvania 2015 TRM to verify savings for projects that were undertaken in PY7, and correctly used the 2014 TRM for those few projects started at the end of PY6 that spilled into PY7.

The SWE Team concludes that no adjustments or changes need to be made to the verified gross savings estimates reported by the evaluation contractors regarding PY7 EDC-reported savings for residential low-income programs.

Figure 2-2 illustrates the PY7 average cost per low-income program participant served for each EDC's low-income program. Each EDC offers different bundles of energy efficiency measures in its programs and has varying numbers of eligible low-income participants. For example, in PY7 PECO provided services to 222,711 participants through four distinct low-income components, one of which consists primarily of CFL savings, which contributed 76% of the program's total savings. By comparison, Penn Power provided services in PY7 to only 981 participants through a direct-install program that realizes savings primarily from high efficiency refrigerators, CFLs and freezers.

Figure 2-2: PY7 Residential Low-Income Program – Average Utility Cost per Participant Served[17]

[17] The Phase II SWE Team is presenting data on the average cost per participant for each EDC's low income program to highlight the variation in delivery costs across EDCs, recognizing that the EDC program offerings vary significantly.

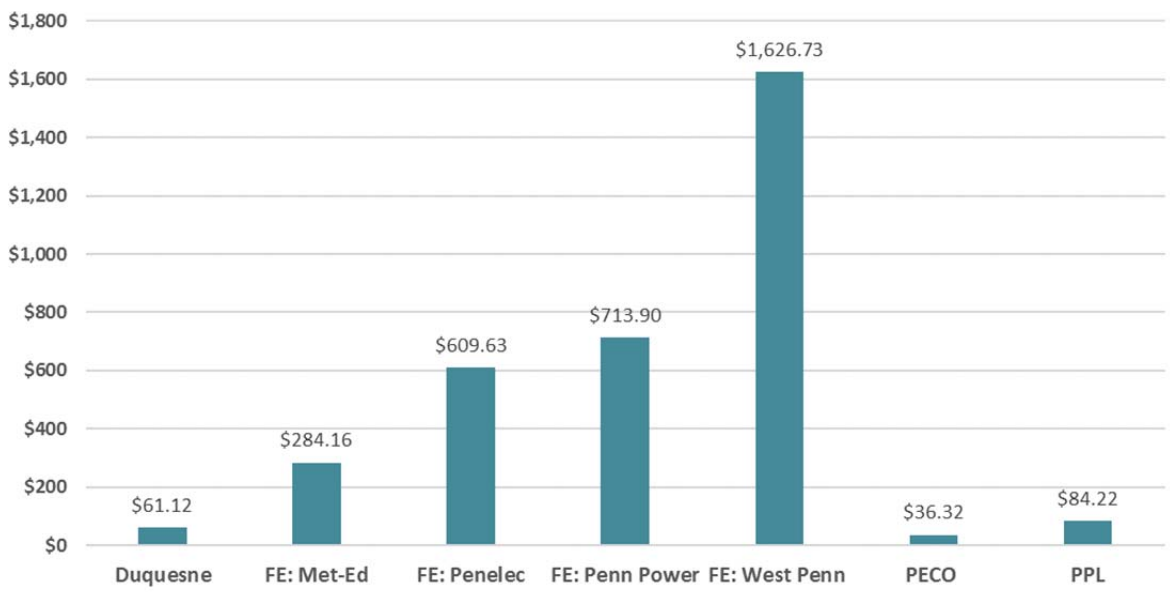


Table 2-12 lists the individual measures and services that the EDC's provide to the low-income community. It is important to note that each EDC provides some combination of walkthrough/comprehensive audits and energy education to low income participants. These types of services help to connect low-income participants with the community and offer them a way to use less of their limited income on energy and more on their basic needs. Each EDC provides numerous energy efficient measures and services to low-income participants with varying delivery methods including giveaways, rebates, direct install, up-stream lighting, behavioral programs, and public agencies and non-profits offering Low-Income Usage Reduction Programs (LIURP). FirstEnergy offered more high cost direct-install measures than Duquesne, PECO and PPL, which is a clear and present factor in the average utility cost per participant for the FirstEnergy EDCs being higher than other EDCs, as shown in Figure 2-2.

Duquesne and PPL provide many additional measures not offered by the other utilities and unlike the other EDCs, Duquesne offers and tracks low income participation in all of its residential programs (LI Rebates, LI kits, LI SEP). This greatly increases the number of measures that are offered through their REEP, RARP, WHEAP, SEP, and HER Residential Programs to the low-income community. FirstEnergy offers direct install, LILU kits, and giveaways, while PPL offers their LI WRAP, Behavioral & Educational, and E-Power Wise programs. PECO's LEEP program uses a varied approach to reach different target markets of the low-income community.

Table 2-12: Low-Income Offerings by Measure

Measure	Duquesne	FE: Met-Ed	FE: Penelec	FE: Penn Power	FE: West Penn	PECO	PPL
CFL Bulbs	X					X	
Smart Strips	X	X	X	X	X		
LED Nightlights	X	X	X	X	X		x
CFL/LED bulbs	X	X	X	X	X		
ENERGY STAR® Refrigerator	X	X	X	X	X	X	X
ENERGY STAR® Freezer	X	X	X	X	X		
ENERGY STAR® Clothes Washer	X						

Measure	Duquesne	FE: Met-Ed	FE: Penelec	FE: Penn Power	FE: West Penn	PECO	PPL
Clothes Dryer with Moisture Sensor	X						
ENERGY STAR® Dehumidifier	X						X
ENERGY STAR® Dishwasher	X						
Programmable Thermostat	X						
Heat Pump	X					X	
Central AC or Heat Pump	X						
ENERGY STAR® Room AC	X						X
High Efficiency Fan Heating	X						
ENERGY STAR® Television	X						
Changing or cleaning of heating and Colling Filters							X
Dryer Venting (Electric Dryer)							X
Smart Strips	X						X
Refrigerators -Recycling	X						
Freezers Recycling	X	X	X	X	X	X	
CFLs - DR	X					X	
LED-DR							X
LED							X
Electroluminescent Night Lights	X						
Kitchen and Bathroom sink faucet Aerators	X	X	X	X	X	X	X
Low flow Showerheads	X	X	X	X	X	X	X
Kitchen and Bathroom Sink Faucet Aerators - Kits							X
Low flow Showerheads - Kits							X
Smart Strips	X	X	X	X	X		X
Smart Plugs							X
Water Heater Pipe Wrap	X	X	X	X	X		X
Furnace Whistle		X	X	X	X		X
Heat Pump Water Heaters		X	X	X	X		X
Energy-efficient resistance water heaters		X	X	X	X		
Programmable thermostats		X	X	X	X		
Walkthrough/Comprehensive Audits	X	X	X	X	X	X	X
Attic Insulation						X	X
Air Sealing/Infiltration						X	X
Blower Door Testing							X
Floor Wall Insulation							X

Measure	Duquesne	FE: Met-Ed	FE: Penelec	FE: Penn Power	FE: West Penn	PECO	PPL
Wall Insulation						X	X
HVAC Repair and Replacement							X
Duct insulation and repair							X
Window repair and replacement							X
ASHP Duct Sealing						X	
ASHP Maintenance						X	
Energy Education	X	X	X	X	X	X	X
Behavioral Program	X						X
Lighting Upstream Program	X						
Refrigerators - LILU Kits	X						
Smart Strips - LILU Kits	X						
CFLs - LIURP		X	X	X	X	X	
LED Nightlights - LIURP		X	X	X	X		
Faucet Aerators -LIURP		X	X	X	X		
Energy Saving Showerheads - LIURP		X	X	X	X		
Adapters for Faucet Aerators - LIURP		X	X	X	X		
Direct Install	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
Number of Measures Offered by EDC LI Program	**31**	**21**	**21**	**21**	**21**	**15**	**29**

The Pennsylvania EDCs define a low-income program participant as a unique premise number, unique home, or unique customer job ID that may have multiple measures installed. Duquesne defines a low income program participant as a customer participating in the program within an individual program quarter (Q1, Q2, Q3, or Q4), represented by a unique participant account number within Duquesne's tracking system. For Duquesne programs, low income participants participating more than once within a quarter are counted once; customers participating more than once but in different quarters are counted more than once (once in each quarter).

Figure 2-3 and Figure 2-4 compare the low-income program total MWh/yr and MW savings (for all participants) for PY7 for each EDC. The total PY7 MWh/yr and MW savings vary significantly among EDCs. This is not surprising, given that each EDC has a different number of eligible low-income participants and a varying array of energy efficiency measure offerings.

Figure 2-3: Residential Low-Income Program PY7 Total MWh/yr Savings by EDC

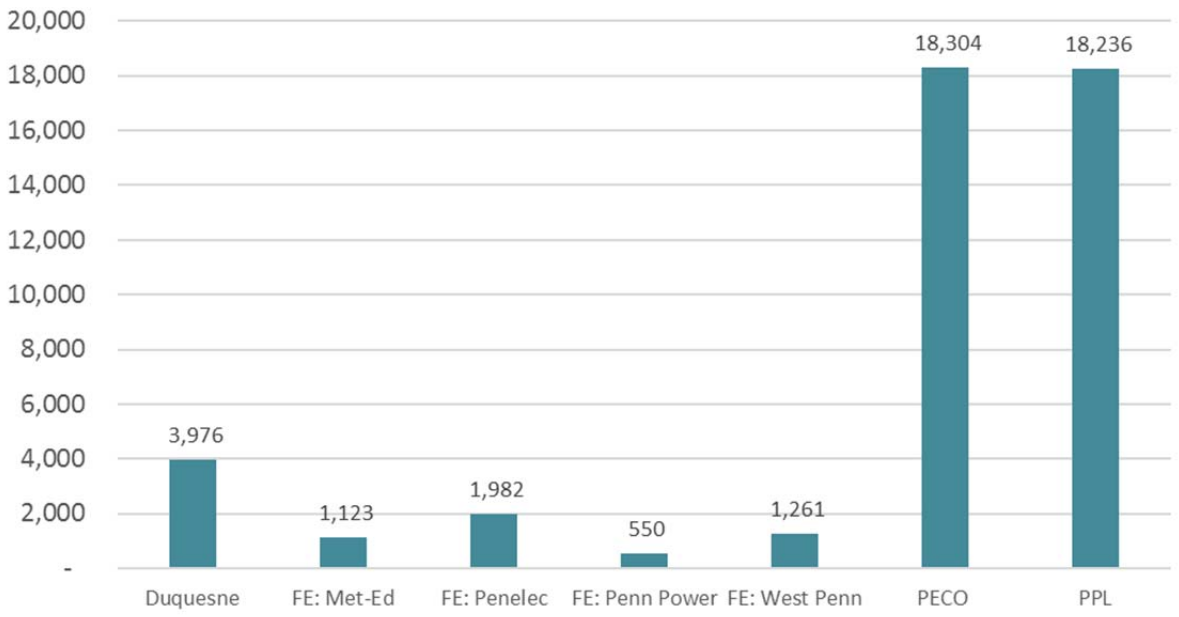


Figure 2-4: Residential Low-Income PY7 Total MW Savings by EDC

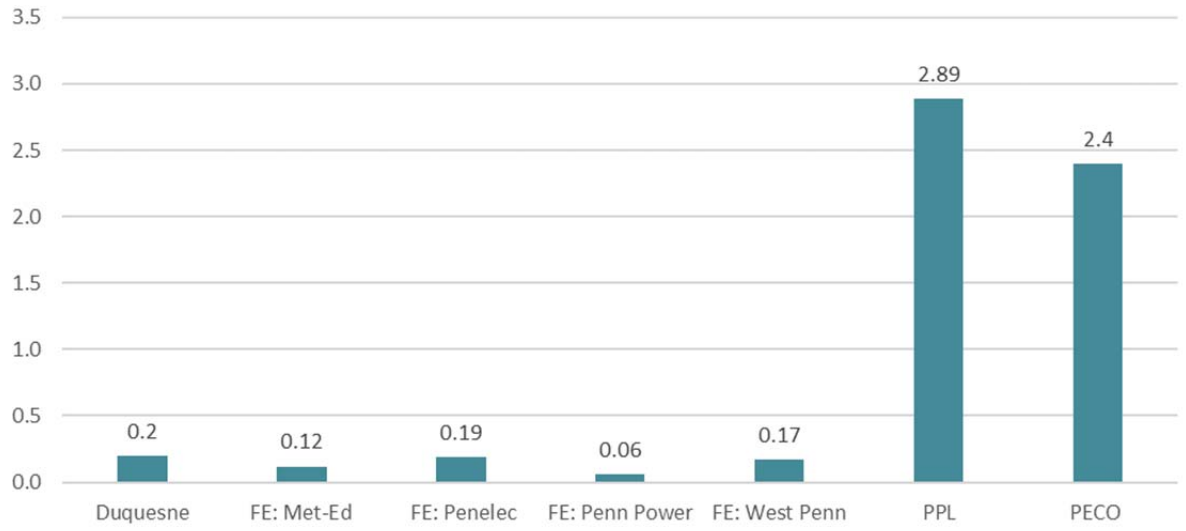


Figure 2-5, Figure 2-6, and Figure 2-7 provide data on the number of on-site inspections, telephone inspections, and desk audits and database reviews, respectively, completed by the EDCs and their evaluation contractors to verify installations and program savings for low-income programs. Duquesne and PECO relied extensively on a TRM-based engineering review of the program-tracking database, which they enhanced with telephone inspections. The four FirstEnergy EDCs and PPL used a combination of on-site inspections and desk audits. On-site inspections are the most accurate method to verify equipment installations and program savings because the auditor can view first-hand whether equipment is properly installed and operating. However, an on-site inspection is more expensive than a desk audit or a telephone interview. When deciding on the best technique to use for verifying savings from low-income programs, one needs to consider the value of information and the relative proportion of total portfolio savings provided by low-income programs versus other programs.

Figure 2-5: Number of PY7 Residential Low-Income Program On-Site Inspections Completed by EDC

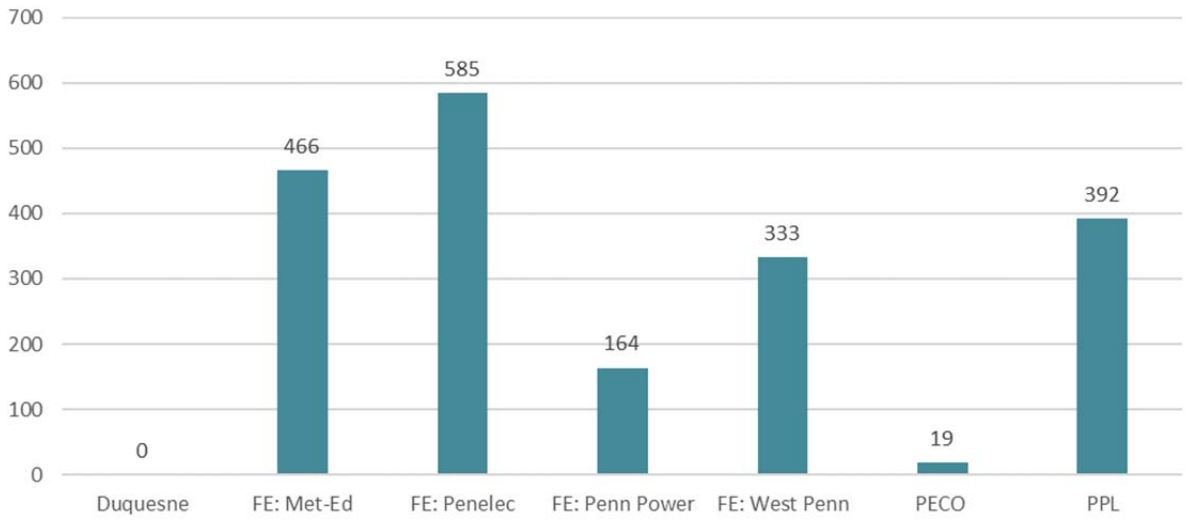


Figure 2-6: Number of PY7 Residential Low-Income Program Telephone Inspections Completed by EDC

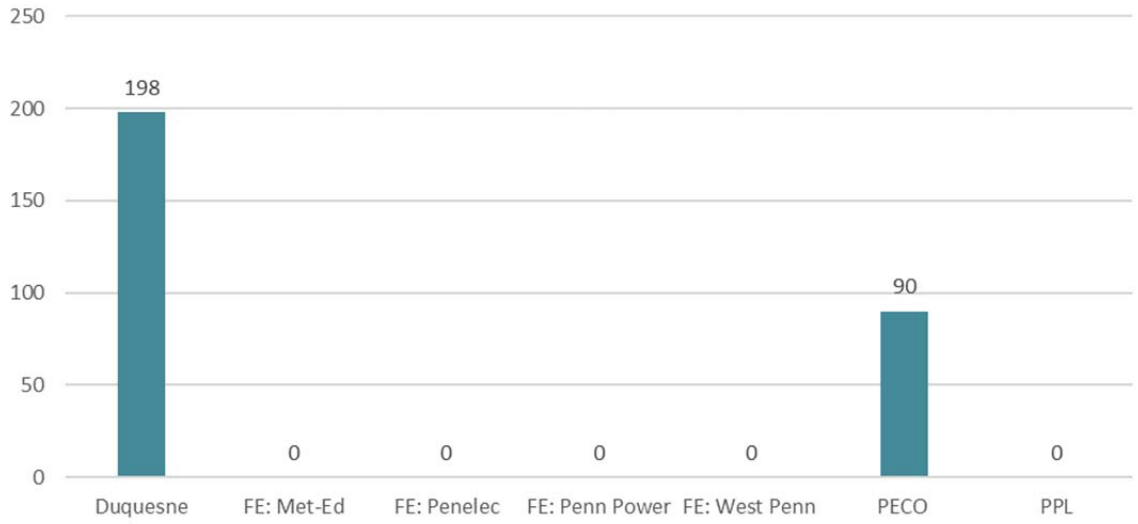


Figure 2-7: Percent Desk Audits versus Database Reviews

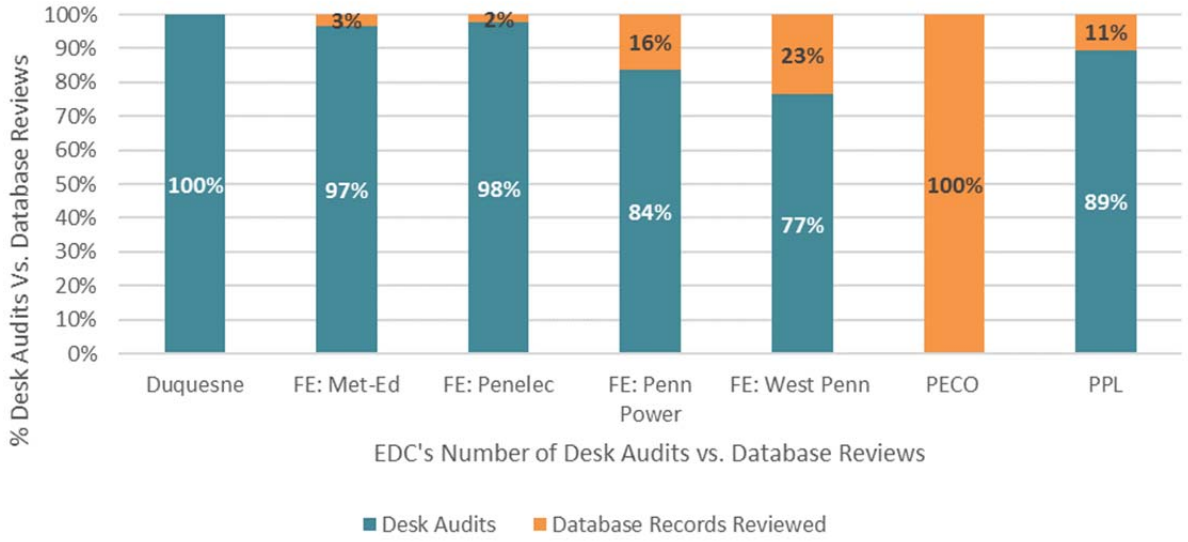


Figure 2-8 shows the combined number of on-site and telephone inspections that were completed by each EDC, and

Figure 2-9 shows each EDC's total low income program on-site and telephone inspections as a percentage of the number of low income program participants. The percentage of participants receiving either a telephone or on-site inspection varied significantly among EDCs. Going forward, the Phase II SWE Team recommends that the TUS staff consider establishing clearer guidelines for the number of telephone and on-site inspections that should be performed for residential low-income programs. Though as stated earlier in this report, when deciding on the best technique to use for verifying savings from low-income programs, one needs to consider the value of information and the relative proportion of total portfolio savings provided by low-income programs versus other programs.

Figure 2-8: Number of PY7 Low-Income Combined On-Site and Telephone Inspections Completed by EDC

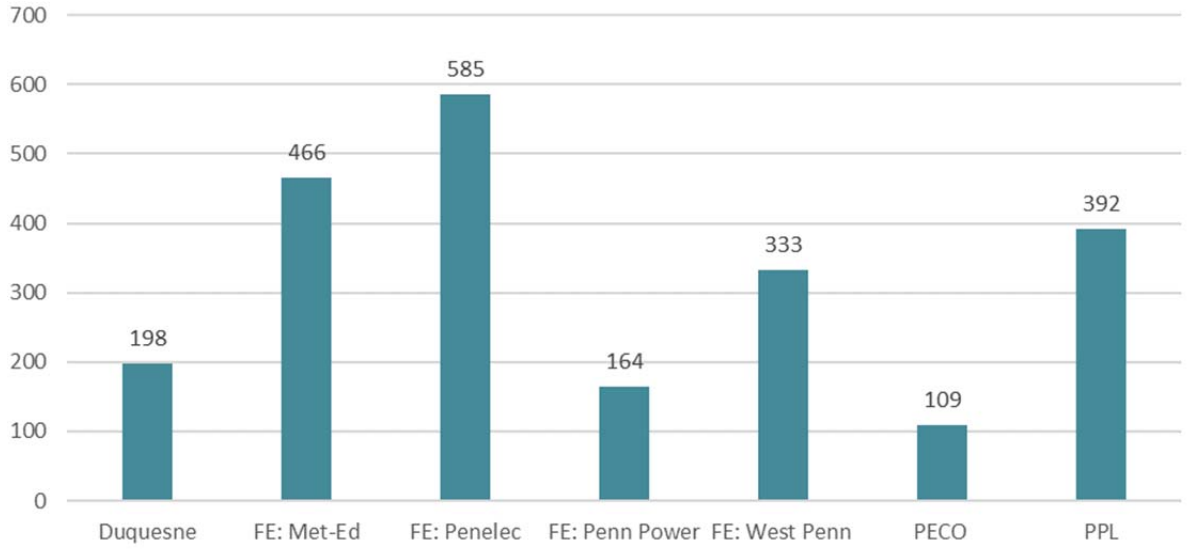


Figure 2-9: PY7 Low-Income Combined On-Site and Telephone Inspections as a Percentage of Participants

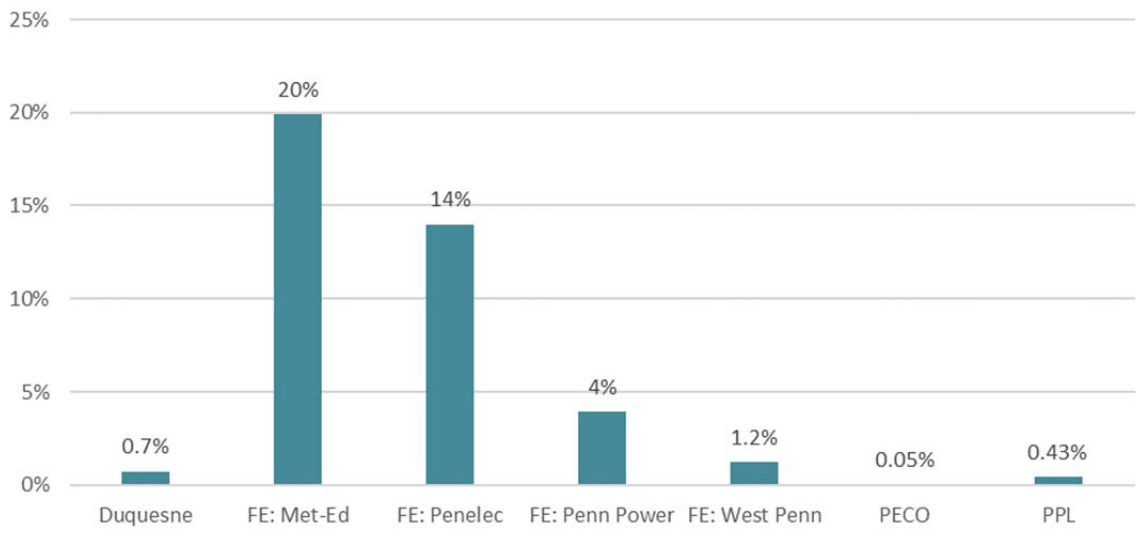


Figure 2-10 shows the low-income programs' TRC ratios by EDC for PY7. The ratios vary significantly, ranging from a low of 0.25 for West Penn to a high of 2.8 for Duquesne. A major reason for the differences is that the measures and services offered vary significantly among EDCs.

Figure 2-10: PY7 Residential Low-Income Program TRC Ratios by EDC

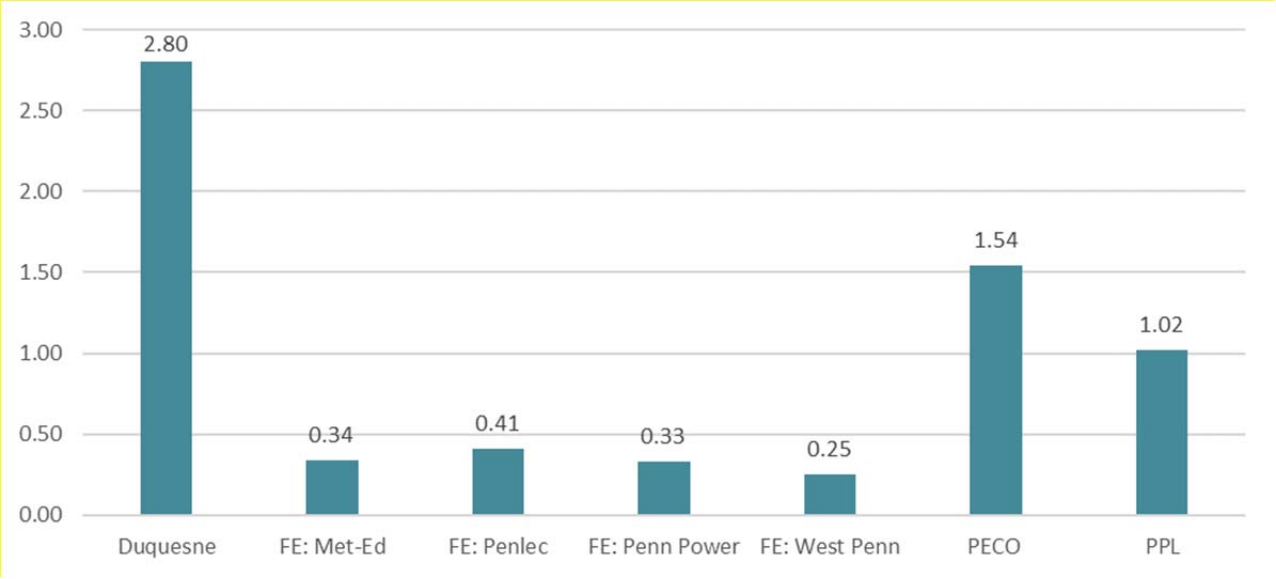
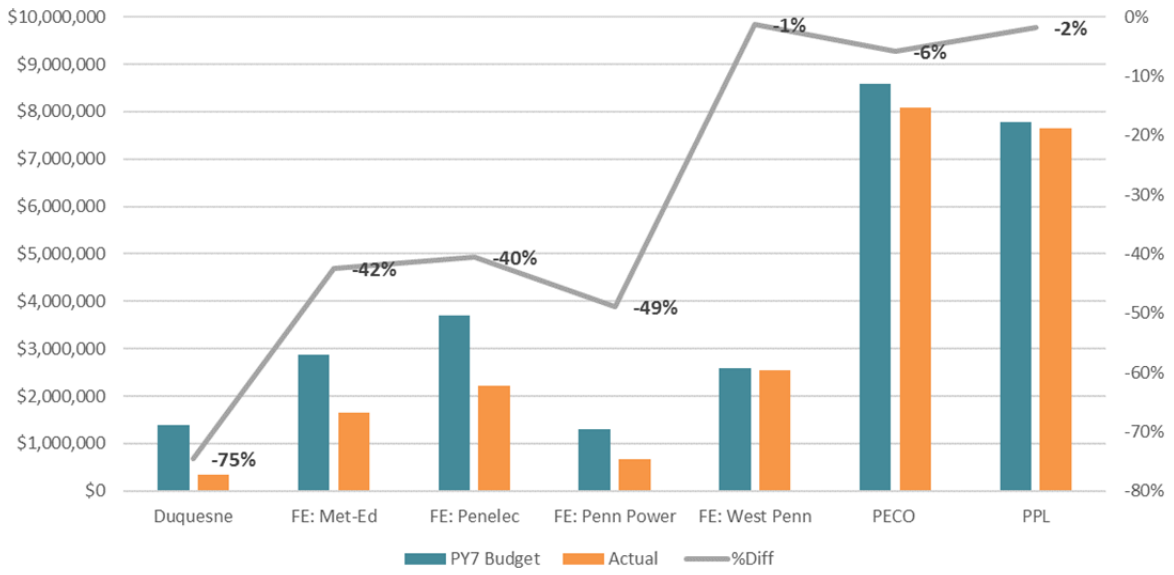


Figure 2-11 compares the seven EDCs' PY7 estimated expenditures in the EE&C Plans for low-income programs with the actual expenditures the programs incurred in PY7.

Figure 2-11: PY7 Residential Low-Income Program EE&C Plan Estimates versus PY7 Actual Expenditures



During PY7, all of the EDCs spent less than they had budgeted for their low-income programs. Actual expenditures for PPL and PECO were slightly below their budget amounts, but PPL met their MWh savings goal for PY7 and PECO achieved 95% of the forecast MWh savings for their program. West Penn Power came close to expending its entire low-income program budget, but as illustrated in Figure 2-12, verified PY7 MWh savings were below Plan savings by 23%. Figure 2-12 compares PY7 EE&C Plan estimates of low-income MWh/yr planned savings by EDC to PY7 verified MWh/yr savings. The data in this chart indicate that only PPL exceeded its PY7 planned MWh savings. The remaining six EDCs missed their PY7 planned savings by 5% to 53%, though PPL, PECO and Duquesne all achieved their Phase II compliance goals. Note that these are PY7 savings for the dedicated low-income programs, and not cumulative savings for all of the Phase II.

Figure 2-12: PY7 EE&C Plan Low-Income Program EE&C Plan Estimated MWh/yr versus Verified MWh/yr PY7 Savings

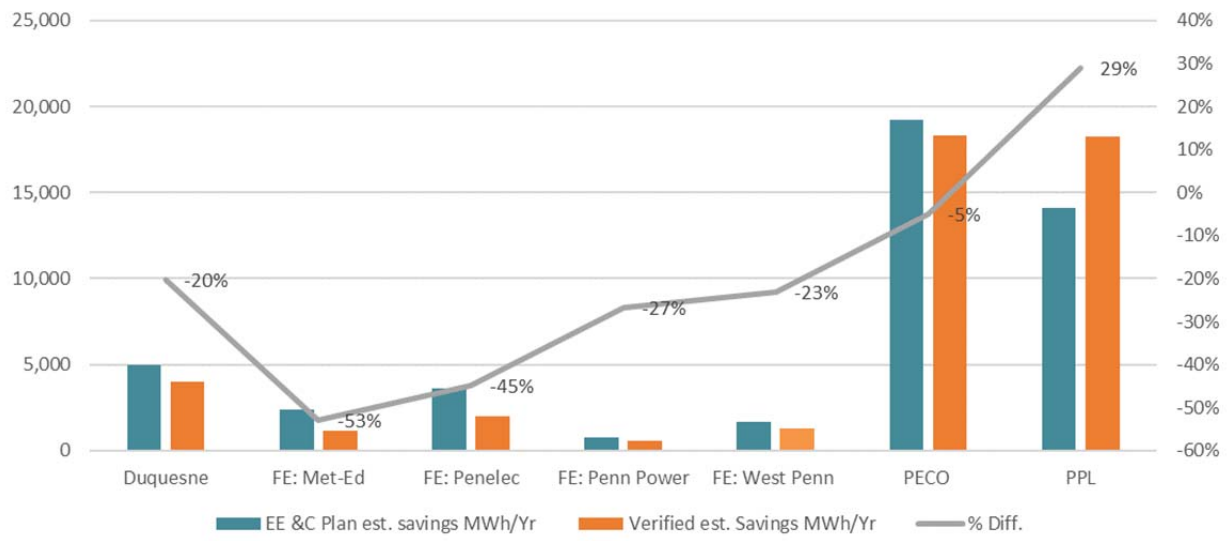


Figure 2-13 compares the EDCs' PY7 EE&C plan MW planned savings to verified MW savings after realization rates were applied. It should be noted there are no compliance requirements for MW savings. The data in this figure follow the same pattern as the data in Figure 2-12.

Figure 2-13: PY7 EE&C Plan Low-Income Program EE&C Plan Estimated MW versus Verified MW PY7 Savings

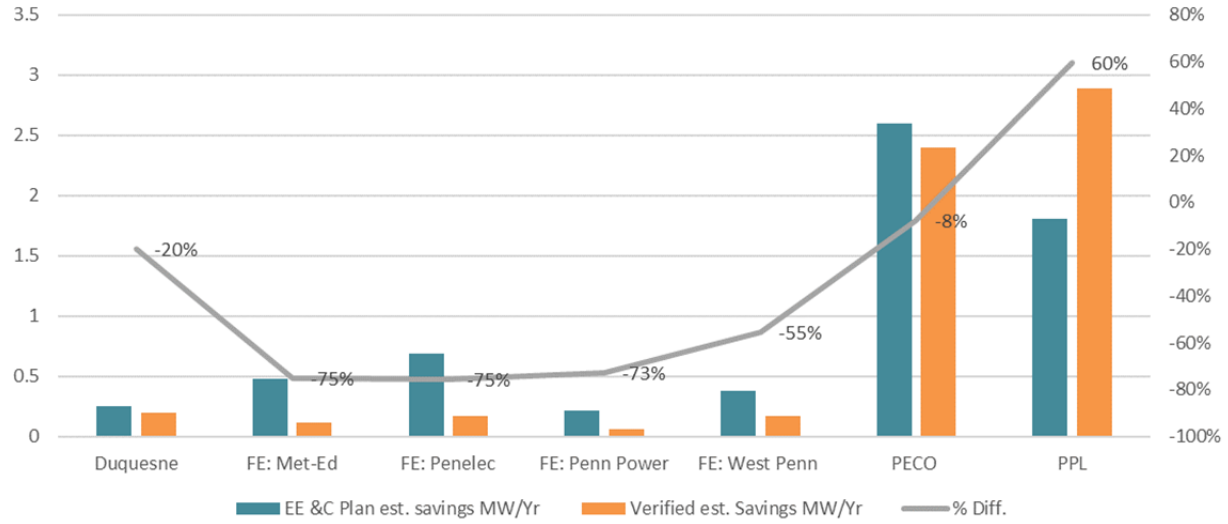
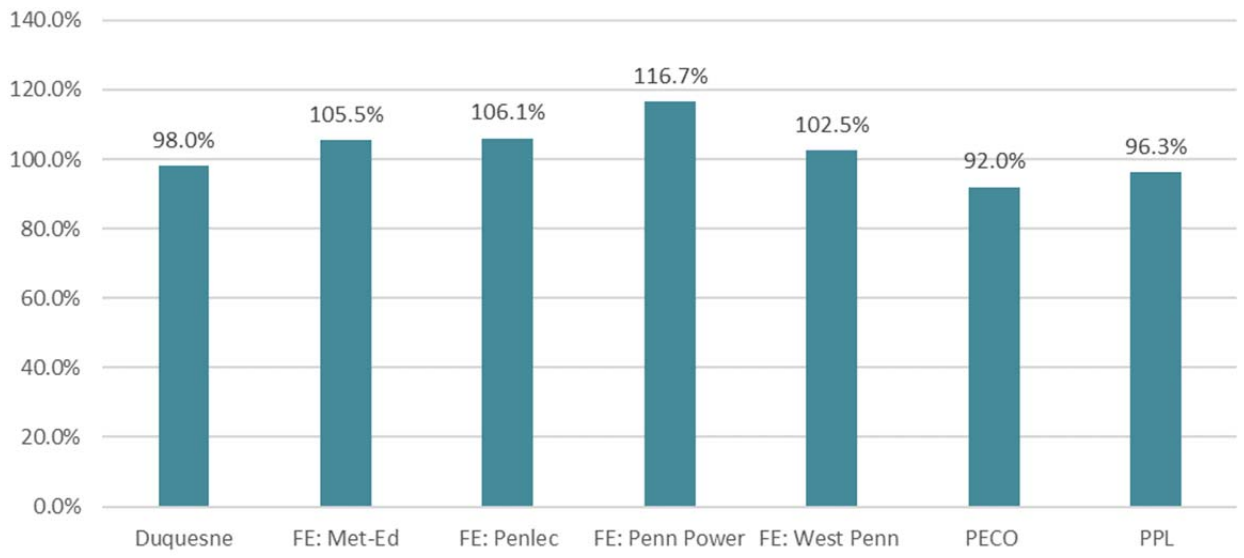


Figure 2-14 shows the PY7 low-income program realization rates[18] by EDC. The realization rates are very similar, which is typical for programs that rely heavily on direct-install programs.

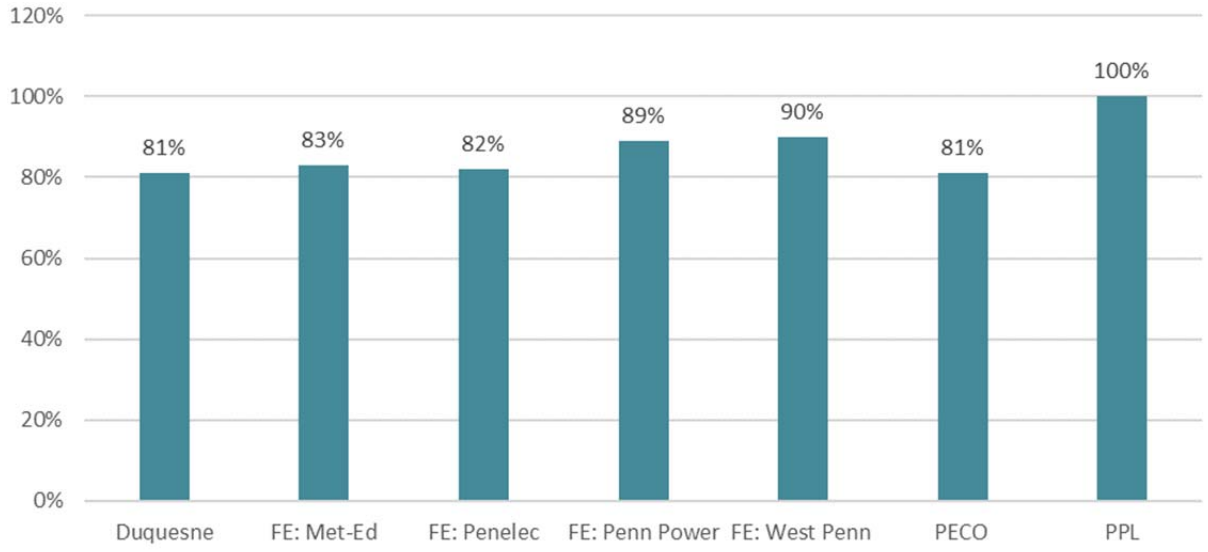
Figure 2-14: PY7 Low-Income Program Energy Savings Realization Rates by EDC

[18] "Realization rate" is defined as a factor representing ex post savings estimates divided by ex ante savings estimates that is applied to gross savings to determine verified savings estimates.



During PY7, all EDCs, except for PPL, conducted NTG research for their low-income programs, as required in the SWE Phase II Evaluation Framework. Figure 2-15 provides a graph of these NTGRs for the EDCs low-income programs. The NTGRs that are based on evaluation research conducted by the EDCs for PY7 ranged from 81% to 90%. This new EDC research shows conclusively that the NTGR for low-income programs is not 100%. Going forward, the Phase II SWE Team recommends that NTG market research for residential low-income programs be conducted at least once in every Act 129 Phase. The Phase II SWE Team also recommends that the Commission consider setting the default NTGR for Phase III for residential low-income programs in the range of 81% to 90% given the results determined from the Phase II NTGR research.

Figure 2-15: PY7 Low-Income Program Net-to-Gross Ratios for each EDC



2.4 RESULTS FOR THREE-YEAR ACT 129 PHASE II

This section presents the energy savings achievements by the EDCs for Phase II of Act 129. It begins with a statewide summary and is followed by results for each EDC.

2.4.1 Statewide Summary

Table 2-13 presents the seven EDCs' aggregated Phase II reported gross MWh/yr and MW impacts and Phase II verified gross MWh/yr and MW impacts. Statewide, the cumulative annual verified gross energy savings exceeded 3 million MWh/yr and 500 MW per year. These savings have resulted in nearly $2.2 billion in benefits to Pennsylvania customers, with a B/C ratio of more than 1.7. The table also includes estimates of the cumulative annual reduction of CO_2 emissions based on Phase II reported and verified energy savings.

Table 2-13: Summary of EDC Aggregated Phase II Impacts

Impact	Phase II Reported Gross Savings [f]	Phase II Verified Gross Savings [h]
Total Energy Savings (MWh/yr)	3,305,997	3,370,673
Total Demand Reduction (MW)	538	524
TRC Benefits ($1,000) [a]	N/A [g]	$2,197,271
TRC Costs ($1,000) [b]	N/A [g]	$1,286,220
TRC B/C Ratio [c]	N/A [g]	1.71
CO_2 Emissions Reduction (Tons) [d][e]	2,547,271	2,597,104

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception-to-Date-Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception-to-Date Verified Gross Savings.

Figure 2-16 shows the Phase II verified gross savings Phase I carryover (CO) savings compared with the aggregated EDC compliance targets. The EDCs collectively achieved enough savings during Phase II to meet the combined target, with the Phase I carryover providing a surplus of savings.

Figure 2-16: Phase II Verified Gross Energy Impacts Statewide

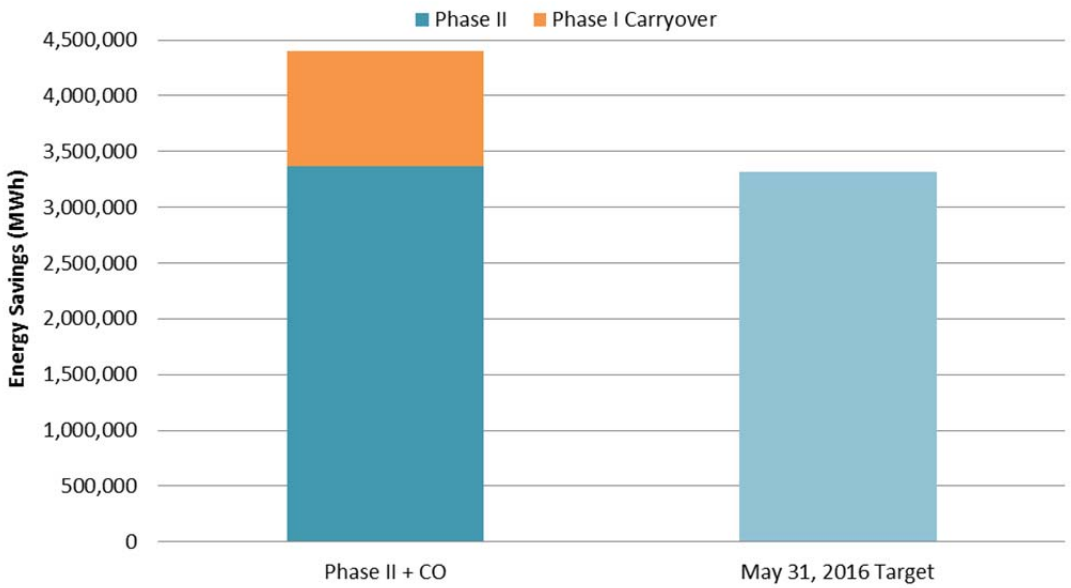


Table 2-14 shows the Phase II gross and net lifetime energy savings. These impacts account for the measure life of the portfolio of measures offered by the EDCs. The gross lifetime savings are 35 million MWh. After accounting for NTG impacts, the net lifetime savings are 24 million MWh in Phase II.

Table 2-14: Summary of Statewide Phase II Lifetime Annual Energy Savings

Element	Statewide Total
Phase II Gross Lifetime Savings (MWh)	35,023,525
Phase II Net Lifetime Savings (MWh)	24,270,063

Table 2-15 provides the Phase II reported and verified gross energy savings, as well as annual and lifetime net energy savings.

Table 2-15: Summary of Statewide Phase II Impacts by EDC

EDC	Phase II Reported Gross Savings (MWh/yr)	Phase II Verified Gross Savings (MWh/yr)	Phase II Net (MWh/yr)	Phase II Net Lifetime Savings (MWh)
Duquesne	384,229	377,248	248,319	2,846,439
Met-Ed	368,430	368,235	255,322	2,257,400
Penelec	369,044	368,508	265,869	2,490,361
Penn Power	104,933	109,368	72,774	695,946
West Penn	357,544	358,073	254,263	2,432,033
PECO	1,001,723	1,090,505	743,747	7,475,429
PPL	720,094	698,736	538,248	6,072,455
Total	**3,305,997**	**3,370,673**	**2,378,542**	**24,270,063**

2.4.2 Duquesne Light

Table 2-16 provides an overview of Duquesne's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-16: Summary of Duquesne's Phase II Savings Impacts

Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	384,229	377,248	133,717	510,965	276,722	185%
Total Demand Reduction (MW)	43.813	45.620	N/A	45.620	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$206,693	N/A	$206,693	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$101,477	N/A	$101,477	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	2.04	N/A	2.04	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	296,048	290,670	103,029	393,699	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

Duquesne achieved 185% of its Act 129 Phase II energy savings target through the end of PY7. The TRC B/C ratio (or TRC ratio) of Duquesne's programs was 2.04, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-17 shows the verified gross savings after each program year during Phase II. The data in this figure do not include carryover savings from Phase I. The C/I sector accounted for the highest savings for Duquesne during Phase II.

Figure 2-17: Duquesne Phase II Cumulative Verified Gross Savings by Program Year and Sector

2.4.3 Metropolitan Edison Company

Table 2-17 provides an overview of Met-Ed's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-17: Summary of Met-Ed's Phase II Savings Impacts

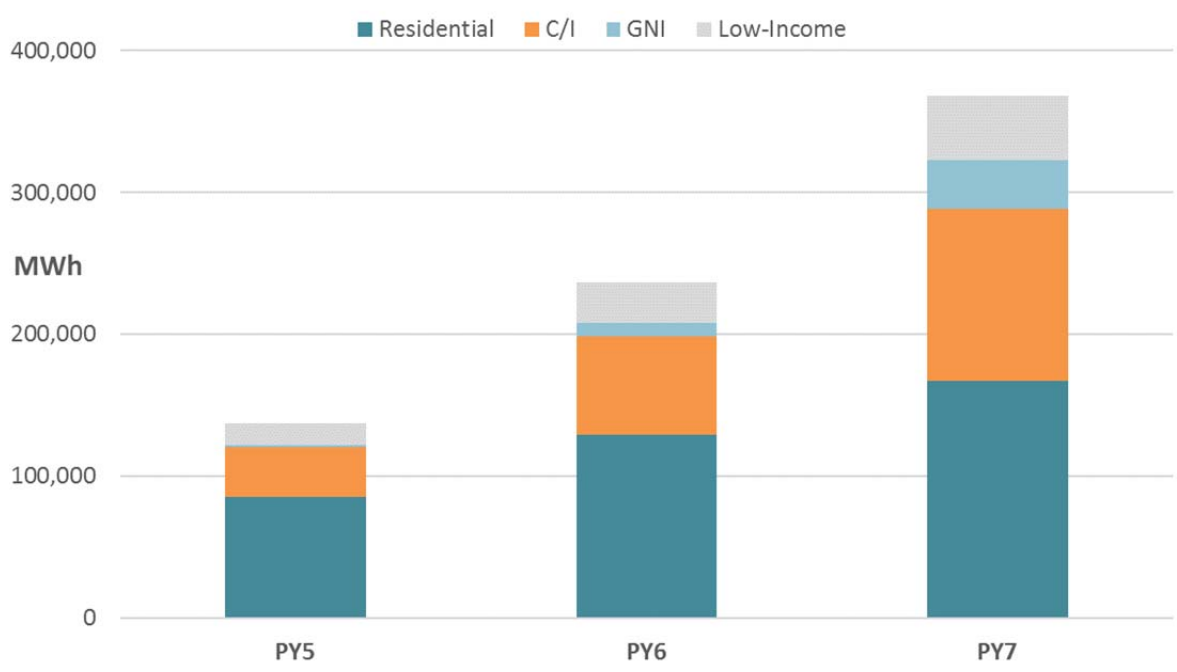
Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	368,430	368,235	47,187	415,422	337,753	123%
Total Demand Reduction (MW)	44.24	45.660	N/A	45.660	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$178,598	N/A	$178,598	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$115,527	N/A	$115,527	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.55	N/A	1.55	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	283,875	283,725	36,358	320,083	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

Met-Ed achieved 123% of its Act 129 Phase II energy savings target through the end of PY7. The TRC ratio of Met-Ed's programs was 1.55, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-18 shows the verified gross savings after each program year during Phase II. The data in this figure does not include carryover savings from Phase I. The residential sector accounted for the highest savings for Met-Ed during Phase II.

Figure 2-18: Met-Ed Phase II Cumulative Verified Gross Savings by Program Year and Sector



2.4.4 Pennsylvania Electric Company

Table 2-18 provides an overview of Penelec's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-18: Summary of Penelec's Phase II Savings Impacts

Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	369,044	368,508	26,805	395,313	318,813	124%
Total Demand Reduction (MW)	44.5	44.310	N/A	44.310	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$182,288	N/A	$182,288	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$105,480	N/A	$105,480	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.73	N/A	1.73	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	284,348	283,935	20,653	304,589	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

Penelec achieved 124% of its Act 129 Phase II energy savings target through the end of PY7. The TRC ratio of Penelec's programs was 1.73, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-19 shows the verified gross savings after each program year during Phase II. The data in this figure do not include carryover savings from Phase I. The residential sector accounted for the highest savings for Penelec during Phase II.

Figure 2-19: Penelec Phase II Cumulative Verified Gross Savings by Program Year and Sector

2.4.5 Pennsylvania Power Company

Table 2-19 provides an overview of Penn Power's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-19: Summary of Penn Power's Phase II Savings Impacts

Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	104,933	109,368	22,580	131,948	95,502	138%
Total Demand Reduction (MW)	12.18	13.210	N/A	13.210	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$46,704	N/A	$46,704	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$41,382	N/A	$41,382	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.13	N/A	1.13	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	80,851	84,268	17,398	101,666	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

Penn Power achieved 138% of its Act 129 Phase II energy savings target through the end of PY7. The TRC ratio of Penn Power's programs was 1.13, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-20 shows the verified gross savings after each program year during Phase II. The data in this figure do not include carryover savings from Phase I. The residential sector accounted for the highest savings for Penn Power during Phase II.

Figure 2-20: Penn Power Phase II Cumulative Verified Gross Savings by Program Year and Sector

2.4.6 West Penn Power

Table 2-20 provides an overview of West Penn's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-20: Summary of West Penn's Phase II Savings Impacts

Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	357,544	358,073	59,929	418,002	337,533	124%
Total Demand Reduction (MW)	44.27	44.370	N/A	44.370	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$177,034	N/A	$177,034	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$91,780	N/A	$91,780	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.93	N/A	1.93	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	275,488	275,895	46,175	322,071	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

West Penn achieved 124% of its Act 129 Phase II energy savings target through the end of PY7. The TRC ratio of West Penn's programs was 1.93, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-21 shows the verified gross savings after each program year during Phase II. The data in this figure do not include carryover savings from Phase I. The residential sector accounted for the highest savings for West Penn during Phase II.

Figure 2-21: West Penn Phase II Cumulative Verified Gross Savings by Program Year and Sector

2.4.7 PECO Energy

Table 2-21 provides an overview of PECO's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-21: Summary of PECO's Phase II Savings Impacts

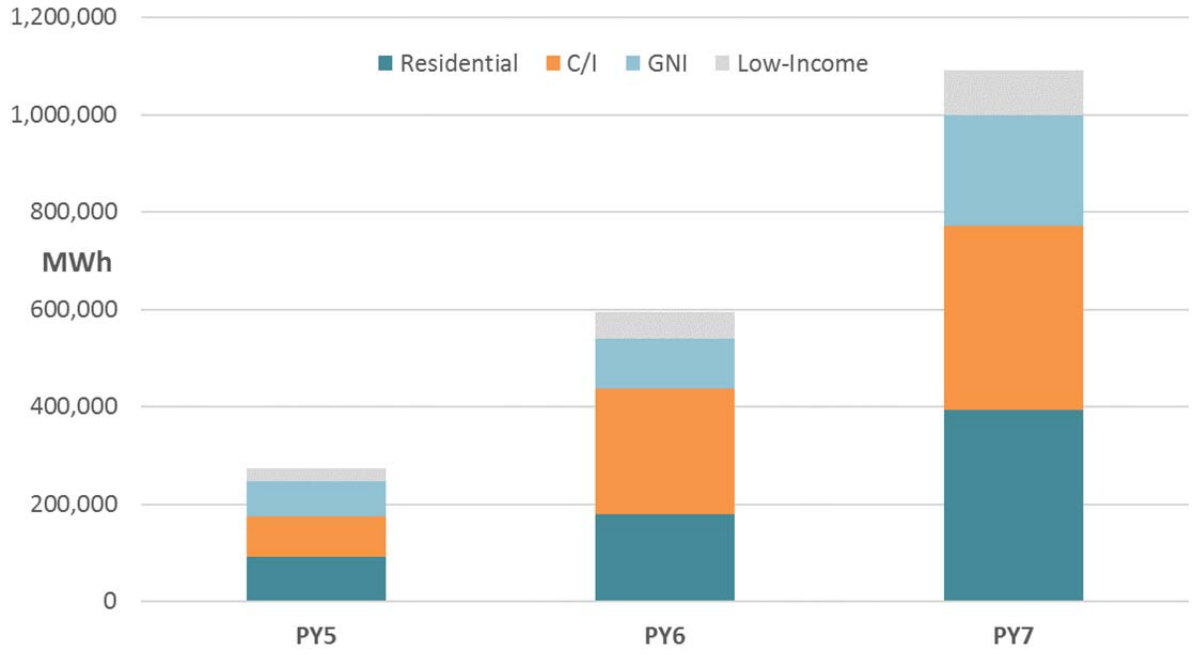
Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	1,001,723	1,090,505	242,793	1,333,298	1,125,851	118%
Total Demand Reduction (MW)	204.1	224.800	N/A	224.800	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$906,714	N/A	$906,714	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$516,392	N/A	$516,392	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.76	N/A	1.76	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	771,828	840,234	187,072	1,027,306	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

PECO achieved 118% of its Act 129 Phase II energy savings target through the end of PY7. The TRC ratio of PECO's programs was 1.76, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-22 shows the verified gross savings after each program year during Phase II. The data in this figure do not include carryover savings from Phase I. The C/I sector accounted for the highest savings for PECO during Phase II.

Figure 2-22: PECO Phase II Cumulative Verified Gross Savings by Program Year and Sector



2.4.8 PPL

Table 2-22 provides an overview of PPL's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the inception of its EE&C programs through the end of Phase II.

Table 2-22: Summary of PPL's Phase II Savings Impacts

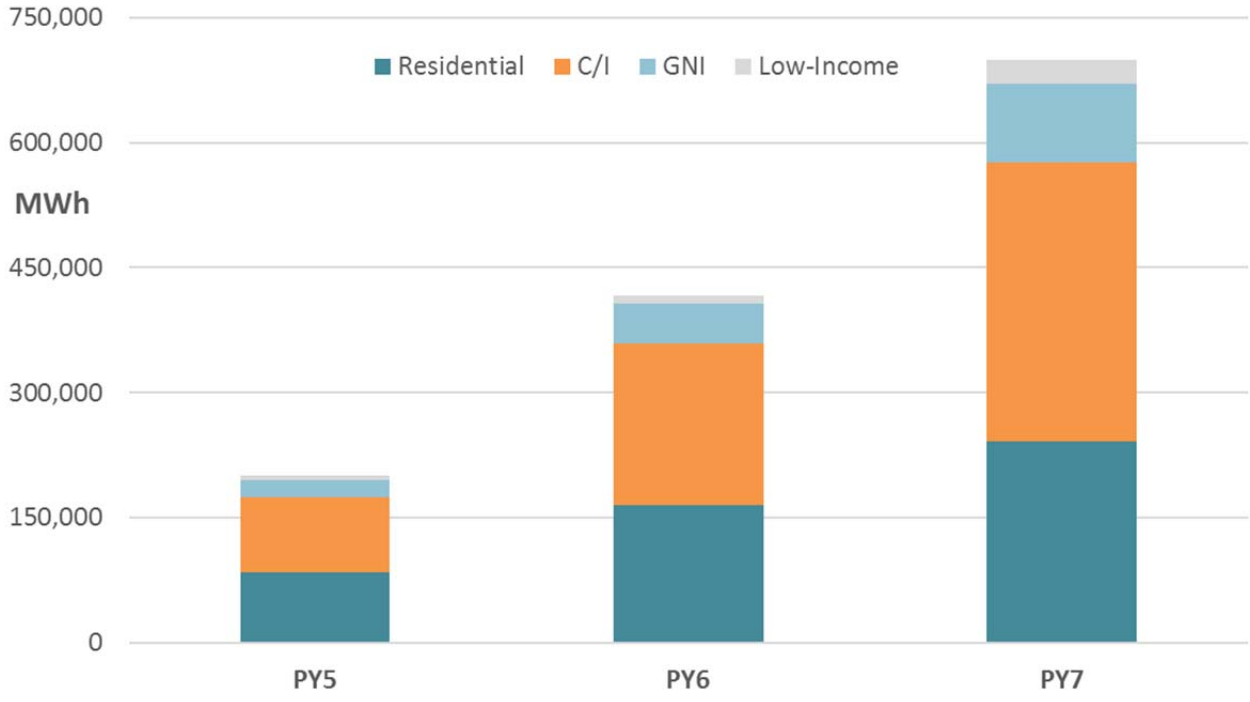
Impact	Phase II RG Savings [f]	Phase II VG Savings [h]	Phase I CO Savings	Phase II VG + Phase I CO Savings	May 31, 2016 Compliance Target (MWh)	Savings Achieved as % of 2016 Targets [i]
Total Energy Savings (MWh/yr)	720,094	698,736	495,636	1,194,372	821,072	145%
Total Demand Reduction (MW)	144.45	106.270	N/A	106.270	N/A	N/A
TRC Benefits ($1,000) [a]	N/A [g]	$499,240	N/A	$499,240	N/A	N/A
TRC Costs ($1,000) [b]	N/A [g]	$314,182	N/A	$314,182	N/A	N/A
TRC B/C Ratio [c]	N/A [g]	1.59	N/A	1.59	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	554,832	538,376	381,888	920,264	N/A	N/A

NOTES:
[a] Avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity. Subject to TRC Order.
[b] Costs paid by the program administrator and participants plus the increase in supply costs for any period when load is increased. Subject to TRC Order.
[c] Subject to the Commission's August 31, 2012 TRC Order.
[d] CO_2 conversion based on 1,541 lbs CO_2 per MWh according to the latest available (2015) PJM Emission Report of marginal off-peak annual CO_2 emission rate.
[e] CO_2 emissions are reported due to Stakeholder interest in this information and to recognize that reporting this information is recommended by the National Action Plan for Energy Efficiency.
[f] Phase II Reported Gross Impact is the cumulative program/portfolio Phase II Inception to Date Reported Gross Savings.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Phase II Verified Impact is the cumulative program/portfolio Phase II Inception to Date Verified Gross Savings.
[i] Savings achieved based on Phase II Inception-to-Date Verified Gross Savings.

PPL achieved 145% of its Act 129 Phase II energy savings target through the end of PY7 (including Phase I carryover). The TRC ratio of PPL's programs was 1.59, which indicates that its portfolio of EE&C programs is cost-effective on an aggregated basis.

Figure 2-23 shows the cumulative verified gross savings after each program year during Phase II. The data in this figure does not include carryover savings from Phase I. The C/I sector accounted for the highest savings for PPL during Phase II.

Figure 2-23: PPL Phase II Cumulative Verified Gross Savings by Program Year and Sector



3 DEMAND SAVINGS FROM ENERGY EFFICIENCY – PY7 AND PHASE II

This section of the report discusses demand reductions achieved under Act 129 by EDC energy efficiency programs. The demand reductions are provided on a statewide basis and by EDC, for both PY7 and Phase II.

3.1 RESULTS FOR THREE-YEAR ACT 129 PHASE II

Although there were no demand reduction targets in Phase II, EDCs tracked, evaluated, and reported peak demand savings for all energy efficiency programs in all sectors. Demand evaluation was not held to the same confidence and precision requirements as established for energy savings at the program and portfolio levels. However, in the course of program energy evaluation, all EDCs managed to achieve 10% precision at the 90% confidence interval for demand savings at the portfolio level for Phase II. This high level of precision gives the SWE confidence in the Phase II verified demand savings presented below.

3.1.1 Statewide Summary

Table 3-1 summarizes the reported and verified gross demand reductions for each EDC for Phase II. Statewide, the verified gross savings were slightly less than the reported gross savings.

Table 3-1: Phase II Cumulative Gross Demand Savings

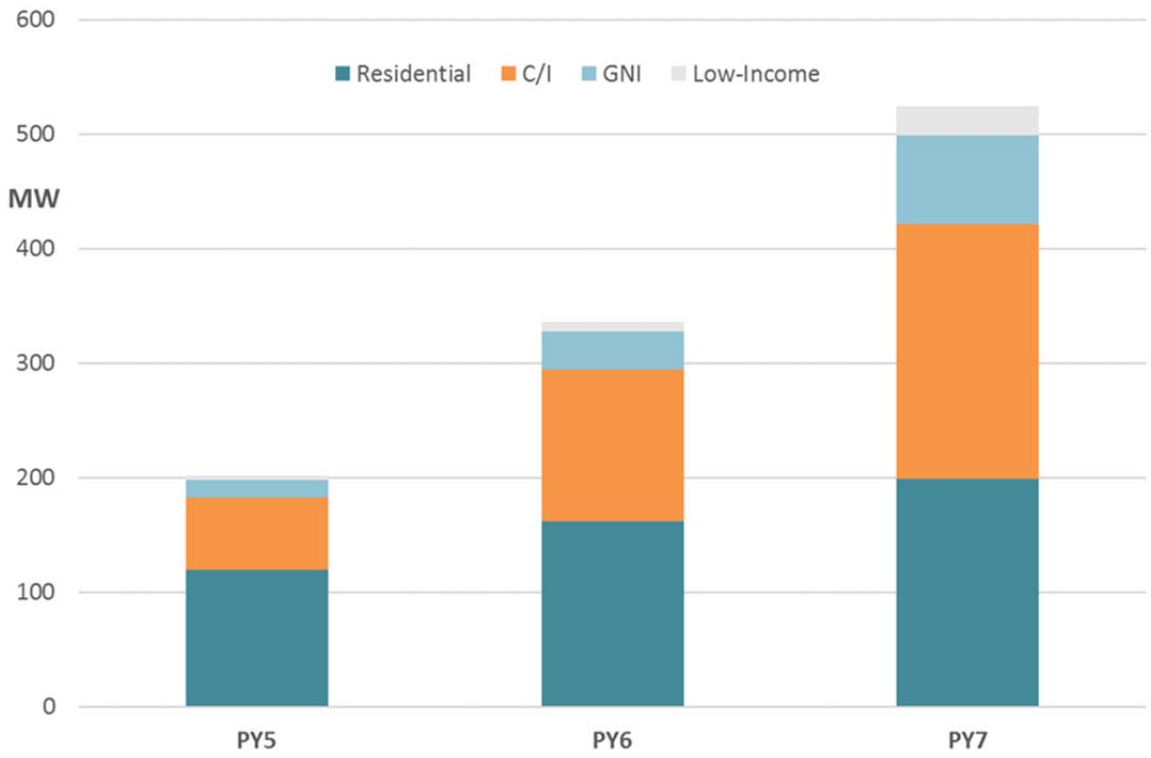
EDC	Phase II Reported Gross Demand Savings (MW)	Phase II Verified Gross Demand Savings (MW)
Duquesne	43.81	45.62
Met-Ed	44.24	45.66
Penelec	44.50	44.31
Penn Power	12.18	13.21
West Penn	44.27	44.37
PECO	204.1	224.8
PPL	144.45	106.27
Total	**537.6**	**524.2**

Table 3-2 summarizes the Phase II verified demand reductions for each EDC, by sector. The C/I sector accounted for the greatest proportion of demand savings across the state in Phase II. Figure 3-1 presents this PY5, PY6, and Phase II cumulative demand savings by sector in graphical form.

Table 3-2: Phase II Cumulative Verified Demand (MW) Savings, by EDC and Sector

EDC	Residential	C/I	GNI	Low-Income	Total
Duquesne	10.79	29.08	4.24	1.51	45.62
Met-Ed	17.70	19.02	6.43	2.51	45.66
Penelec	13.53	22.10	5.93	2.77	44.33
Penn Power	4.18	5.99	2.49	0.56	13.22
West Penn	15.22	21.52	5.46	2.18	44.38
PECO	106.00	69.20	38.00	11.50	224.70
PPL	31.81	55.63	14.41	4.41	106.26
Total	**199.23**	**222.54**	**76.96**	**25.44**	**524.17**

Figure 3-1: Phase II Cumulative Verified Gross Demand Savings



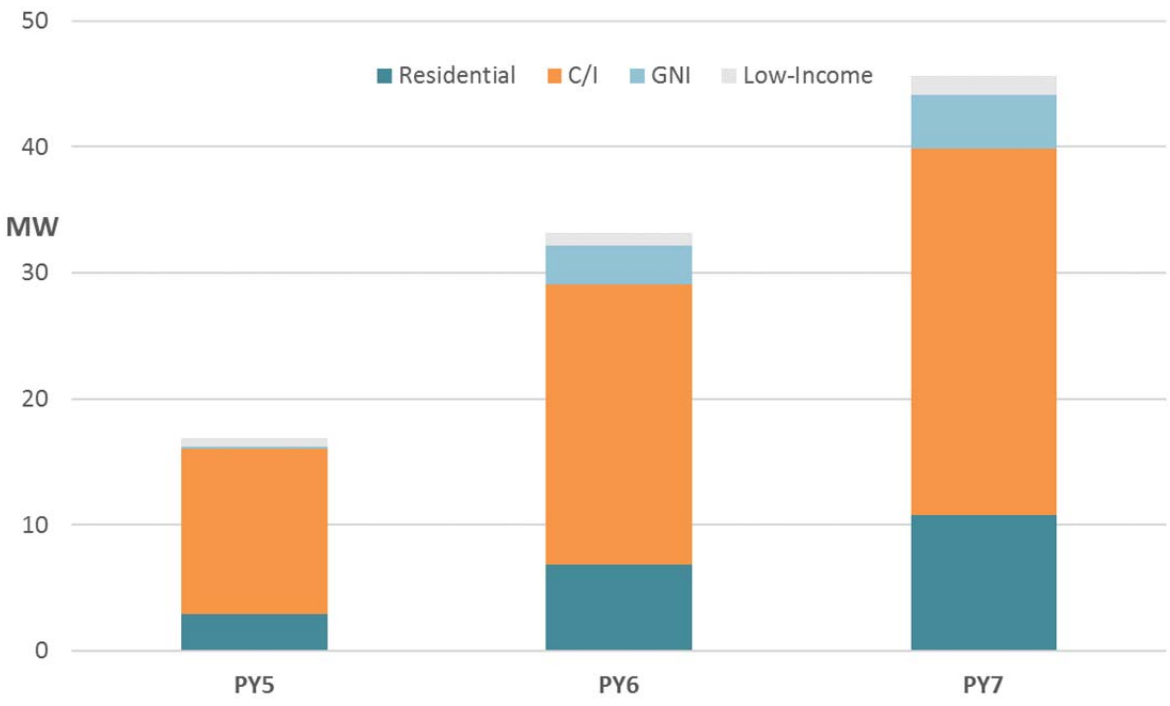
3.1.2 Duquesne Light

Table 3-3 presents Duquesne's cumulative demand savings, stratified by sector. The C/I sector accounted for nearly 60% of the total demand savings in Phase II. Figure 3-2 provides a graphical illustration of these savings.

Table 3-3: Duquesne Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	2.95	13.07	0.17	0.71	16.89
PY6	6.85	22.23	3.05	1.06	33.19
PY7 (Phase II Total)	10.79	29.08	4.24	1.51	45.62

Figure 3-2: Duquesne Phase II Cumulative Demand Savings, by Sector



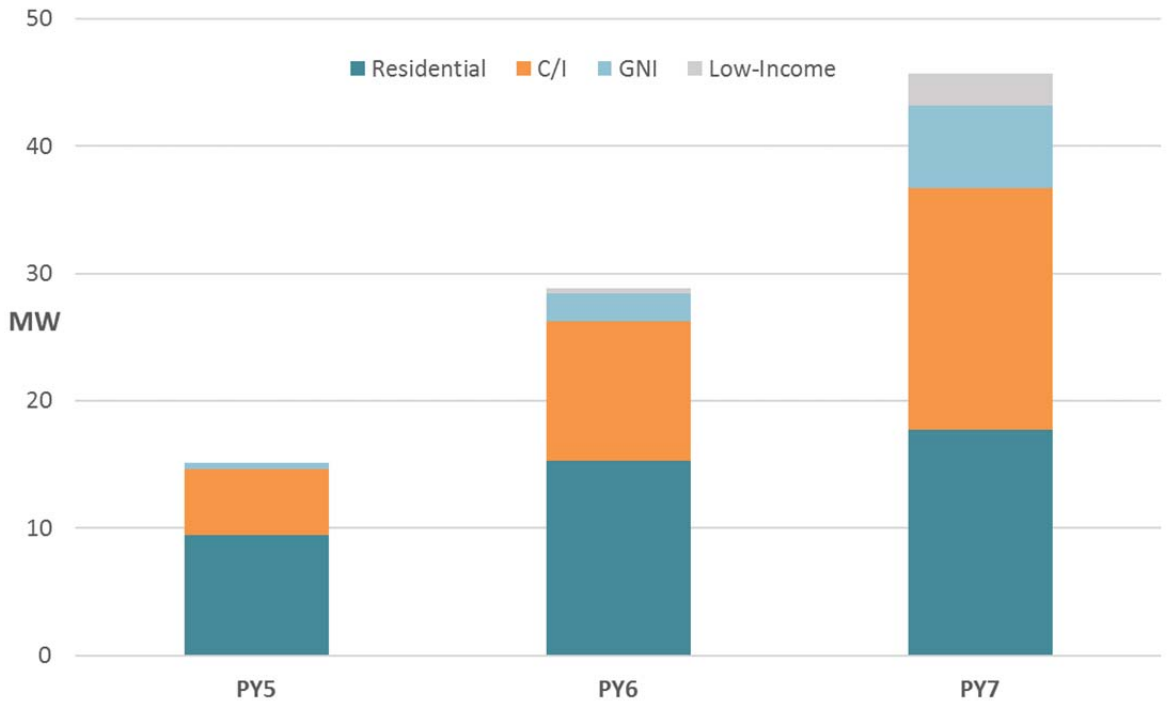
3.1.3 Metropolitan Edison Company

Table 3-4 presents Med-Ed's cumulative demand savings, by sector. The C/I sector accounted for 35% of the total demand savings in Phase II.
Figure 3-3 provides a graphical illustration of these savings.

Table 3-4: Met-Ed Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	9.51	5.18	0.46	0.00	15.15
PY6	15.33	10.95	2.13	0.39	28.80
PY7 (Phase II Total)	17.70	19.02	6.43	2.51	45.66

Figure 3-3: Met-Ed Phase II Cumulative Demand Savings, by Sector



3.1.4 Pennsylvania Electric Company

Table 3-5 presents Penelec's cumulative demand savings, by sector. The C/I sector accounted for nearly 50% of the total demand savings in Phase II.

Figure 3-4 provides a graphical illustration of these savings.

Table 3-5: Penelec Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	9.15	4.65	1.08	0.00	14.88
PY6	12.30	11.64	3.18	0.55	27.67
PY7 (Phase II Total)	13.53	22.10	5.93	2.77	44.33

Figure 3-4: Penelec Phase II Cumulative Demand Savings, by Sector

3.1.5 Pennsylvania Power Company

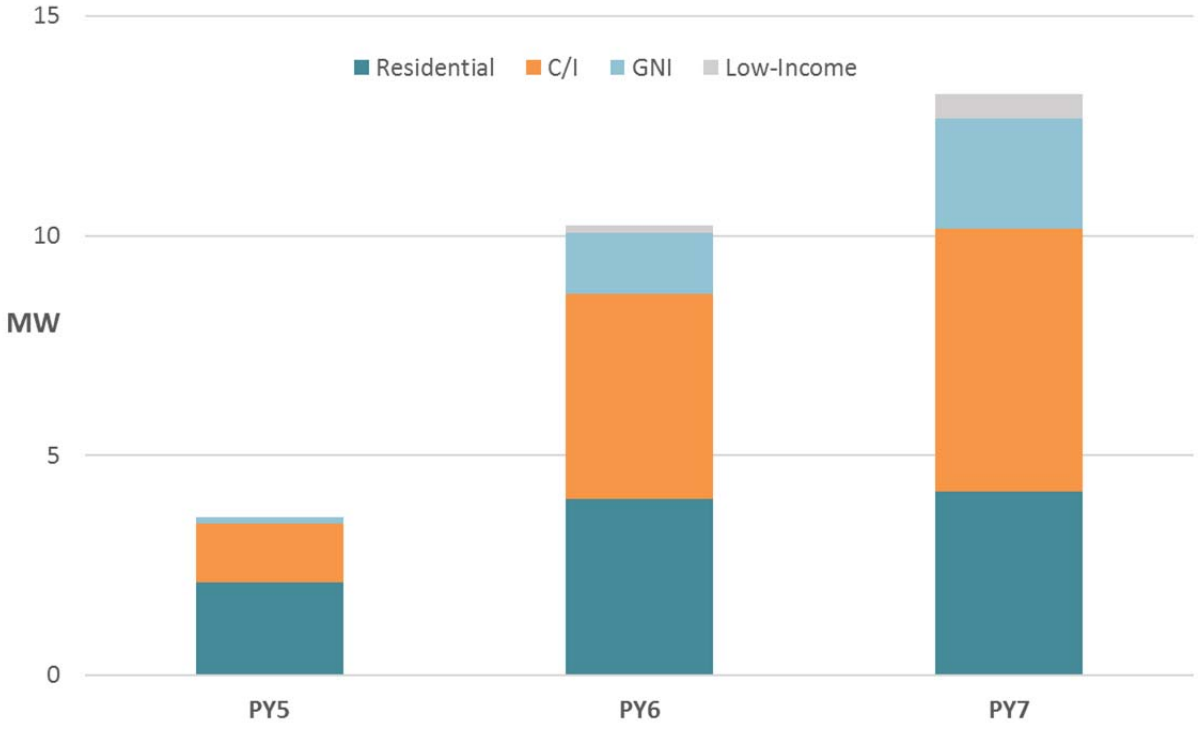
Table 3-6 presents Penn Power's cumulative demand savings, by sector. The C/I sector accounted for nearly 50% of the total demand savings in Phase II.

Figure 3-5 provides a graphical illustration of these savings.

Table 3-6: Penn Power Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	2.11	1.33	0.16	0.00	3.60
PY6	4.01	4.66	1.40	0.17	10.24
PY7 (Phase II Total)	4.18	5.99	2.49	0.56	13.22

Figure 3-5: Penn Power Phase II Cumulative Demand Savings, by Sector



3.1.6 West Penn Power

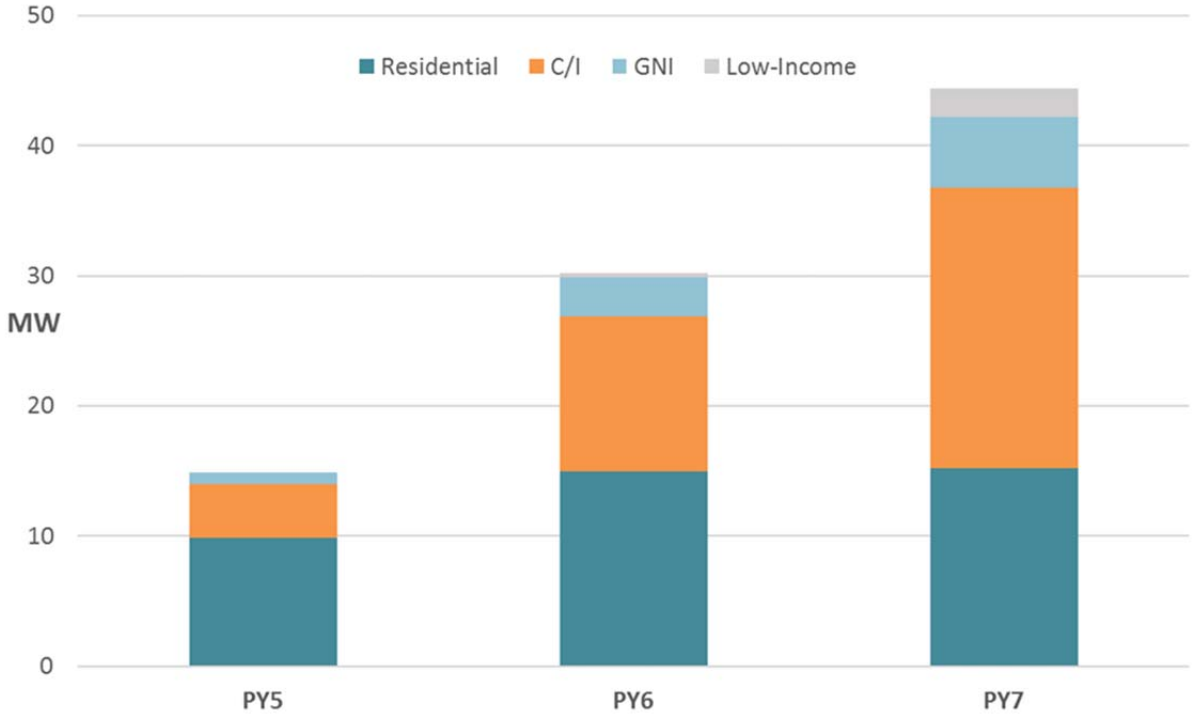
Table 3-7 presents West Penn's cumulative demand savings, by sector. The C/I sector accounted for nearly 50% of the total demand savings in Phase II.

Figure 3-6 provides a graphical illustration of these savings.

Table 3-7: West Penn Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	9.89	4.10	0.87	0.00	14.86
PY6	14.97	11.96	2.97	0.30	30.20
PY7 (Phase II Total)	15.22	21.52	5.46	2.18	44.38

Figure 3-6: West Penn Phase II Cumulative Demand Savings, by Sector



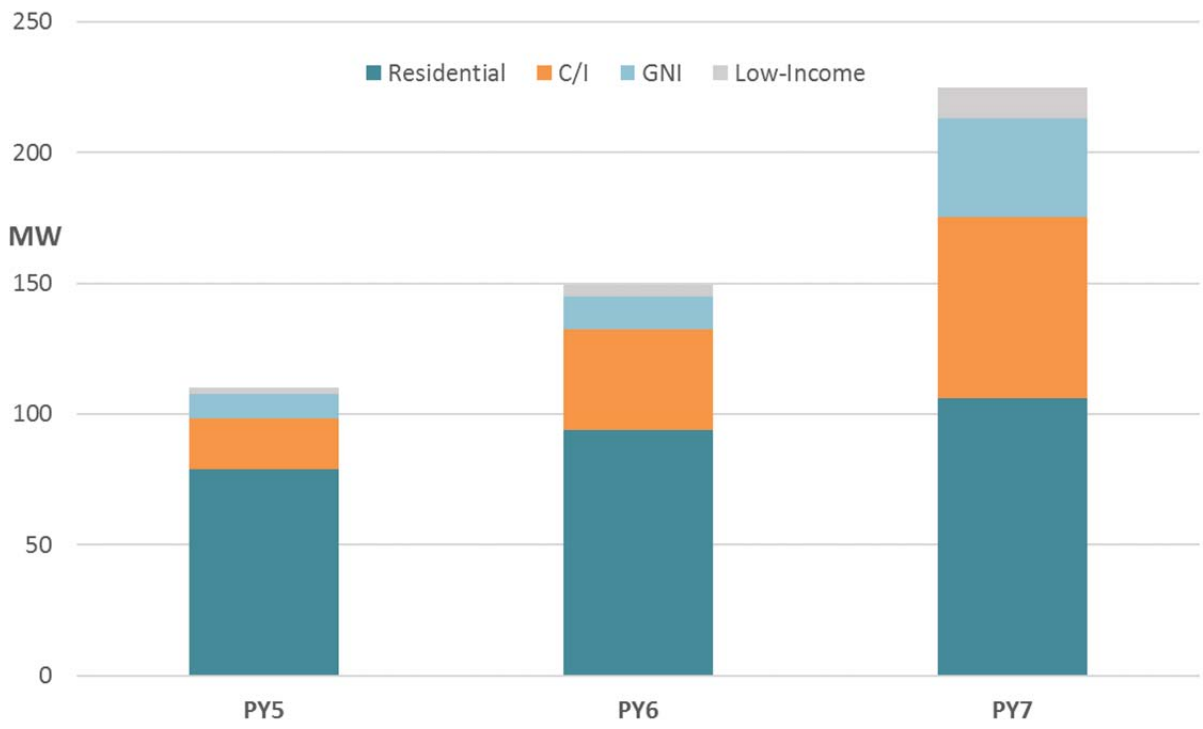
3.1.7 PECO Energy

Table 3-8 presents PECO's cumulative demand savings, by sector. The residential sector accounted for nearly 50% of the total demand savings in Phase II. Figure 3-7 provides a graphical illustration of these savings.

Table 3-8: PECO Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	79.00	19.40	9.50	2.20	110.10
PY6	94.15	38.10	12.70	4.70	149.65
PY7 (Phase II Total)	106.00	69.20	38.00	11.50	224.70

Figure 3-7: PECO Phase II Cumulative Demand Savings, by Sector



3.1.8 PPL

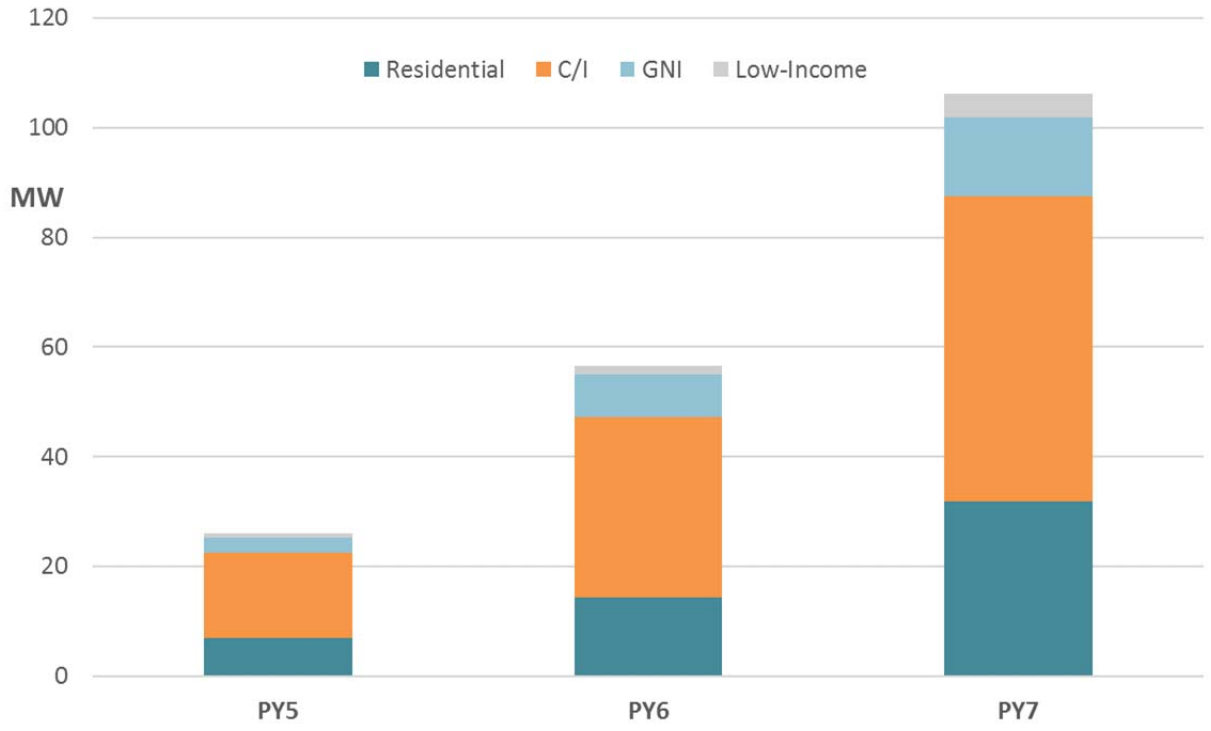
Table 3-9 presents PPL's cumulative demand savings, by sector. The C/I sector accounted for more than 50% of the total demand savings in Phase II.

Figure 3-8 provides a graphical illustration of these savings.

Table 3-9: PPL Phase II Cumulative Demand Savings, by Sector

Statewide	Residential	C/I	GNI	Low-Income	Total
PY5	6.91	15.60	2.84	0.59	25.94
PY6	14.27	32.93	7.87	1.44	56.51
PY7 (Phase II Total)	31.81	55.63	14.41	4.41	106.27

Figure 3-8: PPL Phase II Cumulative Demand Savings, by Sector



4 ACT 129 BENEFITS AND COSTS

Act 129 directs the Commission to use a Total Resource Cost (TRC) test to analyze costs and benefits of the energy efficiency and conservation (EE&C) plans. Act 129 defines the TRC test as "a standard test that is met if, over the effective life of each plan not to exceed 15 years, the net present value of the avoided monetary cost of supplying electricity is greater than the net present value of the monetary cost of energy efficiency measures."[19] The Commission entered its initial TRC Test Order for Phase I of Act 129 on June 23, 2009, adapting the California TRC model[20] for use in evaluating the costs and benefits of the EE&C plan. Subsequent revisions to the TRC Test Order have served to address TRC clarifications or refinements regarding demand response program, fuel-switching, use of NTGRs, general TRC calculations, and other important issues. In August 2012, the Commission adopted the 2013 TRC Test Order for Phase II of Act 129.[21]

A complete overview of the TRC test formulae, benefits, and costs can be found in the 2013 TRC Test Order for Phase II.

4.1 PHASE II TRC TEST RESULTS

4.1.1 TRC Test Results by Program Year

Table 4-1 details the TRC test NPV benefits, costs, and B/C ratio for each EDC's portfolio of programs by program year, based on each EDCs PY5–PY7 annual reports.

With the exception of one program year for Penn Power, all EDC portfolios were cost-effective in each year of Phase II. Although there was some variation of the level of the TRC ratio among program years within each EDC, the cost-effectiveness of statewide energy efficiency programs remained fairly stable, with a B/C ratio between 1.6 and 1.7. While the TRC ratios remained stable, benefits and costs increased each year of Phase II, signifying increased program activity over the course of Phase II.

[19] 66 Pa. C.S. § 2806.1 (m).
[20] California Standard Practice Manual – Economic Analysis of Demand-Side Programs and Projects, July 2002.
[21] Order on the TRC test for Phase II of Act 129. From the Public Meeting of August 30, 2012, at Docket No. M-2012-2300653. Entered August 30, 2012.

Table 4-1: Phase II Verified Gross TRC Benefits, Costs, and Ratios by Program Year and EDC

EDC	PY5			PY6			PY7		
	TRC Benefits ($1000)	TRC Costs ($1000)	TRC Ratio	TRC Benefits ($1000)	TRC Costs ($1000)	TRC Ratio	TRC Benefits ($1000)	TRC Costs ($1000)	TRC Ratio
Duquesne	$49,664	$20,161	2.5	$69,452	$40,373	1.7	$87,660	$40,464	2.2
Met-Ed	$55,851	$28,990	1.9	$48,185	$36,704	1.3	$74,561	$49,833	1.5
Penelec	$41,315	$27,733	1.5	$57,420	$27,794	2.1	$78,244	$49,953	1.6
Penn Power	$12,908	$11,861	1.1	$23,075	$17,936	1.3	$10,390	$11,684	0.9
West Penn Power	$46,360	$29,800	1.6	$60,459	$34,688	1.7	$70,214	$38,943	1.8
PECO	$207,526	$140,885	1.5	$246,816	$148,778	1.7	$446,838	$219,343	2.0
PPL	$140,338	$63,781	2.2	$168,596	$110,631	1.5	$238,285	$173,078	1.4
Total	**$553,962**	**$323,211**	**1.7**	**$674,003**	**$416,904**	**1.6**	**$1,006,192**	**$583,298**	**1.7**

4.1.2 TRC Test Results for Phase II – All Years Combined

Table 4-2 details the TRC test NPV benefits, costs, net benefits, and B/C ratio for each EDC's portfolio for all of Phase II, as reported in the EDCs' PY7 annual reports. For Phase II, the combined NPV lifetime net benefits (benefits – costs) of the EDC energy efficiency portfolios exceeded $900 million.

Table 4-2: Phase II Verified Gross TRC Benefits, Costs, and Ratios by EDC

	Phase II (All Years)			
EDC	TRC Benefits ($1000)	TRC Costs ($1000)	Net Benefits ($1000)	TRC Ratio
Duquesne	$206,776	$101,477	$105,216	2.0
Met-Ed	$178,598	$115,527	$63,071	1.5
Penelec	$182,288	$105,480	$76,808	1.7
Penn Power	$46,704	$41,382	$5,322	1.1
West Penn	$177,034	$91,780	$85,254	1.9
PECO	$903,716	$516,392	$390,322	1.8
PPL	$499,240	$314,182	$185,058	1.6
Total	**$2,194,356**	**$1,286,220**	**$911,051**	**1.7**

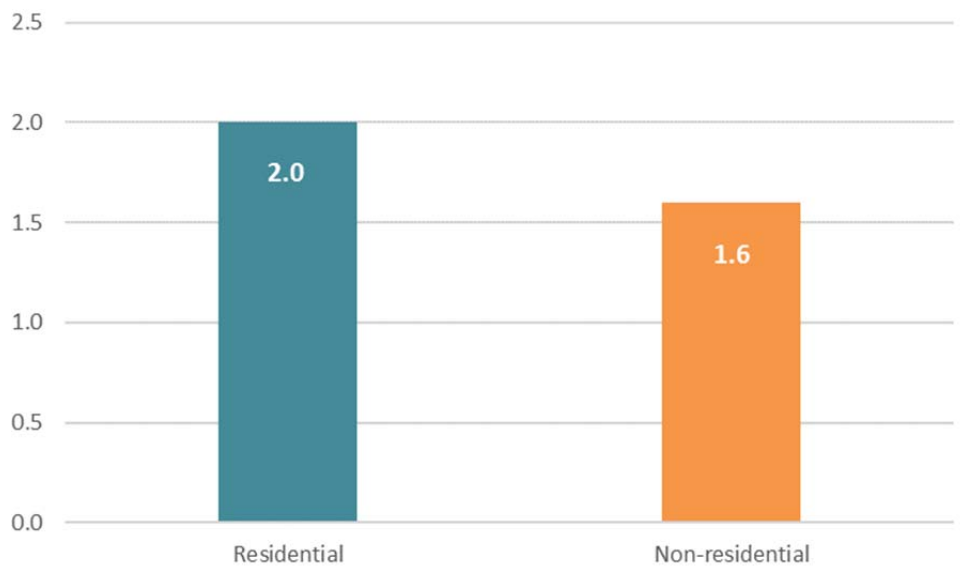
Although similar, the total Phase II benefits and costs are slightly different from the sum of the individual program year annual report values shown in Table 4-1, as EDCs occasionally made minor revisions to the TRC models following SWE review of the models. In addition, PPL reports Phase II benefits and costs by discounting all program year benefits and costs to the beginning of Phase II, producing total Phase II benefits that are less than the combined sum of individual reporting years.[22]

4.1.3 Phase II TRC Test Results by Sector

Figure 4-1 shows the total Phase II TRC ratios for all EDCs combined by sector. The residential sector includes all traditional residential sector programs, low-income programs, and behavior modification programs. The non-residential sector includes all C/I, master-meter buildings, and GNI programs.

[22] This different accounting method for reporting Phase II benefits and cost was originally noted and discussed in the SWE's PY6 annual report. The SWE recommends that the Commission adopt a common reporting method for all EDCs during Phase III.

Figure 4-1: Phase II TRC Ratios by Portfolio Sector

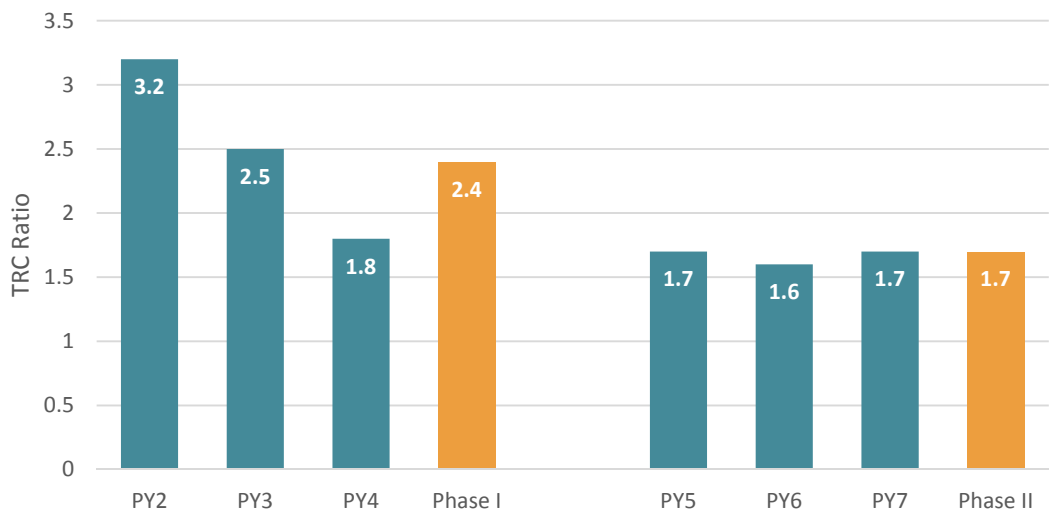


Overall, the residential sector programs were slightly more cost-effective than non-residential programs.

4.1.4 TRC Test Results by Phase

Figure 4-2 shows the portfolio TRC ratios for all EDCs combined by Phase I and II program years. Overall, the combined Phase II portfolios were less cost-effective than in the Phase I portfolios.

Figure 4-2: Phase I and II TRC Ratios



This result is not unexpected, as EDCs continue to diversify their portfolios beyond traditional lighting programs and target hard to reach markets. In addition, the Phase I (PY2) ratios included conservation voltage reduction programs, which were highly cost-effective but not included in Phase II of Act 129.

4.2 PHASE II TRC AUDIT OVERVIEW

For each program year of Phase II, the SWE reviewed the inputs and outputs of each EDC's TRC model to ensure accurate and consistent calculations of TRC benefits and costs. A detailed discussion of each EDC's TRC audit can be found in the Phase II SWE Annual Reports to the PUC for PY5 and PY6, as well as in Appendix A of this report. The SWE's TRC audit included a review of EDC discount rates, line losses, forecasts of avoided costs, assumed measure lives, incremental costs, and other relevant factors.

4.2.1 Discount Rates and Line Losses

The EDC discount rate and line loss factors (LLFs) are two underlying assumptions that have a considerable effect on the final TRC ratio. The discount rate is used to compare the Net Present Value (NPV) of program benefits that will occur throughout a measure's lifetime with the up-front cost of installation and implementation. LLFs account for the energy lost during transmission and distribution due to electric resistance and adjust electricity savings from the meter level to the generation level of the electric grid.

The SWE Team reviewed the discount rate and line loss assumptions included in each EDC's TRC model to ensure consistency with the approved discount rate and line loss assumptions that were approved in the EDC's Phase II EE&C plan. The SWE concludes that, with minor exceptions, the EDCs consistently and correctly applied their EE&C approved discount rate and line loss assumptions in their respective Phase II TRC models.

4.2.2 Avoided Energy and Capacity Costs

Another critical element in the calculation of TRC benefits is the value of avoided energy and capacity costs. Avoided costs are the savings associated with not having to produce or purchase additional units of electricity. Each EDC established a set of approved avoided costs for Phase II in its respective EE&C plan. Each program year, the SWE sought to confirm that the EDCs used the appropriate avoided cost stream from the avoided costs included in their approved Phase II EE&C Plans. The SWE observed limited instances during Phase II where inaccurate avoided costs were applied in the calculation of TRC benefits, and coordinated with EDCs to produce revised TRC calculation results in these instances.

4.2.3 Other Input Assumptions

The SWE also reviewed, in each program year and for each EDC, measure- and program- specific savings, costs, and measure useful lives. The measure savings review ensured that the TRC models were consistent with individual TRM-specified measure savings values as well as aggregate program and portfolio savings for each program year. The TRC audit also included a review of measure cost assumptions to ensure that reasonable EDC and participant costs were included in the TRC models. During Phase II, the SWE updated the SWE Incremental Cost Database to assist EDCs with a consistent set of incremental cost assumptions across the EDCs. EDCs also used program year invoices and additional sources for incremental cost data. The SWE reviewed these sources for reasonableness and accuracy. Last, the SWE reviewed the assumed measure life assumptions included in the TRC models for consistency with prescribed TRM values to ensure that TRC benefits were calculated throughout the proper lifetime of achieved savings.

Throughout Phase II, the SWE audit confirmed that, with minor exceptions, the EDC models used reasonable and accurate input assumptions.

4.2.4 Output Review

As a final component of the TRC model review, the SWE reviewed the calculations and TRC outputs to ensure consistency with the EDC annual reports. Throughout PY5 and PY6, the SWE occasionally found some minor inconsistencies with the TRC benefits and costs in the EDC TRC models compared with the reported values in the EDC annual reports. Typically, these inconsistencies were minimal (less than 1%) and did not require any immediate action by the EDCs. In PY7, the SWE found no reportable differences between the TRC model outputs compared with the reported values in the annual reports.

5 SWE ANALYSIS OF PHASE II PROGRAM DELIVERY

5.1 INTRODUCTION

This chapter presents the findings of the Phase II SWE analysis of process evaluations and NTG research. It also presents a summary of best practices research conducted by the Phase II SWE and EM&V protocol improvements that have been made based on this research, and emerging concepts for the design of energy efficiency programs.

5.2 PROCESS EVALUATION

5.2.1 Role of Process Evaluation in Phase II

The PA PUC Implementation Order for Phase II of Act 129 identifies the need to "ensure that credible … process evaluations are available for Phase II." The SWE Phase II Evaluation Framework describes the purpose of process evaluation ("to determine if there are ways to alter the program to improve program cost-effectiveness or the program's efficiency in acquiring resources"), identifies ways in which decision-makers can use the results of process evaluations, and describes process evaluation approaches and methodologies. The framework also states two specific process evaluation requirements applying to the EDCs: (1) that each process evaluation have a detailed plan that describes the objectives, sampling plan (for surveys, interviews, or focus groups), research activities, and specific issues to be addressed, along with a schedule of milestones and deliverables; and (2) that every program have at least one process evaluation in every funding cycle or phase.

5.2.2 SWE Analysis of Phase II Process Evaluation

The SWE Team's Phase I final report discussed several lessons learned in Phase I about process evaluations. Observing that more time had been spent in Phase I on laying the "essential impact evaluation foundation" for Act 129 programs than on ensuring consistent and effective process evaluations, the SWE Team identified the need for greater structure in process evaluation activities for Phase II, including the following:

- Follow-up to ensure that EDCs act on evaluation contractors' recommendations
- SWE review of survey methods and instruments to ensure consistency across similar programs and thoroughness of evaluation across portfolios
- Earlier feedback to EDCs on evaluation contractors' process evaluation results
- Clear and consistent process evaluation plans
- Clear and consistent reporting formats, covering both methodology and results

To help lay the groundwork for the additional process evaluation guidance in Phase II, the SWE Team identified several process evaluation best practices. Those best practices addressed the types of data that process evaluations use, how process evaluations are designed, what is included in the evaluation plans, and the need for at least one process evaluation of every program in each phase. The report also summarized the primary types of process evaluation activities: standard comprehensive process evaluation; market characterization and assessment evaluation; topic-specific focused evaluation; early feedback evaluation; and real-time evaluation.

The lessons learned and best practices from the SWE's Phase I final report informed the process evaluation guidance incorporated into the Act 129 Evaluation Framework for Phase II. In addition, the SWE added a firm with nationally recognized process evaluation expertise to its Phase II team, to

oversee the team's process evaluation guidance and conduct the process evaluation audits. Those guidance and audit activities have largely produced the desired results of more comprehensive and consistent process evaluations.

During Phase II the evaluation contractors generally followed the framework's guidelines, such as evaluating each program at least once during the phase. With some exceptions identified in the various SWE final reports, the contractors' evaluations for the EDCs generally followed the evaluation plans and incorporated appropriate sampling approaches, and the annual reports used SWE-prescribed tables, reported findings based on research activities, and included actionable recommendations based on research findings. The reports typically described the methods adequately and presented findings clearly. Again, exceptions are noted in the PY5 and PY6 SWE annual reports.

In nearly all cases, even if the reports followed SWE guidelines and satisfied SWE requirements, the SWE Team identified some areas for improvement. The SWE Team identified considerably more reporting shortcomings for one evaluation contractor than for the others in PY5. The reports from that contractor showed considerable improvements over time, such that the PY7 report was on par with those of the other contractors.

To build on the progress made in Phase II, the SWE Team offers the following additional observations and analyses that suggest areas for continued improvement.

5.2.2.1 Timing of Process Evaluations

The Phase II Evaluation Framework requirement that every program have at least one process evaluation in every funding cycle or phase did a reasonable job of preventing long intervals of time between process evaluations for a given program, even if that program had only one process evaluation in Phase I (PY1–4) and one in Phase II (PY5–7). However, starting in Phase III, each phase will encompass five program years. This means a program could go eight years without a process evaluation if it has one in the first program year of one phase and does not have another until the last program year of the next phase.

The SWE Team recognizes that the TUS should not prescriptively specify the maximum interval that may exist between process evaluations for a given program, as other considerations may take precedence in the timing of process evaluations. However, the SWE Team suggests that the framework or other written guidance should specify that the number of years since the previous evaluation be one of several considerations in determining the timing of process evaluations. Other such considerations should include changes in program design, delivery channels, implementers, measures, or incentive levels; higher- or lower-than-expected savings or participation; and preparation for new program cycles.

5.2.2.2 Tracking the Status of Recommendations

As noted above, one of the key concerns identified in the SWE's Phase I final report was that there should be follow-up to ensure that EDCs act on evaluation contractors' recommendations. For Phase II, the SWE has requested that the evaluation contractors include a table in their annual reports listing the recommendations made to the EDCs and the status of each recommendation—that is, whether the EDC has implemented (or plans to implement) it, is still considering it, or rejected it (and if the latter, the reasons for rejection). For each year of Phase II, the program evaluation contractors have included such a table in the EDC annual reports.

Table 5-1 summarizes the status of the recommendations, as recorded in the annual reports, both across EDCs for each program year and across program years for the EDCs. This table shows a trend toward fewer recommendations made over time and an increase in the percentage of recommendations that the EDCs had implemented, or decided to implement, by the time the annual reports were submitted to the SWE.

Table 5-1: Summary of Status of Recommendations, by EDC and Program Year

	Number of Recommendations	Percent Accepted or Implemented	Percent under Consideration	Percent Rejected
Program Year Totals, across all EDCs				
PY5	445	32%	67%	2%
PY6	362	36%	61%	3%
PY7	175	59%	30%	11%
Phase II Totals, by EDC				
Duquesne	54	0%	78%	22%
FirstEnergy EDCs[a]	213	44%	52%	4%
PECO	81	65%	32%	2%
PPL	634	36%	62%	2%

[a] FirstEnergy's evaluation contractor, ADM, took unified process evaluation approaches across the four FirstEnergy EDCs, and so the annual evaluation reports of the four EDCs show identical or nearly identical information about the process evaluation, including recommendations. The SWE Team therefore presents the status of the recommendations for all FirstEnergy EDCs just once.

The SWE Team notes that, in every year, the Duquesne annual report showed that most of Navigant's recommendations were still under consideration, while substantial percentages of the recommendations made to other EDCs had been accepted. The reason for this is not clear. In PY6, the SWE Team followed up with all EDCs to assess the status of PY5 recommendations that were still under consideration at the time of the PY5 EDC annual reports. That analysis found that Duquesne eventually implemented or planned to implement a large majority (83%) of the Navigant recommendations that previously were still under consideration. Similarly, when the SWE Team followed up with Duquesne to assess the status of the PY7 recommendations for the current report, Duquesne reported that it either planned to implement or already had implemented all of Navigant's recommendations.

The SWE Team followed up with Duquesne to find out why it had not noted acceptance of any Navigant recommendations in time for that to be reflected in the annual reports. The Duquesne contact reported that the company was implementing a full Customer Care and Billing System starting at the end of 2014 and continuing into 2016. That activity drew much of the company's resources. Therefore, for the annual reports, the company stated that recommendations were under consideration rather than committing to any recommendation and then later delaying implementation because the resources were not available.

A contact for Duquesne's evaluation consultant, Navigant, has noted that it should not matter whether the EDC annual report for a given program year identifies a given recommendation as accepted. The report appears in the middle of the following program year, so any recommendations in that report could not influence any major implementation decisions in that new program year. The SWE Team understands this point, but does not agree with it. First, a key purpose of EDC reporting to the PUC the status of recommendations and the EDCs' responses to them is to show whether the evaluation contractors have provided clear and actionable recommendations and that the EDCs have given them

due consideration. Second, it is the view of the Phase II SWE Team that evaluation recommendations that can improve the efficiency and effectiveness of a program can most often be implemented at any time, not just at the beginning of a program year.

Therefore, the SWE Team recommends that the TUS and the SWE Team for Phase III consider developing guidance to ensure that all EDCs have or take adequate time to review and make decisions on their evaluation contractors' recommendations prior to the deadline for the annual reports.

5.2.3 Results for Program Year 7 (2015–2016)

5.2.3.1 Statewide Summary of Process Evaluation Activities

The PY7 process evaluations that the evaluation contractors conducted for the EDCs varied in extent. The evaluation framework requires process evaluations be conducted for each program at least once per phase; some PY6 evaluations addressed programs not addressed in PY7 or conducted assessment activities not conducted subsequently.

The evaluations for PECO and PPL covered multiple programs in each sector. The process evaluation for Duquesne covered multiple residential programs, including the low-income program, and one combined evaluation of C/I programs. The least extensive scheduled PY7 evaluations were those for the FirstEnergy EDCs, which included separate evaluations of two residential programs and one combined evaluation of two non-residential programs. All evaluation contractors generally followed their respective PY7 evaluation plans (with a few exceptions, as noted below).

Most evaluations incorporated data from multiple sources, generally including a review of key program documents and databases, participant surveys, key market actor interviews or surveys, and program staff interviews. Some evaluations also included data from nonparticipant or general population surveys. Table 5-2 summarizes the SWE Team's statewide findings of the process evaluations.

Table 5-2: PY7 – Summary of SWE Process Evaluation Findings

SWE Evaluation Report Guideline	SWE Findings
Consistent with evaluation plan	Yes, with very few exceptions for PPL (exceptions noted in PPL annual report)
Methods clearly explained	Yes, with some exceptions for PPL and FirstEnergy EDCs
Sampling approach appropriate	Yes, for all EDCs (to the extent known*)
Key findings provided	Yes, for all EDCs
Actionable, fact-based recommendations provided	Yes, for all EDCs, with minor exceptions
SWE Suggested Reporting Improvements**	
– When reporting response differences between subgroups, indicate whether the differences were statistically significant, and according to what test. – Provide additional insights, when possible, into causes for programs struggling to meet targets. – Where possible, connect recommendations to general conclusions based on multiple findings rather than single findings. – Restrict the number of recommended actions identified in each recommendation.	
NOTES: *ADM/Tetra Tech team, the evaluation contractor for FirstEnergy, did not identify the number of trade allies interviewed for	

two programs.
**Not all suggestions are applicable to all reports.

The various EDCs' evaluation contractors identified a total of 198 key findings. Findings were largely program-specific, providing few data on statewide trends, except in three topic areas. Foremost among those areas was program satisfaction, the single most common topic for findings (36). In nearly all cases, the finding was one of acceptably high program satisfaction among customers and/or market actors. Two other topic areas—efforts related to program success and residential uptake of efficient lighting—had sufficiently consistent bodies of findings to have statewide significance.

Seven findings identified program efforts that helped promote program success. All seven were related either to undertaking special program outreach efforts or to expanding the number of market partners involved in program implementation. Two of those findings specifically cited "limited time offer" marketing or incentive campaigns; one identified targeted marketing and personalized outreach efforts in a school program; two identified an increase in the number of Customer Assistance Program (CAP) agencies distributing energy efficiency kits; one cited identifying and requalifying committed trade allies; and one identified the use of an online application and toll-free number.

Five findings identified specific weaknesses in program outreach (lack of tailoring of program messaging to household characteristics, lack of a clear call to action); lack of effect or a decreased effect of a specific outreach approach (postcards, limited-time higher incentives); or lack of program awareness or the need (according to participants) for more advertising.

Seven findings were related to increased residential uptake of efficient lighting. Four of those findings pointed to increased uptake of light emitting diode (LED) lighting and specifically identified high percentages of LEDs in tenant units, high tenant satisfaction with LEDs, increased awareness and use of LEDs in the general customer population, and increased LED shelf space, at the expense of CFL shelf space.

While a higher number of findings were related to reasons for lack of program success, those findings varied considerably and were generally program-specific. A handful of the findings pointed to implementation- or process-related barriers (implementation delays, infrequent updates of program planning materials, lack of a means to offer more comprehensive projects, long project completion times, the need to obtain a permit from the Pennsylvania Department of Environmental Protection (DEP) for certain projects, and rigidity of prescriptive incentive paths). Other findings pointed to external barriers to success; three findings cited high initial cost for three, and four findings were program-specific (bankruptcy of the appliance recycling implementer, a smaller-than-expected target population, customer distrust, feeling "shamed" by home energy reports (HERs), and difficulty obtaining commitment from project stakeholders).

Several other findings addressed such perennial issues as dissatisfaction with incentive amounts or processing time; the need for trained trade allies; paperwork requirements; participants' lack of recall of program offerings or recommendations; and challenges in identifying eligible program participants.

Process evaluation activities and findings for each EDC are discussed in more detail in Appendix B.

5.2.4 Results for Three-Year Act 129 Phase II

5.2.4.1 Duquesne Light

5.2.4.1.1 Process Evaluation Key Findings from Phase II

Across all demand-side management (DSM) programs, Duquesne exceeded its savings goals for Phase II by saving more than 370,000 MWh across the program years. Savings came from across the portfolio of programs, with some programs meeting or exceeding their specific goals whereas others did not meet their goals. Some of the largest programs, such as the Residential Energy Efficiency Program (REEP), commercial-sector upstream lighting, and commercial program work in the office-building sector, exceeded their goals noticeably. Other programs, such as the School Energy Pledge (SEP) and Whole House Energy Audit Program (WHEAP), did not meet their specific Phase II goals. Navigant identified reasons why those programs did not meet their goals. For example, during Phase II Duquesne elected to replace SEP with a new program in Phase III and therefore did not emphasize SEP.

Across all programs, participants were generally satisfied, and a handful of participants in each program offered insights or suggestions for how to improve the program. These suggestions typically revolved around issues such as increasing awareness of programs or improving specific elements of the program, such as offering larger refrigerators in the Refrigerator Replacement component of the EDC's program. No large-scale program improvements were noted by participants or program staff other than replacing SEP, because the market for SEP had been saturated in Phase II.

5.2.4.1.2 SWE Team Review of Process Evaluation

All Phase II evaluations (PY5, PY6, PY7) followed the evaluation plan. The random sampling for participant and nonparticipant surveys was appropriate, as was the purposive sampling used for staff and implementer interviews. Across the Phase II evaluations, Navigant did the following:

- Followed the evaluation plan's guidelines and activities.
- Evaluated each program at least once across Phase II.
- Used SWE-prescribed tables in the report.
- Described its methods adequately.
- Provided a summary of evaluation findings.
- Reported findings based on research activities.
- Created actionable recommendations based on research findings.

Overall, Navigant followed the SWE guidelines for evaluating Duquesne's programs. The SWE provides the following issues that were noted in more than one of the Phase II SWE reports. The associated suggestions will make the reporting stronger in Phase III.

- As noted in the PY6 SWE report and the PY7 SWE analysis in this document, Navigant generated recommendations based on findings rather than generating broader *conclusions* that relied on multiple sources of information. Taking the intermediary step of generating a conclusion based on multiple findings (ideally from multiple sources, possibly from multiple years) can lead to stronger recommendations.
- In some cases, Navigant discussed separate findings for two groups in a manner that seemed to imply a comparison but did not report statistical significance for the differences. Navigant clarified that the purpose was not to compare or contrast the groups, as the samples were too small to

reveal statistically reliable differences, but to show the findings separately for each group. The SWE Team understands and appreciates this distinction and suggests that Navigant make that point explicit in such cases.

- The PY6 SWE report and the PY7 SWE analysis in this document describe a few instances where the SWE Team found Navigant's discussion of sample sizes confusing. The confusion may relate to lack of a clear explanation of when Navigant was referring to counts of *respondents* and counts of *responses* or to when and how the count for a given analysis was based on a subset formed from the result of a previous analysis. The SWE Team has brought these instances to Navigant's attention and is seeking to clarify the source of confusion.
- The PY5, PY6, and PY7 reports do not provide details about the sample generation, the contact protocols, and a disposition summary of calls. These details, as suggested in the PY5 SWE report, "help the reader judge the adequacy of the research" and so would enhance future reporting. The Framework section 4.4.3 requires transparency in reporting about "the reasons the approach was selected, the sample, the questions used, and the methods used…."

Addressing the above issues will make the reporting stronger in Phase III.

5.2.4.2 Metropolitan Edison

5.2.4.2.1 Process Evaluation Key Findings from Phase II

FirstEnergy implemented a common set of DSM programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn. FirstEnergy's evaluation contractors, ADM/Tetra Tech, used the same evaluation approaches and identified the same findings and recommendations for all four EDCs.

Across all DSM programs, all four FirstEnergy EDCs exceeded each of their savings goals for Phase II. Savings came from across the portfolio of programs, with some programs meeting or exceeding their specific goals whereas others did not meet their goals. Some of the largest programs, such as the residential Products and Home Performance programs and the non-residential Efficient Equipment Program (Large), consistently exceeded their goals. Other programs, such as the residential Appliance Turn-In and non-residential Energy Efficient Buildings programs, fell short of their specific Phase II goals.

Across the four EDCs' programs, participants were generally satisfied. Contractors and other trade allies were also generally satisfied, but they commonly found handling program paperwork challenging. No large-scale program improvements were noted by participants or program staff in Phase II.

5.2.4.2.2 SWE Team Review of Process Evaluation

ADM/Tetra Tech conducted Phase II process evaluations generally following the evaluation plan. The data-collection methodologies, including sampling strategies, were appropriate and adequately documented. The reports generally included valuable process findings. ADM/Tetra Tech adequately followed the SWE guidelines for evaluating FirstEnergy's programs during Phase II and performed the following:

- Followed the evaluation plan's guidelines and activities.
- Evaluated each program at least once across Phase II.
- Used SWE-prescribed tables in the report.
- Described its methods adequately.
- Provided a summary of evaluation findings.
- Reported findings based on research activities.

- Created actionable recommendations based on research findings.

Although ADM/Tetra Tech adequately fulfilled the evaluation requirements, the SWE found the following notable issues that should be addressed in Phase III evaluations:

- A few elements of evaluation activities outlined in the evaluation plan were not included in the reports. For instance, the plan stated conducting benchmarking review for some residential programs and surveys of nonparticipating trade allies during PY5 and PY6, but the reports did not mention any of these activities. The SWE recommends that any significant deviations from the plan be justified.
- Across the PY5–PY7 reports, discussions of sampling approaches for surveys as well as interviews often lacked sufficient justifications or details. Some additional methodology details would be valuable. The SWE recommends that sampling methodology for each data-collection activity clearly discuss (1) the sizes of the population and completed sample and (2) sufficient sampling details, such as random, stratified random, or purposive sampling, that enable replication of the methodology.
- Most process evaluation findings were based on the total sample across the four FirstEnergy EDCs, and the reports largely provided an identical set of findings across the four EDCs, while these EDCs produced different levels of program savings for different programs. The SWE recommends that the evaluation identify some unique issues that each EDC faces.

5.2.4.3 Pennsylvania Electric

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penelec, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation in each year. Therefore, the SWE Team's audit summary described in Section 5.2.4.2 pertains to all four FirstEnergy EDCs, including Penelec.

5.2.4.4 Pennsylvania Power

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penn Power, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation in each year. Therefore, the SWE Team's audit summary described in Section 5.2.4.2 pertains to all four FirstEnergy EDCs, including Penn Power.

5.2.4.5 West Penn Power

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including West Penn Power, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation in each year. Therefore, the SWE Team's audit summary described in Section 5.2.4.2 pertains to all four FirstEnergy EDCs, including West Penn Power.

5.2.4.6 PECO Energy

5.2.4.6.1 Process Evaluation Key Findings from Phase II

Across all DSM programs, when accounting for cumulative portfolio savings that include carry-over savings from Phase I, PECO exceeded the energy savings compliance target. Savings came from across the portfolio of programs, with some programs meeting or exceeding their specific goals whereas others

did not meet their goals. Some of the largest programs, such as Smart Home Rebates (SHR), exceeded their goals noticeably. Other programs, such as Smart Appliance Recycling (SAR), did not meet their specific Phase II goals. For example, JACO's bankruptcy during Phase II, which interfered with the delivery of participant rebates, was responsible for SAR failing to reach its PY7 and Phase II goals. Navigant identified reasons why programs exceeded or did not meet their goals.

Across all programs, participants were generally satisfied. Participant feedback on PECO's programs provided insights into the efficiency of the program delivery and opportunities for improvement. The latter revolved around issues such as increasing cross promotion of PECO programs and ways to simplify program delivery. A decline in satisfaction was noted among the 10% of SAR's PY7 participants impacted by JACO's bankruptcy.

5.2.4.6.2 SWE Team Review of Process Evaluation

The SWE Team's review found that the PY5, PY6, and PY7 evaluations were consistent with Navigant's Phase II evaluation plan. The random sampling for participant and nonparticipant surveys was appropriate, as was the purposive sampling used for staff, implementer, and market actor interviews. Across the Phase II evaluations, Navigant did the following:

- Followed the evaluation plan's guidelines and activities.
- Evaluated each program at least once across Phase II.
- Used SWE-prescribed tables in the report.
- Described its methods adequately.
- Provided a summary of evaluation findings.
- Reported findings based on research activities.
- Created actionable recommendations based on research findings.

The PY5, PY6, and PY7 annual evaluation reports and supporting documentation generally provided a comprehensive overview of the process evaluation key findings and recommendations. Additionally, the PY7 report, compared with the PY5 and PY6 reports, included more detail on data gathered from interviews with market actors and program and implementer staff across various programs.

Two issues were noted in more than one SWE report across Phase II:

- As noted in the PY6 SWE report and the PY7 SWE analysis in this document, many recommendations were drawn from key findings rather than from conclusions. Taking the intermediary step of generating a conclusion based on multiple key findings can lead to stronger recommendations.
- The PY6 SWE report and the PY7 SWE analysis in this document note that Navigant did not report statistical significance when describing differences in groups. Providing statistical assessments would help the reader better understand the scale of noted differences, as well as explicitly noting when sample sizes are too small to conduct statistical assessments."

Addressing the above issues will make the reporting stronger in Phase III.

5.2.4.7 PPL

5.2.4.7.1 Process Evaluation Key Findings from Phase II

Across all DSM programs and pilots, PPL achieved 145% of its planned energy savings for Phase II, including carry-over savings from Phase I. Savings came from across the portfolio of programs, with

most programs exceeding the estimates identified in the EE&C Plan and a few programs slightly below the EE&C Plan estimates. Cadmus identified reasons why those programs did not meet their estimates.

Across all programs, participants were satisfied, and a handful of participants in each program offered insights or suggestions for program improvements. These suggestions typically revolved around improving specific elements of the program, such as the applications, workshops, or program offerings. Program staff did not report any substantial program changes for Phase II but did note some changes for Phase III.

The Master Metered Low-Income Multifamily Housing Program will not continue as a stand-alone program in Phase III; however, all multifamily buildings (both low income and market rate) are eligible to participate in the Phase III program offerings. Two pilots, the De Facto Heating Pilot (a component of the PY7 WRAP program) and the Wise Homes Pilot (a component of the PY7 E-PowerWise Program) will not continue or be mainstreamed in Phase III due to a variety of reasons, including cost per annual kWh saved. However, PPL will offer elements of the latter pilot as part of the Manufactured Home Park Initiative under the WRAP program. Offered measures will include LEDs and water measures (as offered by WRAP to all participants), as well as limited air sealing (without a blower door test or leakage assessment, as was done in the pilot).

5.2.4.7.2 SWE Team Review of Process Evaluation

All Phase II evaluations (PY5, PY6, PY7) followed the evaluation plan, with very few exceptions. The random sampling for participant and nonparticipant surveys, and the purposive sampling used for staff and implementer interviews, was appropriate, even though Cadmus was not able to achieve planned sample sizes for some survey efforts. Cadmus provided explanations where planned sample sizes were not achieved. Across the Phase II evaluations, Cadmus did the following:

- Followed the evaluation plan's guidelines and activities, with very few exceptions.
- Evaluated each program at least once across Phase II.
- Used SWE-prescribed tables in the report, with some exceptions for PY5.
- Described its methods adequately, with a few exceptions in PY5 that were addressed in PY6 and PY7.
- Provided a summary of evaluation findings.
- Reported findings based on prescribed research questions and activities.
- Created actionable recommendations based on research findings and conclusions.

Cadmus implemented most of the SWE Team's recommendations and improved its reports in each successive year. The SWE Team did not identify any issues that were present across multiple Phase II reports. Addressing the SWE Team's few recommendations from the PY7 audit will make the reporting stronger in Phase III.

5.3 NET-TO-GROSS RESEARCH TO SUPPORT PROGRAM DESIGN

5.3.1 Purpose of Net-to-Gross Research

The Phase II PA PUC Implementation Order specifies that in Phase II of Act 129, as in Phase I, compliance is based on meeting energy and demand reduction targets on gross verified savings. However, the PUC order also states that the EDCs should continue to use net verified savings to inform program design and implementation.

Net savings are gross savings minus free-ridership plus spillover, where free-ridership is the savings that would have occurred even without the program, and spillover is additional non-incented savings that occurred because of program influence. The ratio of net savings to gross savings is the net-to-gross ratio (NTGR), which is equal to 1 – FR + SO, where FR and SO represent free-ridership and spillover, each expressed as a proportion of gross savings.
This section summarizes the results from the EDCs' NTG research, and the SWE Team's determination of how closely the EDCs' NTG evaluations aligned with the SWE guidelines.

5.3.2 SWE Analysis of Phase II Net-to-Gross Reporting

The Evaluation Framework states that NTG research should be conducted "to direct Act 129 program design and implementation" and provides detailed guidance on how NTG research should be conducted. For Phase II, the SWE Team introduced a common method for NTG estimation for downstream programs to help ensure consistent assessment of NTG across EDCs and programs. Since the evaluation contractors relied on this method—and typically executed it well—the NTG results across the EDCs are quite comparable, allowing for analysis of intra- and inter-EDC trends. Portfolio-level NTG ratio (NTGR) decreased over Phase II for four EDCs (including three of the FirstEnergy EDCs), increased for one EDC, and showed no trend for two EDCs.

The SWE Team has identified two additional areas in which further TUS and SWE guidance may be valuable in Phase III.

5.3.2.1 Comprehensiveness of NTG Research

The Evaluation Framework does not explicitly state that NTG research must be conducted for each program, nor does it state how often it must be conducted for a given program. This lack of specificity has led to some differences of understanding between the SWE Team and EDC evaluation contractors regarding the expectations for NTG research.

The SWE Team believes that NTG research should be performed every year for high-impact programs (as defined by the Phase III SWE) and at least every three years for all other programs, unless an evaluation plan provides an acceptable reason not to conduct NTG research for a given program in a given year. The SWE Team understands that the new guidance in the Phase III framework is consistent with this perspective.

5.3.2.2 Assumption of an NTG Ratio of 1.0

The Phase II Evaluation Framework specified that the EDCs' evaluation contractors should conduct NTG research "to inform program design and program planning." In PY6 and PY7, evaluation contractors assumed an NTGR of 1.0 for most low-income programs as well as for some other residential and non-residential programs, under the rationale that the energy efficient measures were distributed at no cost to the recipients. The Phase II framework did not specify that any types of programs were exempt from NTG research—in fact, the framework identified the type of research often used for low-income programs—and therefore the SWE Team stated its disagreement with the evaluation contractors' reasoning. Research conducted by SWE Team members in other jurisdictions indicates that the NTGR for low-income programs is often different from 1.0.

The SWE Team understands that the TUS does not believe that NTG research in the low-income sector is a priority. Moreover, there are some conditions under which NTG research may be inappropriate or unwarranted even in programs outside the low-income sector. The framework or other written

guidance should identify the reasons for which NTG research may be waived. Such reasons may include, but are not necessarily limited to, the following:

- The EDC is discontinuing the program.
- The program represents a very low percentage of sector-level savings.
- The program has a very small population, making it difficult to develop a statistically reliable sample.

However, no-cost delivery of measures should not justify the assumption of no free-ridership in programs outside the low-income sector. The fact of how the participants got the measures through the program is independent of how they *would have* gotten them if there had been no program.

5.3.3 Results for Program Year 7 (2015–2016)

5.3.3.1 Summary of NTG Results

Table 5-3 summarizes the portfolio-level free-ridership, spillover, and NTGRs reported by the EDCs in their PY7 annual reports. The EDCs estimated their portfolio-level NTGRs by weighting the program-level NTGRs by program savings. Reported results were fairly consistent across the EDCs, with most free-ridership estimates ranging from 0.32 to 0.39, most spillover estimates ranging from 0.01 to 0.06, and all NTGRs ranging from 0.60 to 0.76. Penn Power and PECO had the lowest portfolio-level NTGRs.

Table 5-3: PY7 Portfolio Net-to-Gross Ratios by EDC

EDC	Free-Ridership	Spillover	NTGR[a]
Duquesne	0.32	0.06	0.74
FE: Met-Ed	0.39	0.06	0.67
FE: Penelec	0.34	0.06	0.71
FE: Penn Power	0.49	0.09	0.60
FE: West Penn	0.34	0.06	0.72
PECO	0.39	0.01	0.62
PPL	0.24	0.00	0.76

NOTE:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.

Although comparison across EDCs is challenging because of differences in the way EDCs package their program offerings, it appears that the 0.60 NTGR for Penn Power may have been driven by NTGR values in the C/I small business segment, while the 0.62 NTGR for PECO may have been driven by NTGR values for the residential Smart Home Rebates program, as well as for commercial new construction and for the GNI sector overall.

5.3.3.2 Summary of NTG Audits for Each EDC

Table 5-4 summarizes the SWE Team's findings regarding the EDCs' use of common NTG methods. In cases in which common methods are required, all EDCs either used the common methods or used them with acceptable modifications. Some EDCs also used other acceptable methods for program types for which the SWE Team did not establish a common method. All evaluation contractors provided NTG data for all programs evaluated in PY7 (where primary data were collected), with one exception: the

evaluation contractors did not consistently provide the underlying calculations that combined strata-level values into reported program-level values.

Table 5-4: Summary of SWE Findings on the Application of NTG Methods by EDCs

EDC	NTG Data and Documents Available?	Common NTG Methods Used?	Common NTG Methods Applied Correctly?
Duquesne	Yes, with noted exceptions	Yes, with acceptable modifications	Yes
FirstEnergy EDCs[a]	Yes, with noted exceptions	Yes, with few exceptions	Yes
PECO	Yes, with noted exceptions	Yes	Yes
PPL	Yes, with noted exceptions	Yes, with acceptable modifications	Yes

NOTE:
[a] The evaluation contractor for FirstEnergy applied the same NTG methods for all four FirstEnergy EDCs.

5.3.3.3 Summary of NTG by Sector

Table 5-5 shows the EDCs' NTGR calculations across sectors. In the residential sector, program-specific NTGRs ranged from 0.26 to 0.99. In the low-income sector, in three PPL low income programs the evaluation contractor assumed a program-specific NTGR of 1.00 for three low-income programs (one whose impact evaluation methodology generates net savings and two that provide measures to customers seeking help paying electric bills). The good news is that following the Phase II SWE Team's PY6 recommendation, all EDCs performed NTG studies on their low-income programs for the first time. In the non-residential sector, program-specific NTGRs ranged from 0.39 to 0.89 (with the exception of one program for which the evaluation contractor assumed an NTGR of 1.00).

Table 5-5: PY7 Net-to-Gross Ratios by Sector and Program – All EDCs

EDC	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Residential Sector					
Duquesne	Residential Energy Efficiency Program (REEP)	0.54	0.23	0.69	99
	Residential Appliance Recycling Program (RARP)	0.72	0.04	0.32	109
	Residential Home Energy Report (HER) Program	N/A	N/A	N/A	N/A
	School Energy Pledge Program (SEP)	0.31	0.19	0.87	27
	Whole House Energy Audit Program (WHEAP)	0.33	0.06	0.73	22
FE: Met-Ed	Appliance Turn-In	0.75[c]	0.00	0.26	71

EDC	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
	Energy Efficient Products	0.38	0.05	0.67	137
	Home Performance	0.36	0.06	0.70	N/A
FE: Penelec	Appliance Turn-In	0.66[c]	0.00	0.34	59
	Energy Efficient Products	0.38	0.02	0.65	131
	Home Performance	0.34	0.04	0.70	N/A
FE: Penn Power	Appliance Turn-In	0.59[c]	0.00	0.42	52
	Energy Efficient Products	0.36	0.02	0.67	101
	Home Performance	0.40	0.10	0.70	N/A
FE: West Penn	Appliance Turn-In	0.69[c]	0.00	0.31	66
	Energy Efficient Products	0.38	0.01	0.63	131
	Home Performance	0.02	0.01	0.99	N/A
PECO	Smart Home Rebates (SHR)	0.49	0.03	0.54	542
	Smart House Call	0.13	0.07	0.94	130
	Smart Builder Rebates (SBR)	0.50	0.00	0.50	7
	Smart Appliance Recycling (SAR)	0.50	0.00	0.50	140
	Smart Multi-Family (SMF) Solutions Program	0.43	0.01	0.59	48
	Smart AC Saver – Residential	N/A	N/A	N/A	N/A
PPL	Residential Retail Program[c]	0.39	0.00	0.61	84
	Appliance Recycling Program (ARP)	0.40	0.00	0.60	N/A
	Residential Home Comfort	0.42	0.04	0.61	224
	Student and Parent Energy-Efficiency Education Program	N/A	N/A	1.0	N/A
	Residential Energy-Efficiency Behavior & Education Program	N/A	N/A	1.0	N/A
Low-Income Sector					
Duquesne	Low-Income Energy Efficiency Program (LIEEP)	0.26	0.10[c]	0.83[c]	162[c]

EDC	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
FE: Med-Ed	Low-Income	0.33	0.16	0.83	43
FE: Penelec	Low-Income	0.26	0.09	0.82	44
FE: Penn Power	Low-Income	0.28	0.17	0.89	46
FE: West Penn	Low-Income	0.27	0.17	0.90	46
PECO	Low-Income Energy Efficiency Program (LIEEP)	0.19	0.00	0.81	90
PPL	E-Power Wise	N/A	N/A	1.00	N/A
	Low-Income Energy Efficiency Behavior & Education	N/A	N/A	1.00	N/A
	Low-Income Winter Relief Assistance Program (WRAP)	N/A	N/A	1.00	N/A
Non-Residential Sector					
Duquesne	Commercial Program Group	0.33[d]	0.00	0.67	38
	Industrial Program	0.32	0.00	0.68	18
FE: Med-Ed	Small C/I Equipment	0.45	0.11	0.66	N/A
	Large C/I Equipment	0.34	0.05	0.72	N/A
	Small C/I Buildings	0.32	0.01[c]	0.69	122
	Large C/I Buildings	0.62	0.00	0.39	11
	Government and Institutional	0.38	0.11	0.73	N/A
FE: Penelec	Small C/I Equipment	0.38	0.12	0.75	N/A
	Large C/I Equipment	0.26	0.07	0.81	N/A
	Small C/I Buildings	0.36	0.00	0.64	73
	Large C/I Buildings	0.50	0.00	0.50	5
	Government and Institutional	0.38	0.11	0.73	N/A
FE: Penn Power	Small C/I Equipment	0.68	0.13	0.44	N/A
	Large C/I Equipment	0.33	0.11	0.78	N/A
	Small C/I Buildings	0.55	0.00	0.45	16

EDC	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
	Large C/I Buildings	0.50	0.00	0.50	1
	Government and Institutional	0.38	0.11	0.73	N/A
FE: West Penn	Small C/I Equipment	0.39	0.10	0.72	N/A
	Large C/I Equipment	0.35	0.08	0.73	N/A
	Small C/I Buildings	0.40	0.00	0.60	83
	Large C/I Buildings	0.52	0.00	0.48	9
	Government and Institutional	0.38	0.11	0.73	N/A
PECO	Smart Equipment Incentives (SEI) – C/I	0.37	0.01	0.64	51
	Smart Equipment Incentives (SEI) – GNI	0.58	0.01	0.43	35
	Smart Construction Incentives (SCI)	0.48	0.00	0.52	N/A
	Smart Multi-Family (SMF) Solutions Program	0.38	0.00	0.62	22
	Smart AC Saver – Commercial	N/A	N/A	N/A	N/A
	Smart On-Site (SOS)	0.11	0.00	0.89	6
	Smart Business Solutions (SBS)[e]	0.10	0.00	0.90	N/A
PPL	Prescriptive Equipment Program	0.23	0.00	0.77	77
	Custom Incentive Program	0.39	0.00	0.61	21
	School Benchmarking	NS	NS	NS	NS
	Master Metered Low-Income Multifamily (MMMF) Program	N/A	N/A	Not reported	N/A
	Continuous Energy Improvement (CEI) Program	0.00	0.00	1.00	23

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] N/A denotes programs for which no sample was collected to estimate NTGR. NS denotes programs for which no savings are claimed.
[c] Program-level NTGR combines downstream and upstream NTG values. Downstream NTGR was estimated from surveys with 84 participants. Upstream NTGR was estimated using sales data.
[d] Denotes misprinted value in the PY7 annual report. The value reported in this table is the actual value.
[e] No NTGR research was performed for this program in PY7. The PY7 report provided NTGR data estimated by the PY5 evaluation.

The distribution of NTGRs was somewhat tighter for non-residential than for residential programs. To illustrate this point, while the mean NTGR across residential programs (0.60) was similar to that for non-residential programs (0.64, excluding the program where NTGR was assumed to 1.00), the standard deviation for residential programs (0.20) was half again as great as that for non-residential programs (0.13). Simply put, two-thirds of residential programs had standard deviations that fell within a range of 0.40 to 0.80, while a comparable proportion of the non-residential programs had standard deviations within a smaller range of about 0.50 to 0.77.

Among residential programs, appliance recycling programs tended to have a lower NTGR (mean = 0.38) and rebate programs a comparatively higher NTGR (mean = 0.69). These differences are largely a function of free-ridership, as spillover was typically low in both types of programs. In the non-residential sector, differences in how EDCs package their program offerings make it harder to detect trends among program types.

Evaluation contractors assumed an NTGR of 1.0 for most low-income programs as well as for three residential programs that were not low-income and for one non-residential program. The Evaluation Framework does not specify any conditions under which EDCs and their evaluation contractors may assume an NTGR of any specific value for any program, including low-income programs. The SWE questioned evaluation contractors' assumption of an NTGR of 1.0 for low-income programs in the PY6 report and continues to assert that the assumption is not justified.

There may be circumstances in which it is reasonable to assume lack of free-ridership (the primary factor driving the NTGR). This may be the case for one residential and one non-residential program with an assumed NTGR value of 1.0 that were demand curtailment programs. In those cases, the evaluation contractor indicated that there would be no motive to curtail demand without the program.

In the case of the two other residential non-low-income programs, the SWE Team does not agree with the assertion that assuming an NTGR of 1.0 was justified because the energy efficient measures were distributed at no cost to the recipients. It is possible that some of the program participants would have installed the measures even if they had not received them through the program. Therefore, the fact that the measures were distributed at no cost to the recipient does not ensure that there were no free-riders.

5.3.4 Results for Three-Year Act 129 Phase II

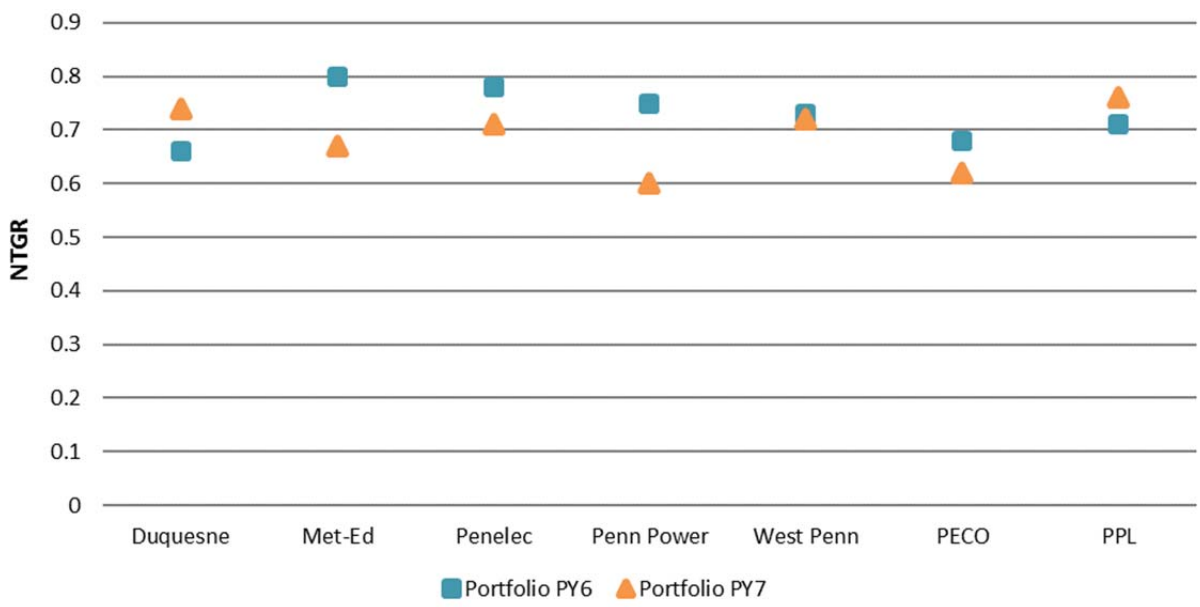
This section shows each EDC's program-specific NTGRs for PY5, PY6, and PY7 and notes trends across the program years.

Figure 5-1 illustrates the portfolio NTGRs for each ECD for PY6 and PY7. Duquesne and PPL show a modest increase in portfolio NTGR from PY6 to PY7 (8 and 5 percentage points, respectively), West Penn Power shows no change, and the remaining four EDCs show decreases ranging from 6 to 15 percentage points.

Two changes in evaluation methods influenced portfolio PY7 NTGRs. One, the gross savings methodology for the appliance recycling programs changed in the 2015 TRM to eliminate add-backs for

replacement appliances. This change tends to yield a higher gross impact and a lower NTGR.[23] Two, most of the NTGRs for the low-income programs were lower in PY7 than in PY6, for which the NTGR had been assumed by most EDCs to be 1.0.[24]

Figure 5-1: Portfolio NTGR for PY6 and PY7, by EDC



5.3.4.1 Duquesne Light Phase II NTG Summary

Table 5-6 shows Duquesne's Phase II NTGRs by program year. Despite intra-program variation, portfolio-level NTGR increased steadily throughout Phase II.

Table 5-6: Duquesne's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Residential Energy Efficiency Program (REEP)	0.56	0.69	0.69
	Residential Appliance Recycling Program (RARP)	0.47	0.64	0.32
	Residential Home Energy Report (HER) Program	*	*	N/A
	School Energy Pledge Program (SEP)	0.85	0.92	0.87
	Whole House Energy Audit Program (WHEAP)	*	0.84	0.73
Low-Income	Low-Income Energy Efficiency Program	0.54	0.76	0.81

[23] The NTGRs for appliance recycling declined from PY6 to PY7 for Duquesne and Met-Ed by over 32 percentage points and for Penelec and Penn Power by about 13 percentage points. The NTGRs for the West Penn Power and PECO appliance recycling programs remained unchanged and the NTGR for PECO increased in PY7 by 15 percentage points.

[24] The NTGRs for the low income programs of the FirstEnergy EDCs and PECO fell in PY7 to values of ranging from 0.81 to 0.90 from the PY6 assumed value of 1.0. Duquesne's low income NTGR rose in PY7 to 0.81 from a PY6 estimate of 0.76. PPL's low income NTGR remained unchanged at the assumed value of 1.0.

Sector	Program	PY5	PY6	PY7
	(LIEEP)			
Non-Residential	Commercial Program Group	0.52	*	0.67
	Industrial Program	0.24	*	0.68
	Small Commercial Direct Install (SCDI) Program	*	0.99	*
	Multifamily Housing Retrofit (MFHR) Program	*	0.95	*
Portfolio		**0.55**	**0.66**	**0.74**

NOTE:
*Denotes that no NTGR research was conducted in that year.

5.3.4.2 Metropolitan Edison Phase II NTG Summary

Table 5-7 shows Met-Ed's Phase II NTGRs by program year. Met-Ed did not conduct any NTG evaluation activities during PY5. Most programs experienced a drop in NTGR from PY6 to PY7, which resulted in a lower portfolio-level NTGR in PY7. The change in evaluation methodologies for appliance recycling and low income (see text associated with Figure 5-1), as well as first-time NTGR estimates in PY7 for two programs, contributed to the decrease.

Table 5-7: Met-Ed's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Appliance Turn-In	*	0.57	0.26
	Energy Efficient Products	*	0.65	0.67
	Home Performance	*	0.89	0.70
Low-Income	Low-Income	*	1.00	0.83
Non-Residential	Small C/I Equipment	*	0.71	0.66
	Large C/I Equipment	*	0.73	0.72
	Small C/I Buildings	*	*	0.69
	Large C/I Buildings	*	*	0.39
	Government and Institutional	*	0.73	0.73
Portfolio		*	**0.80**	**0.67**

NOTE:
* Denotes programs/NTGRs that were not included in a given annual report.

5.3.4.3 Pennsylvania Electric Phase II NTG Summary

Table 5-8 shows Penelec's Phase II NTGRs by program year. Penelec did not conduct any NTG evaluation activities during PY5. There was considerable intra-program NTGR variation from PY6 to PY7, leading to a lower portfolio-level NTGR in PY7. The change in evaluation methodologies for appliance recycling and low income (see text associated with Figure 5-1), as well as first-time NTGR estimates in PY7 for two programs, contributed to the decrease.

Table 5-8: Penelec's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Appliance Turn-In	*	0.49	0.34

Sector	Program	PY5	PY6	PY7
	Energy Efficient Products	*	0.54	0.65
	Home Performance	*	0.87	0.70
Low-Income	Low-Income	*	1.00	0.82
Non-Residential	Small C/I Equipment	*	0.75	0.75
	Large C/I Equipment	*	0.80	0.81
	Small C/I Buildings	*	*	0.64
	Large C/I Buildings	*	*	0.50
	Government and Institutional	*	0.57	0.73
Portfolio		*	**0.78**	**0.71**

NOTE:
* Denotes programs/NTGRs that were not included in a given annual report.

5.3.4.4 Pennsylvania Power Phase II NTG Summary

Table 5-9 shows Penn Power's Phase II NTGRs by program year. Penn Power did not conduct any NTG evaluation activities during PY5. There was considerable intra-program NTGR variation from PY6 to PY7, leading to a lower portfolio-level NTGR in PY7. The change in evaluation methodologies for appliance recycling and low income (see text associated with Figure 5-1), as well as first-time NTGR estimates in PY7 for two programs, contributed to the decrease.

Table 5-9: Penn Power's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Appliance Turn-In	*	0.53	0.42
	Energy Efficient Products	*	0.57	0.67
	Home Performance	*	0.88	0.70
Low-Income	Low-Income	*	1.00	0.89
Non-Residential	Small C/I Equipment	*	0.39	0.44
	Large C/I Equipment	*	0.75	0.78
	Small C/I Buildings	*	*	0.45
	Large C/I Buildings	*	*	0.50
	Government and Institutional	*	0.57	0.73
Portfolio		*	**0.75**	**0.60**

NOTE:
* Denotes programs/NTGRs that were not included in a given annual report.

5.3.4.5 West Penn Power Phase II NTG Summary

Table 5-10 shows West Penn's Phase II NTGRs by program year. West Penn did not conduct any NTG evaluation activities during PY5. Due to minimal intra-program NTGR variation from PY6 to PY7, the portfolio-level NTGR was stable across the two years.

Table 5-10: West Penn's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Appliance Turn-In	*	0.32	0.31
	Energy Efficient Products	*	0.52	0.63

Sector	Program	PY5	PY6	PY7
	Home Performance	*	0.99	0.99
Low-Income	Low-Income	*	1.00	0.90
Non-Residential	Small C/I Equipment	*	0.71	0.72
	Large C/I Equipment	*	0.73	0.73
	Small C/I Buildings	*	*	0.60
	Large C/I Buildings	*	*	0.48
	Government and Institutional	*	0.57	0.73
Portfolio		*	**0.73**	**0.72**

NOTE:
* Denotes programs/NTGRs that were not included in a given annual report.

5.3.4.6 PECO Energy Phase II NTG Summary

Table 5-11 shows PECO's Phase II NTGRs by program year. There was considerable intra-program NTGR variation from PY6 to PY7, leading to a lower portfolio-level NTGR in PY7.

Table 5-11: PECO's Phase II NTGRs by Program Year

Sector	Program	PY5[a]	PY6	PY7
Residential	Smart Home Rebates (SHR)	0.5	0.49	0.54
	Smart House Call	0.9	1.15	0.94
	Smart Builder Rebates (SBR)	N/A	*	0.50
	Smart Appliance Recycling (SAR)	0.3	0.35	0.50
	Smart Multi-Family (SMF) Solutions Program	N/A	0.75	0.59
	Smart AC Saver – Residential	N/A	1.00	N/A
Low-Income	Low-Income Energy Efficiency Program (LIEEP)	1.0	1.00	0.81
Non-Residential	Smart Equipment Incentives (SEI) – C/I	0.7	0.81	0.64
	Smart Equipment Incentives (SEI) – GNI	0.4	0.42	0.43
	Smart Construction Incentives (SCI)	N/A	0.52	0.52
	Smart Multi-Family (SMF) Solutions Program	N/A	0.83	0.62
	Smart AC Saver – Commercial	N/A	1.00	N/A
	Smart On-Site (SOS)	0.8	*	0.89
	Smart Business Solutions (SBS)	0.9	0.9[b]	Not reported
Portfolio		**0.7**	**0.68**	**0.62**

NOTES:
[a] Navigant reported to the tenth decimal place in PY5.
[b] In PY6, Navigant reported the PY5 estimate.
* Denotes programs/NTGRs that were not included in a given annual report.

5.3.4.7 PPL Phase II NTG Summary

Table 5-12 shows PPL's Phase II NTGRs by program year. Due to minimal intra-program NTGR variation from PY6 to PY7, the portfolio-level NTGR experienced minimal fluctuation in Phase II.

Table 5-12: PPL's Phase II NTGRs by Program Year

Sector	Program	PY5	PY6	PY7
Residential	Residential Retail Program	0.57/0.84[a]	0.52	0.61
	Appliance Recycling Program (ARP)	0.74	0.60	0.60
	Residential Home Comfort	0.58	0.60	0.61
	Student and Parent Energy-Efficiency Education Program	1.00	1.00	1.00
	Residential Energy-Efficiency Behavior & Education Program	*	1.00	1.00
Low-Income	E-Power Wise	1.00	1.00	1.00
	Low-Income Energy Efficiency Behavior & Education	*	*	1.00
	Low-Income Winter Relief Assistance Program (WRAP)	1.00	1.00	1.00
Non-Residential	Prescriptive Equipment Program	0.75	0.74	0.77
	Custom Incentive Program	0.55	0.45	0.61
	School Benchmarking	NS[b]	NS	NS
	Master Metered Low-Income Multifamily (MMMF) Program	0.77	0.86	*
	Continuous Energy Improvement (CEI) Program	N/A	1.00	1.00
Portfolio		**0.79**	**0.79**	**0.71**

NOTES:
[a] Cadmus reported equipment (NTGR = 0.57) and upstream lighting (NTGR = 0.84) separately in PY5.
[b] NS denotes programs for which no savings are claimed.
* Denotes programs/NTGRs that were not included in a given annual report.

5.4 BEST PRACTICES AND LESSONS LEARNED

5.4.1 Evaluation, Measurement, and Verification Best Practices

During Phase II the SWE Team continued to search for and identify EM&V best practices from across the United States that could be implemented in Pennsylvania. The following sections discuss examples of such best practices that the SWE Team has identified and that are now in place either in the SWE Evaluation Framework or the 2016 Pennsylvania TRM.

5.4.1.1 Department of Energy Uniform Methods Project Protocols

The U.S. DOE's UMP[25] develops M&V protocols for evaluating program energy savings. The UMP includes all the major commercial and residential energy efficiency programs in the United States. The DOE's Office of Energy Efficiency and Renewable Energy leads the UMP, and the National Renewable Energy Laboratory manages the common components of the UMP. The protocols are developed with a combination of inputs from technical experts throughout the energy industry. Cadmus organizes this aspect of the project, and its goal is to promote the idea that using one specific M&V protocol for

[25] http://energy.gov/eere/about-us/ump-protocols.

calculating energy savings will increase the overall accuracy of reported savings. The SWE Phase I and II project manager, Dick Spellman of GDS Associates, serves on the Technical Advisory Group that reviews new UMP protocols before they are finalized.

The SWE Team identified the UMP protocol for residential appliance recycling programs as one that should be adopted in Pennsylvania. It became evident that there was a need for a common approach among EDCs for determining free-ridership and net savings for appliance recycling programs. As a result, in PY5 the SWE Team issued a guidance memo (GM-026) that incorporated the UMP protocol for determining free-ridership and net savings. It was then fully incorporated into the 2015 TRM as the protocol for determining both gross and net savings for residential refrigerator recycling.

The UMP protocols for calculating savings for residential and commercial lighting recommend conducting metering studies to determine hours of use (HOUs) for such equipment. In following these guidelines, the SWE conducted comprehensive, Pennsylvania-specific residential and commercial lighting studies at the beginning of Phase II to collect HOU data for lighting. The HOU and coincidence factor (CF) results from these studies are now incorporated into the 2016 Pennsylvania TRM.
The SWE Team manages a Technical Working Group (TWG) to discuss and approve the inclusion of UMP protocols on a case-by-case basis. A thorough vetting of the applicability of each protocol for Pennsylvania is organized and accomplished by parties from the EDCs and their evaluation contractors, the TUS, and members of the SWE Team. All protocols are opened to public comment before incorporation into the Pennsylvania TRM.

5.4.1.2 Net-to-Gross Protocols

The Phase II SWE Team worked with the Pennsylvania NTG TWG to identify and develop best practices for developing NTGRs for different types of energy efficiency programs. The SWE Team emphasized that the lack of a common approach would lead to different NTGRs, and thus the group concentrated on discussing the pros and cons of different protocols from other states and the viability of measure-level assessments for Phase III.

This NTG protocol has been adopted by the TWG, and EDCs used this NTG protocol in Phase II EM&V plans. The SWE Team also determined that the TWG is a beneficial source of feedback from the EDCs on NTG issues and should be an integral part of the planning process.

5.4.1.3 Residential Site-Inspection Protocols

The Phase II SWE identified best practices for making better use of residential on-site inspection results collected by EDCs, EDC implementation contractors, or EDC evaluation contractors. During Phase II the SWE has significantly clarified how EDCs are to collect and report the results of such EDC-sponsored residential on-site inspections. During Phase I the results of such inspections were not routinely collected into a central EDC database, and during Phase I EDCs could not readily provide statistics to the SWE on the percentage of inspections conducted that showed discrepancies. Additionally, the SWE conducted its own independent site visits, the results of which were not statistically significant and which potentially duplicated the EDC evaluation contractors' visits. Now the SWE has more transparent data provided by the EDCs on the number and percentage of EDC inspections where equipment is reported as being installed or not installed, along with other discrepancies.[26] Therefore, the SWE is

[26] A discrepancy is defined as occurring when energy efficiency equipment or measures were reported as installed by an EDC or an EDC implementation contractor but were found not to be installed or not operating properly when on-site or telephone inspections were conducted.

focusing its resources on reviewing the results gleaned from the extensive on-site visits already being performed by the EDCs and their implementation contractors or evaluation contractors.

5.4.1.4 Lighting Audit Tool

A significant update was made to the TRM Appendix C lighting calculator during PY6 based on numerous industry best practices as well as feedback from the EDCs and their evaluation contractors. These modifications helped address the dual baseline issue encountered during some lighting retrofits and how to account for the savings in a concise manner.

5.4.1.5 Demand Response Protocols

Phase III of Act 129 includes goals for peak demand reduction through demand response. In order to consistently govern and determine savings for these programs, the SWE drafted both residential and commercial demand response measures that are included in the 2016 TRM. As foundations for these protocols, the SWE used existing guidelines established by the PJM Interconnection, LLC, regional transmission organization. PJM's long-standing and constantly updated guidelines for estimating savings attributed to demand response are industry standard and serve as a best practice for these types of programs. For residential programs, the SWE built the protocol using PJM Manual 19, which governs load forecasting and analysis. For C/I programs, the SWE built the protocol using PJM Manual 11.

5.4.1.6 Best Practices Workshop

To assist EDCs and their evaluation contractors in planning and carrying out effective process evaluations, the SWE Team presented a workshop on best practices in process and market evaluations during the quarterly Program Evaluation Group (PEG) meeting held on June 20, 2014. In this workshop, the SWE Team identified four areas of best practice: design of the process evaluation, execution of the process evaluation, the process evaluation report, and the response to the report.

The SWE Team identified several protocols and guidelines for process evaluations, including the New York Process Evaluation Protocols, which the June 2015 Phase II Evaluation Framework references. Based on the New York protocols, the workshop summarized best practices relating to whom to include in planning, when to conduct process evaluations, ongoing monitoring, and important process evaluation activities. The workshop also covered program logic modeling, which is not mentioned in the New York protocols.

Finally, the workshop included a guided discussion of lessons learned about best practices. Discussion topics covered timing of evaluations; important research questions to address; the use of process evaluation as a management tool; the evaluation scope and execution; and evaluation reporting, including recommendations and the program staff's response.

5.5 TECHNICAL REFERENCE MANUAL

The Pennsylvania TRM was not updated in PY7, as the design for the Phase III TRM (to be in effect for PY8) was completed during PY6. The Phase III, or 2016 TRM, became effective June 1, 2016 and contained protocols that were designed to align with the potential shifts in policy or code legislation for a large portion of the phase, without the need for significant modification. The 2016 TRM Final Order (with manual and appendices) was approved early in PY7, on July 8, 2015.

The TRM Working Group was active, however, during PY7 and engaged both the Phase II and Phase III SWE for a collaborative effort to design an Interim Measure Protocol (IMP) to address the learning or smart thermostat savings potential, as requested by the EDCs and their evaluation contractors. Formal written comments were collected from all Working Group participants and were discussed with the TUS. Multiple facets of the measure design were analyzed and compared with recent studies across the country, in an effort to provide deemed savings values in accordance with the TRM design. A substantial portion of the analysis focused on the following characteristics of the measure protocols:

- The definitions of "smart" or "learning" and "Wi-Fi enabled" as they relate to the current industry thermostat offerings, and how those definitions continue to evolve.
- Whether the "geo-fencing" feature should be included as a prerequisite for the technology and the approach to deemed savings in the measure. Significant discussion also occurred around the pros and cons of the occupancy-sensing capabilities of the current technologies.
- The variation in savings factors that were found in the industry studies collected and the viability of a de-rate factor for the IMP.
- Equipment characteristics of the participant populations and the primary fuel sources for heating and cooling.

The TRM Working Group also developed an IMP designed to augment the existing refrigerator recycling measure, so that it can address a direct-install program designed for low-income participants. Comments were collected, and a final version of the IMP was released on July 20, 2016.

5.6 RECOMMENDATIONS FOR PROGRAM IMPROVEMENTS FOR SUBSEQUENT ACT 129 PHASES

One of the key contractual responsibilities of the Phase II SWE is to make recommendations for Act 129 program modifications and improvements. This section presents recommendations for program improvements based on a literature search of recent energy efficiency and demand response papers presented at major national conferences.

5.6.1 Emerging Ideas in Program Design and Implementation

In order to fulfill the SWE's contractual obligation to provide recommendations for program improvements, the SWE Team reviewed recent industry literature, focusing on identifying emerging trends in program design and implementation. This review sought to identify emerging program approaches that the Pennsylvania EDCs may wish to consider, recognizing that the context in which each program operates is unique and that an approach that is promising in one area may not succeed in another area.

The SWE Team reviewed the proceedings of the 2014 American Council for an Energy-Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings, the 2015 Association of Energy Service Professionals (AESP) National Conference, and the 2014 International Energy Program Evaluation Conference (IEPEC), and identified 50 papers relevant to program design and implementation.

The majority of these papers can be divided into four categories:

- Innovative marketing and outreach approaches
- Midstream approaches to lighting and plug load

- Shifting strategies in whole-building upgrades
- Behavioral interventions

After reviewing the papers in each category, the SWE Team sought additional sources to fill any remaining information gaps, including program evaluation reports as well as reports by the State and Local Energy Efficiency Action Network (SEE Action) and other industry groups. The remainder of this section summarizes findings from the industry literature in each of the four areas identified.

5.6.1.1 Innovative Marketing and Outreach Approaches

In a diverse service territory, no single marketing message is likely to appeal to all customers. As a result, program administrators (PAs) seek to identify the customers most likely to participate in their programs and reach out to them with the messages most likely to resonate with them. Recent industry literature focuses on two approaches to this type of targeted marketing. One draws on the growing array of customer data available to PAs, while the other seeks to leverage existing communities and social relationships.

5.6.1.1.1 Data-Based Targeting Approaches

PAs have access to a great deal of information about their customers, which they can supplement with purchased data and their own primary research. These data include customer demographics, energy usage, and home characteristics. Industry literature detailed the experience of two PAs—Pacific Gas & Electric (PG&E) and Northeast Utilities—that used such data to identify the customers most likely to participate in particular program offerings. Both PAs conducted classification and regression tree analyses to identify common characteristics among program participants, anticipating that other customers who shared those characteristics would be more likely to participate.

Northeast Utilities identified three characteristics associated with greater program participation (level of natural gas usage, home value, and home equity loan-to-value ratio), which together indicate both the potential to benefit from weatherization and the likely ability to afford an energy upgrade project. Northeast Utilities used an experimental design to test the effectiveness of a mailing promoting the program in generating interest among customers with the identified characteristics. Initial findings indicated that customers with the identified characteristics scheduled and completed audits at a greater rate than customers who did not have those characteristics but received the mailing and customers who had those characteristics but did not receive the mailing.

PG&E identified 13 indicators—including the age and size of the home, the amount of time the homeowner had lived there, the number of people in the household, and the household's energy usage and billing characteristics that were associated with participation—from which it developed a propensity score to rate customers' likelihood of program participation. PG&E conducted an analysis comparing program participants with those who began, but did not complete, the participation process. The program dropouts had characteristics similar to those of complete participants in many ways, but expressed a lower sense of self-efficacy in controlling their energy savings.

5.6.1.1.2 Community-Based Outreach Approaches

Another strategy PAs have used to reach targeted participants seeks to leverage social and community dynamics, often following the tenets of Community Based Social Marketing (CBSM). Recent industry literature describes three broad community-based outreach approaches: use of third-party advocates as trusted messengers, individual contact with potential participants, and neighborhood targeting.

Trusted Messengers

A common strategy that efficiency programs have used to reach a targeted community involves identifying a trusted individual or organization within that community and working with that person or group to spread the program's message. In a summary of six CBSM programs in Wisconsin, the implementer, Wisconsin Energy Conservation Corporation, found this type of outreach more effective than traditional advertising or presentations by a program or utility representative. One of the Wisconsin CBSM programs found a statistically significant increase in program participation when a well-known community member recommended the iCan Conserve program.

These strategies may be particularly effective in hard-to-reach populations where it is difficult for program staff to build rapport with community members. Nonetheless, these types of approaches can also pose challenges for PAs: community groups may lack the time and resources to promote an efficiency program, particularly if energy efficiency and sustainability are not part of the group's mission. As a result, providing education and support to such third-party program advocates can be time- and resource-intensive for utility staff. One Wisconsin program found a way to leverage the trusted messenger approach without the time commitment of supporting community groups, by printing marketing materials that included quotes about the program from local residents. The implementer found that this added credibility for residents, and that "the names associated with the quotes were one of the first things participants noticed."

Individual Contact

One study of six CBSM programs found one-on-one interactions with potential participants, particularly in combination with a trusted messenger, to be one of the most effective outreach strategies, generating greater interest in the program than multiple touches from more traditional marketing approaches. This type of individual contact can also draw on staff members, contractors, or members of community groups with the necessary language skills and cultural understanding to reach members of non-English-speaking communities.

This type of individual outreach is very expensive for PAs to provide. As a result, some grantees in the American Recovery and Reinvestment Act (ARRA) funded the Better Buildings Neighborhood Program (BBNP) and used open houses and similar events to create an opportunity to bring their programs into this type of individual or small group contact with a larger number of people. These open houses or house parties typically included a presentation describing the benefits of energy upgrades, the program offerings, and the participation process. In some cases, a contractor would conduct an audit during the event, describing the process and findings; in other cases, visitors could tour a home that had received upgrades, with signage highlighting the improvements. The events also provided attendees with an opportunity to speak with program staff and contractors individually, to address any questions or concerns they might have.

Neighborhood Targeting

Some programs have sought to both increase the efficiency of their outreach efforts and leverage neighbor-to-neighbor social dynamics by focusing intensive outreach in a specifically targeted

geographic area. This was a common approach among BBNP grantees. Programs selected neighborhoods to target based on a variety of factors, ranging from housing stock and demographic characteristics to the presence of strong neighborhood associations and community groups. In most cases, these strategies did not achieve their desired results, but the experience of the BBNP grantees provides some lessons learned for neighborhood targeting:

- **Do not constrain participation to the targeted area** | Requiring program participants to reside within a narrow targeted area can limit the potential for a program to leverage social relationships other than those among neighbors.
- **Ensure that the targeted area is large enough to provide sufficient project volume** | Targeting too small a population may constrain a program's ability to generate enough initial participation to gain traction, particularly if the upgrades the program promotes are relatively unknown or expensive.
- **More visible upgrades may be better candidates for neighborhood targeting** | For example, neighborhood-focused approaches have been successful in increasing uptake of solar photovoltaic systems. These approaches were less successful in promoting whole-house energy upgrades.

5.6.1.2 Midstream Approaches to Lighting and Plug Load

Lighting has traditionally been a key source of residential energy savings for PAs. However, changes in the lighting market driven by recent changes in standards have altered the baseline over which programs achieve savings. Programs have also been challenged to effectively integrate LED technologies as products rapidly evolve and prices fall. Recent industry literature suggests that opportunities remain to increase the efficiency of residential lighting, but the changing context in which programs operate has led some PAs to seek new program approaches.

Residential plug loads are another end use in which PAs have recently sought new program approaches. While the energy use of other end uses has decreased over the past decades, plug loads' proportion of residential electric loads has grown, and plug load energy use is projected to continue to grow. Plug loads, made up of many small consumer electronics and other household products, pose challenges for traditional efficiency program approaches. The energy use and potential energy savings of any given plug load product are generally small. As a result, incentives large enough to influence an end user's purchase decision are unlikely to be cost-effective.

PAs have looked to new midstream program approaches as a solution to the challenges they face in both lighting and plug loads. Lighting programs have long used midstream and upstream buy-downs to reduce the prices of efficient lamps. However, while buy-downs typically are designed to minimize the impact of the intervention on the retailer's business outcomes, these new program approaches seek to change retailers' behavior to motivate them to consider energy efficiency in their business decisions and take action to increase sales of efficient products.

5.6.1.2.1 Market Lift

Market lift programs offer retailers incentives for sales of efficient products that exceed a predefined baseline level. The programs do not specify the actions the retailers take to achieve an increase in sales; retailers are free to apply the incentives to price discounts, promotions of qualified products, or profits. A primary benefit of a market lift approach from the PA's perspective is a high NTGR. A traditional buy-down or an approach that incentivizes sales of every efficient unit sold inevitably provides incentives on

products that would have sold in the absence of the program. Because a lift program only incentivizes sales above a baseline, it can claim an NTGR of 100%.[27]

A small group of PAs, including PAs in Oregon, Vermont, and Massachusetts, recently conducted market lift pilots to increase sales of CFLs. In all cases, the pilots successfully increased sales of CFLs over baseline. The pilots also encountered challenges. Many retailers were reluctant to participate in a lift approach. Lift approaches can be risky for retailers because they may not receive any compensation for the actions they take and costs they incur to increase sales of efficient products if sales do not exceed the program's baseline. National retailers also work with many PAs across the country and may be reluctant to agree to a program approach that is unique to only a few PAs.

5.6.1.2.2 Retail Products Portfolio

The Retail Products Portfolio (RPP) Program offered by PG&E targets a range of consumer electronics and appliance products.[28] RPP offers participating retailers an incentive for each unit sold in the participating PAs' service territories that meets a program-defined efficiency specification.[29] The PAs supporting RPP anticipate that these incentives will effectively increase the profit margin that efficient products offer to retailers and thus motivate retailers to take action to sell more efficient products. RPP works with large retailers, and the program anticipates that, while its per-unit incentives would not be enough to influence an end user's purchase decision, in aggregate they will be sufficient to motivate retailers to take action.

Unlike a more traditional buy-down, RPP does not specify how retailers apply the incentives they receive. Reducing the sales price is one of a few actions the program anticipates retailers might take to increase sales of efficient products. Other actions retailers might take include favoring efficient products in ads and other promotions, giving efficient products more prominent placement in the store, and increasing the proportion of efficient products in their product assortments. Some PAs plan to require participating retailers to submit an annual plan detailing the steps they will take to increase sales of efficient products.

Retailers make many of the decisions that RPP seeks to influence—including decisions about assortment and promotion—at a national level. As a result, the program can have a greater influence on retailers' decisions as its incentives cover a greater proportion of their markets. To this end, through the ENERGY STAR program, the U.S. EPA has taken a coordinating role seeking to encourage PAs around the country to offer RPP and align their offerings with those of other PAs to the extent possible. This coordination is also designed to increase retailer engagement by presenting retailers with a single, large efficiency program rather than multiple small programs that might struggle to gain a retailer's attention.

RPP is relatively new. PG&E worked with a single retailer to implement an RPP pilot from November 2013 to December 2014. The Northwest Energy Efficiency Alliance implemented an RPP pilot with multiple retailers in 2014 and 2015. Evaluations of both pilots found that retailers engaged with the

[27] Note that this does not necessarily mean a lift program is more cost-effective: to the extent that retailers' actions are driven by the aggregate incentive amount they expect to receive; a lift program may need to provide a larger incentive on a per-unit basis to motivate retailers to take a given set of actions to increase sales of efficient products.

[28] In 2016, PG&E planned to provide incentives for dryers, sound bars, air purifiers, room air conditioners, and freezers. RPP design allows product categories to easily transition in and out of the program.

[29] These specifications are typically ENERGY STAR or ENERGY STAR Most Efficient, but may be defined as a proportion more efficient than ENERGY STAR (e.g., 15% more efficient than ENERGY STAR, expressed as ENERGY STAR + 15%).

efforts, although the pilots' small scales limited their results. The PG&E pilot increased sales of efficient products by an average of approximately 5% across all the product categories it targeted.

5.6.1.2.3 Common Challenges of New Midstream Approaches

Both the RPP model and a market lift approach share two related challenges. First, both models require programs to obtain full category sales data (including both qualified and nonqualified units) from participating retailers. Retailers guard their sales data closely, and programs must provide the retailer with a sufficiently compelling value proposition to motivate them to provide data. Retailers have provided data to national programs like ENERGY STAR and regional ones like RPP, and to RPP's predecessor business and consumer electronics programs. However, retailers may be reluctant to provide data to smaller-scale program efforts and may be reluctant to provide the level of data PAs and their evaluation contractors would like.

The second challenge both models face is in defining a baseline level of sales. While incentives payments depend on the baseline definition in a lift approach, PAs must also develop a baseline for RPP in order to evaluate the program's effects. The experience of the PAs piloting lift approaches demonstrates the challenges that developing a baseline can pose. One PA selected a comparison area outside its program area against which to measure baseline but had to find a different comparison area when a natural disaster in its original comparison area affected sales of CFLs. Comparison area analyses face further challenges in a program model like RPP that seeks to influence decisions that retailers make on a national level. To the extent that these programs succeed in influencing national product assortment or promotional decisions, those changes would be present in both the program area and any comparison area. Evaluation contractors are working to develop ways to identify the effects of these national decisions, but no approach has gained widespread acceptance to date.

5.6.1.3 Shifting Strategies in Whole-Building Upgrades

Whole-house energy upgrade programs have focused on encouraging homeowners to complete a single, comprehensive energy upgrade project and developing a market of trade allies focused on providing those comprehensive upgrades. Recently, the experience of PAs, including many ARRA (American Recovery and Reinvestment Act) grantees who focused heavily on these types of upgrades, has suggested there may be a benefit to adopting an approach that is closely integrated with the existing home improvement market. Recent industry literature provides findings on the roles of audits and contractor training that are relevant to this shift in whole-house program approach, as well as the potential benefits and limitations of financing in driving energy upgrades.

5.6.1.3.1 Audit Approaches

An analysis of 54 comprehensive residential efficiency programs supported by grants from the ARRA-funded BBNP found that offering multiple audit types predicted program success across a range of factors. In particular, grantees found that offering less expensive and less comprehensive audits resulted in a wider range of participants engaging in the program, including those who may be interested in completing some efficiency improvements but are not prepared to complete a comprehensive project. Grantees who took this approach achieved similar levels of average energy savings per upgrade as grantees who offered only comprehensive audits, but did so at a considerably lower cost. Another study comparing phone-based energy audits to in-person audits similarly found no significant increase in customer satisfaction or uptake of audit recommendations among participants who received in-home audits relative to those who received phone advising.

The BBNP grantees who offered less comprehensive assessment options in addition to comprehensive audits nonetheless took steps to encourage participants to install multiple measures. While these grantees relied on prescriptive incentives for participants who did not receive comprehensive audits, their incentive structures required participants to install a set number or package of measures, provided bonuses for installation of multiple measures, or both. In many cases these programs would also reach out to participants after their upgrades were complete, hoping to leverage an initial positive experience and encourage them to make additional improvements.

Other effective audit practices identified in industry literature include charging customers at least a nominal fee for the audit. Programs have found that doing so helps reduce the number of audit participants who are curious about what the audit might find but not seriously interested in completing an energy upgrade. Thus, audit fees can increase audit-to-retrofit conversion rates. Providing direct installation of measures during the audit is another practice that industry sources have found to be effective. These measures can allow the program to claim some energy savings from audit participants who do not go on to make additional energy upgrades. Programs offering direct measure installation have also generated high customer satisfaction.

5.6.1.3.2 Contractor Engagement and Training

In the home improvement market as a whole, general home remodeling contractors and HVAC contractors complete most projects; contractors dedicated specifically to energy efficiency improvements conduct relatively few projects. As a result, recent industry literature suggests that, for energy upgrades to attain significant scale, PAs will need to engage contractors across multiple building trades, looking beyond those who have adopted energy upgrades as a business focus.

Consistent with this approach, the evaluation of the BBNP found that programs with a larger number of participating contractors were more likely to be successful. Homeowners' practices in selecting a contractor for home improvement projects likely contribute to both this finding and the importance of programs engaging with a wide range of contractors. Homeowners most often select contractors for home improvement projects based on word-of-mouth recommendations, past experience working with the contractor, or some other type of previous personal relationship with the contractor. Roughly half of homeowners contact only one contractor for any given project. As a result, working with a larger pool of participating contractors may increase the likelihood that a homeowner would contact one of a program's trade ally contractors for any given project, giving that contractor an opportunity to recommend energy upgrades.

As the only program representative likely to be present at the time a homeowner decides whether or not to move forward with an energy upgrade, trade ally contractors play a key role in selling energy upgrade projects. As a result, contractor training, and particularly training in sales skills, can play an important role in the success of efficiency programs. The BBNP evaluation found that grantees who did not offer contractor training were significantly more likely to be among the least successful, and the more types of training a grantee offered, the more likely they were to be successful. BBNP grantees drew on a variety of providers for contractor training, ranging from national training vendors to community colleges to equipment manufacturers' representatives. Grantees also used both in-the-field mentoring and classroom training.

5.6.1.3.3 Financing

PAs have long looked to financing as a tool to increase uptake of comprehensive home energy upgrades by eliminating the up-front costs of those upgrades to homeowners. Recently, a growing number of PAs have launched energy efficiency financing offerings as a way to leverage private funds to meet increasing energy savings targets. The experience of these PAs provides lessons learned on the role financing can play in residential energy upgrade programs.

The BBNP grantees and other PAs found that financing is not appealing to many program participants, but it is valuable to those who use it. Eighteen percent of all participants in residential BBNP-funded programs that offered loans used them. This figure is consistent with the loan uptake range of 10%–20% that PAs around the country have identified as typical for residential financing programs. Nonetheless, a large majority of participants in BBNP-funded programs who received loans (73%) reported that the availability of the loan was important in their decision to make upgrades.

Consistent with the limited appeal of financing among efficiency program participants, industry literature suggests that financing is most effective as a sales tool to address the specific concerns that prevent an individual homeowner from moving forward with an upgrade. Financing is less effective as a marketing tool seeking to generate interest in energy upgrades among the general public. BBNP grantees found that offering low interest rates increases uptake of financing offerings. Nonetheless, lenders may be unwilling to use expanded or alternate underwriting criteria for loans offered at very low interest rates.[30] As a result, programs offering very low rates may do so at the expense of a program's ability to reach low- and moderate-income homeowners who are less likely to have other financing options.

It is important for programs to seamlessly integrate financing into their processes and make participation easy for homeowners. Providing loans involves a wide range of actors and communication flows that have not traditionally been part of efficiency programs, and the long processes that can result may lead participants to drop out of the program before completing the process.

Increased convenience for participants is one of the primary benefits programs have seen in offering loan repayment on the participant's utility or property tax bill. Nonetheless, on-bill repayment has the potential to offer a variety of additional benefits: by attaching loans to a meter or property, programs may be able to overcome some homeowners' concerns that they would move before seeing financial returns on any investments they make in energy efficiency. Furthermore, on-bill repayment has the potential to reduce the lender's risk because there is very low delinquency on utility bills, and programs can impose utility service disconnection as a penalty for nonpayment of on-bill loans.

Many of the potential benefits of on-bill lending remain untested on a large scale. A review of programs across the country found that default rates for on-bill lending programs were low (less than 2%), regardless of whether the program included the possibility of utility service disconnection for nonpayment. To date, programs have relatively little experience with loans transferring from one resident to another. The benefits of transferability depend on the new resident accepting the loan, and

[30] Expanded underwriting criteria use traditional financial metrics to judge a borrower's creditworthiness, but allow a wider range of borrowers than a lender would traditionally accept (e.g., accepting borrowers with credit scores of 580 and above, rather than limiting loans to those with credit scores above 640). Alternate underwriting criteria use metrics other than traditional financial metrics, like utility bill or mortgage repayment history, to determine creditworthiness.

the proportion of loans that transfer relative to those that are paid off before a property is sold is unclear.[31]

5.6.1.4 Behavioral Interventions

Recent industry literature reflects a growing focus among energy efficiency program PAs on using strategies from social and behavioral science to motivate people to reduce their energy consumption. Two elements stand out in the way regulators and PAs have defined these programs: they are based on the deliberate application of social science theory, and they identify specific behaviors that they seek to change. As described below, industry literature identified three common behavioral strategies and two primary challenges that behavioral programs face.

5.6.1.4.1 Behavioral Strategies

As noted above, programs seeking to bring about behavioral change do so by leveraging specific interventions based in social science theory. Catalogs of behavioral interventions have identified 33 strategies to influence energy use that fit into 12 categories. This section describes three of the most common strategies PAs have employed, based on industry literature.

5.6.1.4.2 Social Norms

Social norms form when individuals observe other members of their community adopting a particular behavior and come to view that behavior as "widely accepted, socially supported, and therefore natural."[32] Interventions seeking to leverage social norms as a behavioral strategy compare participants with other members of their community and make community members' energy savings actions visible in order to build norms around the targeted energy savings behaviors. These interventions also often seek to leverage existing social networks, and messages delivered by individuals who are influential within those networks can be particularly effective in building norms and motivating behavior. HER programs that compare participants with their neighbors may be the most common strategy PAs have used to leverage social norms. Other strategies drawing on social norms include competitions, opt-in feedback programs, and benchmarking programs.

The Ontario Power Authority's Project Porchlight is an example of a program seeking to leverage social norms to influence behavior. The program encouraged residents in targeted neighborhoods to replace the incandescent lamps in their porch lights with CFLs. Volunteers went door-to-door in their own neighborhoods distributing CFLs and encouraging their neighbors to install them. The program anticipated that this peer-to-peer interaction would build social norms encouraging the use of CFLs. The program operated in four Canadian provinces and three U.S. states and distributed a large number of CFLs for a very low cost of saved energy ($0.01/kWh).

5.6.1.4.3 Feedback

Feedback programs provide participants with information about their energy use, which they can use to inform decisions on energy savings actions and potentially see the results of those actions. Asynchronous feedback programs provide participants with information about their energy use over a

[31] Some loans are structured to transfer "automatically" when a home sells, without requiring the buyer to explicitly agree to the loan transfer. Even in these cases, however, the buyer has the discretion to ask that the seller pay off the loan as a condition of the home sale.

[32] Susan Mazur-Stommen and Kate Farley. 2013. "ACEEE Field Guide to Utility-Run Behavior Programs." B132. Washington, D.C.: American Council for an Energy-Efficient Economy.

defined period in the past. HERs are the most common form of asynchronous feedback that PAs are currently using.[33] These programs typically generate net energy savings ranging from 0.9% to 2.2%.

Real-time feedback programs provide customers with information about their home's current energy use, through an online portal, mobile app, in-home display, or smart thermostat. These programs allow participants to observe the immediate impact of changes in behavior on their energy use. PAs have used real-time feedback to support real-time pricing and behavioral demand response programs. Southern California Edison's (SCE's) SmartConnect Program provides in-home displays and offers tools to help participants set a budget, including alerts when they approach the budget and suggestions for actions they can take to stay within their budget. The program also alerts customers on days when incentives are available for behavioral demand response savings.[34] While SCE's SmartConnect Program does not include real-time pricing, its approach is consistent with research that has found that real-time pricing programs are most effective when integrated with other behavioral strategies like goal setting and notifications.

5.6.1.4.4 Commitment

Social scientists have found that individuals are more likely to follow through on an action if they make a public commitment or publicly state a goal to take that action. The public nature of these commitments can provide social pressure to follow through with the action and generate an uncomfortable sense of cognitive dissonance if the individual does not follow through.[35] Programs seeking to leverage commitment as a behavior change strategy have asked participants to make public pledges to save energy, and have used competitions as a way to motivate participants to make and follow through on commitments.

Entergy Solutions Rewards is a pledge program in Arkansas that asks customers to sign a pledge committing to energy savings behaviors. The behaviors vary but include pledges to change the dryer lint filter, install CFLs, use an advanced power strip, or lower the thermostat setting in winter.[36] Respondents are rewarded with a $5 gift card to Walmart, Barnes and Noble, or a variety of other retailers and restaurants.[37]

5.6.1.4.5 Designing Behavioral Interventions for Evaluation

Traditional efficiency program evaluation approaches focus on identifying the impact of a discrete action—like replacing a piece of equipment or making an improvement to a building—on a participant's energy use. Participants' responses to behavioral programs may not include these types of large, one-time actions. Instead they may include many smaller activities to reduce energy use. As a result, behavioral programs require distinct evaluation approaches, and incorporation of these approaches often has implications for program design. Two approaches to measure the impact of behavioral programs are pre- and post-treatment comparisons and controlled experiments.

[33] As noted above, HERs can also leverage social norms if they are framed as a comparison with other members of one's community. Many behavioral programs seek to combine multiple strategies.
[34] Source: SCE website. Accessed 12/15/2015 at www.sce.com/wps/portal/home/customer-service/my-account/smart-meters/opt-out/.
[35] Cognitive dissonance occurs when a person's actions do not align with that person's beliefs or attitudes.
[36] Source: Entergy Solutions Rewards website. Accessed 12/15/2015 at www.entergysolutionsrewards.com.
[37] Source: Entergy Solutions Rewards website. Accessed 12/15/2015 at www.entergysolutionsrewards.com/faqs.

Pre- and post-treatment comparisons evaluate an intervention by comparing the energy use of individual participants prior to and following the intervention. This approach can be effective for programs in which participants opt in (rather than being randomly selected). Individuals who opt in to the program may not be representative of the population, making it difficult to identify a control group that would serve as an effective comparison. Pre- and post-treatment comparisons also face challenges, however, in that factors external to the program intervention, like seasonal changes and changes in energy use associated with changing economic conditions, may alter participants' energy use between the pre- and post-treatment time periods.

Randomized controlled experiments define both a treatment group, which receives the intervention, and a control group, which does not receive the intervention, and compare the energy use of the two groups. More complex experimental designs may identify multiple treatment groups to receive varying elements of the intervention in order to isolate the effects of specific elements. To effectively design the experiment, PAs must carefully select the treatment and control groups to ensure that they do not differ across any characteristics that might influence their energy use or response to the intervention. These types of controlled experiments are most effective with relatively straight-forward program designs, and have been used to evaluate real-time feedback and HER programs.

5.6.2 Process Evaluation Recommendations

Based on the recommendations provided by evaluation contractors and included in the EDCs' PY7 annual reports, and making an effort to include at least one recommendation for each program type, the SWE Team has identified the following recommendations as having the greatest potential impact. In some cases, the SWE Team had edited the recommendations for length.

Residential Products

- FirstEnergy: Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and customers more quickly if project documentation is incomplete.
- PECO: Focus outreach efforts on HVAC installers for the non-lighting aspect of Smart Home Rebates program in Phase III as the program ramps back up and invites new installation companies to join.
- PPL: Consider implementing an online model number look-up mechanism for customers, including incentive levels, to minimize confusion when tiered rebates are offered for the same type of appliance.

Residential Lighting

- Duquesne: If Phase III activities shift from promoting primarily CFLs to LEDs, consider updating or changing Wattley, the Watt Choices image, to look less like a CFL.
- PPL: Investigate the feasibility of using product placement as a lower-cost mechanism for generating sales lift.

Residential New Homes

- FirstEnergy: As the Home Performance – New Construction program becomes more streamlined or as incentives change, attempt to attract builders who began with the program but dropped out.

Residential Other

- Duquesne: With the new and differently implemented Whole House Energy Audit Program (WHEAP), track the awareness of and implementation rate for Residential Energy Efficiency Program (REEP) rebates among WHEAP participants, to determine whether the link between the two programs is being made effectively to participants.
- Duquesne: If it is cost-effective, consider using the REEP and Low-Income Energy Efficiency Program (LIEEP) kits to introduce LEDs to participants in addition to one or more CFLs, as LEDs may result in lower free-ridership.

Low-Income

- PECO: Develop targeted Low-Income Energy Efficiency (LEEP) program materials that prioritize next steps and guide customers to the most appropriate program component, and ensure that schedule expectations are clear and applied consistently across customers.

Non-Residential

- PECO: Use the limited time offer as a lever in future years if participation is low in the Smart Equipment Incentives (SEI) program.
- PECO: Set final Phase III Smart On-Site (SOS) project enrollment deadlines of January 1, 2019 for projects over 1 MW and January 1, 2020 for projects less than 1 MW, to mitigate completion risks that lead to portfolio-level uncertainty.
- PPL: Consider incorporating a way for applicants to track the status of their application online.
- PPL: Improve the application process by providing examples of completed applications on the website and providing a contact to answer questions.

The SWE Team also identified three SWE recommendations from the PY6 EDC annual reports that, based on findings from PY7, bear repetition and elaboration:

- There is still evidence of high free-ridership for several EDC programs, and there is even evidence that free-ridership has increased over Phase II for some EDCs. While the SWE Team acknowledges and understands that free-ridership is one of several factors that EDCs consider when making decisions to modify programs, the SWE Team reiterates the recommendation, from the PY6 SWE Annual Report, that when high free-ridership exists, EDCs should examine program requirements and practices to determine whether free-ridership can be reduced and suggest some methods for doing so.
- Retailers and contractors are an important source of program information, and they respond to direct, personal contact. When programs involve these market actors, the programs should engage with them directly and personally to encourage sales, which may help increase program participation.
- Process evaluations of home audit programs continue to demonstrate opportunities for getting audit participants to make energy efficient purchases and upgrades. The PY7 process evaluations for PECO and PPL included recommendations for increasing conversion that centered around greater follow-up (creating a checklist for auditors that includes following up with customers) and improving cross-promotion of programs (engaging with auditors more, to improve their ability to cross-promote programs, and adding banners on rebate forms or other infographics for program materials and utility contact info). In addition, the SWE Team reiterates the recommendation that EDCs conduct research to estimate the level of energy efficient purchases and installations (whether incented or not) that result from home energy audits. The research should account for the fact that an audit one year may influence actions in subsequent years.

The SWE Team offers the following recommendations for all EDCs, based on the literature review of innovative program practices in the non-residential sector:

- For commercial lighting programs, consider providing incentives for comprehensive changes to lighting systems (such as through redesign, delamping, or including advanced controls), rather than or in addition to one-for-one replacements, with incentives based on changes to lighting power density.
- For commercial lighting programs, consider working with distributors in designing midstream lighting programs (if this is not already being done), because of the distributors' central position in the supply chain.
- For small businesses, reassess the level of custom- or micro-targeting for this segment. Some programs are starting to replace vertical segmentation strategies (e.g., based on energy usage) with strategies that incorporate other customer characteristics, such as business type or geographic density of businesses in the customer's area. These tailored marketing approaches have the potential to better predict the probability of participating in a program than does relying on traditional vertical segmentation strategies.

6 PHASE I AND PHASE II SAVINGS

The Pennsylvania PUC's TUS staff requested that the Phase II SWE include in this report information on the trends in program energy savings, EDC annual expenditures, and the utility cost per first-year kWh saved over the seven years covered by Phases I and II of Act 129. To respond to this request, the Phase II SWE created an Excel database that includes detailed data on each EDC's Phase I and II savings, EDC expenditures, and costs per first-year kWh saved. This chapter presents tables showing all of the data collected by the Phase II SWE Team regarding these items, and figures showing trends in the data by EDC and statewide (for all EDCs combined) over Phases I and II. There are several overarching observations that the Phase II SWE Team has about the data presented in this chapter:

- Over the seven years of Phases I and II, the statewide cost per first-year kWh saved (for all EDCs combined) ranged from a low of $0.12 in PY2 to $0.18 in PY6 (see Table 6-1). While some EDCs were concerned during Phase I that acquisition costs per first-year kWh-saved would end up being well over $0.30 during Phase II, this did not happen.
- In five of the seven years of Phases I and II, the acquisition cost per first-year kWh saved for non-residential programs was equal to or lower than that for residential programs (see Table 6-1).
- A regression trend fit to the annual statewide cost per first-year kWh saved data clearly shows a gradual increasing trend over the seven years of Phases I and II (see Figure 6-6Figure 6-6). This is good news for Pennsylvania ratepayers in that it indicates that utility program delivery costs remained very stable in both Phases I and II, as compared to initial concerns expressed by some that costs may reach upwards of $0.30 per kWh within this time period.
- While there was substantial variability across EDCs in the utility cost per kWh saved for all sectors, this variability decreased markedly after PY1.
- The total (all sectors combined) cumulative annual kWh savings at the end of Phases I and II for each EDC, expressed as a percentage of the total baseline kWh sales for 2010 for each EDC ranged from a low of 5.35% for West Penn to a high of 6.88% for PECO (see Figure 6-7).
- None of the seven EDCs spent all of their combined Phase I and II budgets over these two phases. This suggests that EDCs could have saved more electricity with more aggressive and more extensive program activities and marketing. The percent of the Phase I and II budgets spent by the EDCs ranged from a low of 78.58% for PECO to a high 89.65% for PPL (see Figure 6-8).

6.1 Cost Per kWh

Table 6-1 through Table 6-9 present detailed historical data on the total annual utility costs, incremental annual kWh savings, and annual cost per first-year kWh saved for each sector by program year and EDC for all years in Phases I and II. Figure 6-1 through Figure 6-6 show the cost per first-year kWh for each sector (residential non-low-income, residential low-income, residential total, and non-residential total) by program year and EDC, as well as totals for all sectors and for all EDCs combined. These tables and figures are useful for comparing the cost per first-year kWh saved across EDCs and across PY1 to PY7.

The utility cost per first-year kWh saved for all EDCs combined was very similar across the seven program years, varying from a low of $0.12 per kWh to a high of $0.18 per kWh, however, there was much variation among the EDCs. For example, in PY1 there was a range of $0.82, with West Penn having a cost of $0.90 per first-year kWh saved and PECO having cost of $0.08. This range was greatly reduced over the next six years. In PY7, this average utility cost across all seven EDCs was $0.15 per first-year kWh saved, with PPL having a cost of $0.21 per first-year kWh saved and Penelec having a cost of $0.10 per kWh. There does not seem to be a pattern where one EDC was regularly higher than the others.

Table 6-1: Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year – All EDCs Combined

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$21,098,011	$77,769,017	$78,044,381	$65,509,242	$77,730,330	$88,751,988	$101,192,878
	Residential Low Income	$5,116,208	$23,784,122	$25,945,124	$19,818,325	$21,142,334	$25,239,356	$25,117,620
	Residential Total	$26,214,219	$101,553,139	$103,989,505	$85,327,567	$98,872,664	$113,991,344	$126,310,498
	Non-Residential Total	$9,902,453	$76,868,755	$101,793,117	$124,074,172	$68,181,380	$86,789,656	$102,139,032
	Total	$36,116,672	$178,421,894	$205,782,622	$209,401,740	$167,054,044	$200,781,000	$228,449,530
First-Year kWh Saved	Residential Non Low Income	223,016,526	759,004,979	647,471,524	709,774,218	560,751,746	523,196,336	714,005,249
	Residential Low Income	6,180,298	63,605,860	51,172,000	57,013,305	53,772,074	36,611,000	47,066,000
	Residential Total	229,196,824	822,610,839	698,643,524	766,787,522	614,523,820	559,807,336	761,071,249
	Non-Residential Total	57,632,392	634,442,432	728,364,476	961,231,478	404,631,180	544,686,664	745,248,751
	Total	286,829,216	1,457,053,271	1,427,008,000	1,728,019,000	1,019,155,000	1,104,494,000	1,506,320,000
Utility $/kWh	Residential Non Low Income	$0.09	$0.10	$0.12	$0.09	$0.14	$0.17	$0.14
	Residential Low Income	$0.83	$0.37	$0.51	$0.35	$0.39	$0.69	$0.53
	Residential Total	$0.11	$0.12	$0.15	$0.11	$0.16	$0.20	$0.17
	Non-Residential Total	$0.17	$0.12	$0.14	$0.13	$0.17	$0.16	$0.14
	Residential and Non-Residential Combined[38]	$0.13	$0.12	$0.14	$0.12	$0.16	$0.18	$0.15

[38] All of the $ per first-year kWh saved calculations presented in Tables 6-1 through 6-9 for the residential, non-residential and total sectors were calculated by dividing the total utility costs for a sector by the total first-year kWh savings for each sector presented in each table. The $ per first-year kWh saved for a sector were not calculated by taking a simple average of the $ per first-year kWh saved for the sub-sectors of each sector. This means that the overall $ per first-year kWh saved for a sector is a weighted average of the $ per first-year kWh saved for each sub-sector.

Table 6-2: Total Costs, kWh Savings, and Cost per First-Year kWh Saved by EDC for All Years Combined

	Duquesne	Met Ed	Penelec	Penn Power	West Penn	PECO	PPL	Total
Total Utility Costs	$114,851,379	$122,820,357	$105,445,344	$33,835,238	$125,985,384	$361,910,066	$361,159,735	$1,226,007,502
First-Year kWh Saved	882,387,794	934,683,672	872,485,094	289,167,557	1,084,939,370	2,065,246,000	2,399,969,000	8,528,878,487
Utility $/kWh	$0.13	$0.13	$0.12	$0.12	$0.12	$0.18	$0.15	$0.14
$ Savings[39]	$552,540,000	$553,100,000	$523,488,000	$169,428,000	$592,973,000	$2,194,255,000	$1,803,876,000	$6,389,660,000

Table 6-3: Duquesne Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$812,402	$4,074,163	$7,923,777	$8,992,405	$6,343,275	$7,052,000	$6,224,692
	Residential Low Income	$214,397	$780,431	$768,225	$651,342	$1,753,199	$692,000	$351,182
	Residential Total	$1,026,799	$4,854,594	$8,692,003	$9,643,746	$8,096,474	$7,744,000	$6,575,874
	Non-Residential Total	-$2,585	$11,251,030	$15,119,997	$13,908,264	$7,187,526	$11,249,000	$9,504,657
	Total	$1,024,214	$16,105,624	$23,812,000	$23,552,010	$15,284,000	$18,993,000	$16,080,530
First-Year kWh Saved	Residential Non Low Income	2,123,875	47,499,391	80,834,000	59,458,000	51,077,000	36,818,000	62,571,000
	Residential Low Income	413,512	15,649,108	7,403,000	13,713,000	12,798,000	2,293,000	3,976,000
	Residential Total	2,537,387	63,148,499	88,237,000	73,171,000	63,875,000	39,111,000	66,547,000
	Non-Residential Total	0[40]	101,710,908	51,832,000	131,880,000	64,546,000	60,153,000	75,639,000

[39] Dollar savings values are the sum of total NPV TRC benefits for Phase I and II for each EDC.

[40] No reported savings for non-residential programs in PY1

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
	Total	2,537,387	164,859,407	140,069,000	205,051,000	128,421,000	99,264,000	142,186,000
Utility $/kWh	Residential Non Low Income	$0.38	$0.09	$0.10	$0.15	$0.12	$0.19	$0.10
	Residential Low Income	$0.52	$0.05	$0.10	$0.05	$0.14	$0.30	$0.09
	Residential Total	$0.40	$0.08	$0.10	$0.13	$0.13	$0.20	$0.10
	Non-Residential Total	$0.00	$0.11	$0.29	$0.11	$0.11	$0.19	$0.13
	Residential and Non-Residential Combined (weighted average)	$0.40	$0.10	$0.17	$0.11	$0.12	$0.19	$0.11

Table 6-4: Met-Ed Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$2,392,918	$12,413,000	$10,214,403	$14,082,499	$12,625,449	$10,063,680	$8,709,000
	Residential Low Income	$179,834	$1,173,065	$1,247,027	$1,287,852	$1,761,025	$1,637,015	$1,659,000
	Residential Total	$2,572,752	$13,586,065	$11,461,429	$15,370,351	$14,386,474	$11,700,695	$10,368,000
	Non-Residential Total	$994,982	$12,344,616	$4,182,571	$7,658,590	$4,390,526	$5,205,305	$8,598,000
	Total	$3,567,734	$25,930,681	$15,644,000	$23,028,942	$18,777,000	$16,906,000	$18,966,000
First-Year kWh Saved	Residential Non Low Income	11,426,380	82,036,589	71,908,000	109,822,000	96,883,000	90,954,000	97,572,000
	Residential Low Income	64,764	3,771,732	799,000	1,096,000	3,391,000	1,949,000	1,123,000
	Residential Total	11,491,144	85,808,321	72,707,000	110,918,000	100,274,000	92,903,000	98,695,000
	Non-Residential Total	5,783,979	80,929,228	47,011,000	80,821,000	33,792,000	40,826,000	72,724,000
	Total	17,275,123	166,737,549	119,718,000	191,739,000	134,066,000	133,729,000	171,419,000

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Utility $/kWh	Residential Non Low Income	$0.21	$0.15	$0.14	$0.13	$0.13	$0.11	$0.09
	Residential Low Income	$2.78	$0.31	$1.56	$1.18	$0.52	$0.84	$1.48
	Residential Total	$0.22	$0.16	$0.16	$0.14	$0.14	$0.13	$0.11
	Non-Residential Total	$0.17	$0.15	$0.09	$0.09	$0.13	$0.13	$0.12
	Residential and Non-Residential Combined (weighted average)	$0.21	$0.16	$0.13	$0.12	$0.14	$0.13	$0.11

Table 6-5: Penelec Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$2,310,592	$9,570,741	$8,897,934	$9,843,208	$11,343,710	$8,770,559	$7,222,916
	Residential Low Income	$132,718	$1,695,740	$1,698,978	$1,574,038	$2,552,044	$2,072,021	$2,224,976
	Residential Total	$2,443,310	$11,266,481	$10,596,913	$11,417,246	$13,895,754	$10,842,580	$9,447,892
	Non-Residential Total	$1,078,899	$3,570,654	$6,559,087	$7,368,754	$4,041,246	$5,877,420	$7,039,108
	Total	$3,522,209	$14,837,135	$17,156,000	$18,786,000	$17,937,000	$16,720,000	$16,487,000
First-Year kWh Saved	Residential Non Low Income	10,168,452	78,457,352	66,991,000	92,973,000	81,449,000	74,944,000	89,114,000
	Residential Low Income	81,432	4,618,224	1,357,000	1,324,000	5,051,000	2,755,000	1,982,000
	Residential Total	10,249,884	83,075,576	68,348,000	94,297,000	86,500,000	77,699,000	91,096,000
	Non-Residential Total	3,245,391	88,288,243	57,368,000	54,510,000	28,231,000	56,275,000	73,302,000
	Total	13,495,275	171,363,819	125,716,000	148,807,000	114,731,000	133,974,000	164,398,000
Utility $/kWh	Residential Non Low Income	$0.23	$0.12	$0.13	$0.11	$0.14	$0.12	$0.08

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
	Residential Low Income	$1.63	$0.37	$1.25	$1.19	$0.51	$0.75	$1.12
	Residential Total	$0.24	$0.14	$0.16	$0.12	$0.16	$0.14	$0.10
	Non-Residential Total	$0.33	$0.04	$0.11	$0.14	$0.14	$0.10	$0.10
	Residential and Non-Residential Combined (weighted average)	$0.26	$0.09	$0.14	$0.13	$0.16	$0.12	$0.10

Table 6-6: Penn Power Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$525,962	$2,804,351	$2,831,344	$3,654,736	$4,218,044	$2,652,000	$1,383,000
	Residential Low Income	$29,716	$571,641	$288,785	$42,000	$824,000	$493,000	$670,000
	Residential Total	$555,678	$3,375,992	$3,120,129	$3,696,736	$5,042,044	$3,145,000	$2,053,000
	Non-Residential Total	$301,870	$3,570,654	$912,871	$2,628,264	$1,318,000	$2,251,000	$1,864,000
	Total	$857,548	$6,946,646	$4,033,000	$6,325,000	$6,360,044	$5,396,000	$3,917,000
First-Year kWh Saved	Residential Non Low Income	5,451,292	27,346,277	25,038,000	35,383,000	29,105,000	22,252,000	12,471,000
	Residential Low Income	19,240	2,085,616	163,000	0[41]	1,168,000	1,010,000	550,000
	Residential Total	5,470,532	29,431,893	25,201,000	35,383,000	30,273,000	23,262,000	13,021,000
	Non-Residential Total	651,682	31,611,450	15,980,000	22,573,000	7,797,000	34,252,000	14,260,000
	Total	6,122,214	61,043,343	41,181,000	57,956,000	38,070,000	57,514,000	27,281,000
Utility	Residential Non Low Income	$0.10	$0.10	$0.11	$0.10	$0.14	$0.12	$0.11

[41] No reported savings for low income programs in PY4

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
$/kWh	Residential Low Income	$1.54	$0.27	$1.77	N/A[42]	$0.71	$0.49	$1.22
	Residential Total	$0.10	$0.11	$0.12	$0.10	$0.17	$0.14	$0.16
	Non-Residential Total	$0.46	$0.11	$0.06	$0.12	$0.17	$0.07	$0.13
	Residential and Non-Residential Combined (weighted average)	$0.14	$0.11	$0.10	$0.11	$0.17	$0.09	$0.14

Table 6-7: West Penn Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$2,104,529	$6,531,579	$14,142,085	$7,480,890	$11,532,486	$7,636,926	$6,940,543
	Residential Low Income	$272,046	$3,695,271	$5,254,505	$3,032,593	$1,828,026	$2,124,011	$2,561,000
	Residential Total	$2,376,575	$10,226,850	$19,396,590	$10,513,483	$13,360,513	$9,760,938	$9,501,543
	Non-Residential Total	$2,363,946	$3,180,457	$8,463,410	$16,674,073	$5,484,487	$7,051,062	$7,631,457
	Total	$4,740,521	$13,407,307	$27,860,000	$27,187,556	$18,845,000	$16,812,000	$17,133,000
First-Year kWh Saved	Residential Non Low Income	1,801,020	54,857,100	137,460,000	95,007,000	96,924,000	83,244,000	85,814,000
	Residential Low Income	844,000	5,978,530	7,760,000	3,788,000	1,722,000	1,743,000	1,261,000
	Residential Total	2,645,020	60,835,630	145,220,000	98,795,000	98,646,000	84,987,000	87,075,000
	Non-Residential Total	2,633,680	26,730,040	156,563,000	147,293,000	31,792,000	70,039,000	71,685,000
	Total	5,278,700	87,565,670	301,783,000	246,088,000	130,438,000	155,026,000	158,760,000
Utility	Residential Non Low Income	$1.17	$0.12	$0.10	$0.08	$0.12	$0.09	$0.08

[42] No reported savings for low income programs in PY4

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
$/kWh	Residential Low Income	$0.32	$0.62	$0.68	$0.80	$1.06	$1.22	$2.03
	Residential Total	$0.90	$0.17	$0.13	$0.11	$0.14	$0.11	$0.11
	Non-Residential Total	$0.90	$0.12	$0.05	$0.11	$0.17	$0.10	$0.11
	Residential and Non-Residential Combined (weighted average)	$0.90	$0.15	$0.09	$0.11	$0.14	$0.11	$0.11

Table 6-8: PECO Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$9,725,502	$30,057,000	$12,855,631	$7,724,002	$15,148,942	$34,305,712	$43,638,538
	Residential Low Income	$1,208,467	$6,068,000	$6,415,814	$6,019,807	$7,396,053	$10,470,536	$8,783,087
	Residential Total	$10,933,969	$36,125,000	$19,271,445	$13,743,809	$22,544,995	$44,776,247	$52,421,625
	Non-Residential Total	$2,632,722	$17,722,000	$18,313,555	$28,059,566	$29,469,005	$27,168,753	$38,727,375
	Total	$13,566,691	$53,847,000	$37,585,000	$41,803,375	$52,014,000	$71,945,000	$91,149,000
First-Year kWh Saved	Residential Non Low Income	140,676,000	255,857,000	61,708,000	26,411,964	95,834,241	115,379,000	235,720,000
	Residential Low Income	3,286,000	24,664,000	24,652,000	30,320,305	23,268,074	18,716,000	18,304,000
	Residential Total	143,962,000	280,521,000	86,360,000	56,732,268	119,102,315	134,095,000	254,024,000
	Non-Residential Total	15,856,700	112,480,300	107,949,000	152,092,732	154,262,685	173,532,000	274,276,000
	Total	159,818,700	393,001,300	194,309,000	208,825,000	273,365,000	307,627,000	528,300,000
Utility $/kWh	Residential Non Low Income	$0.07	$0.12	$0.21	$0.29	$0.16	$0.30	$0.19
	Residential Low Income	$0.37	$0.25	$0.26	$0.20	$0.32	$0.56	$0.48

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
	Residential Total	$0.08	$0.13	$0.22	$0.24	$0.19	$0.33	$0.21
	Non-Residential Total	$0.17	$0.16	$0.17	$0.18	$0.19	$0.16	$0.14
	Residential and Non-Residential Combined (weighted average)	$0.08	$0.14	$0.19	$0.20	$0.19	$0.23	$0.17

Table 6-9: PPL Costs, Annual kWh Savings, and Cost per First-Year kWh Saved by Program Year

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
Total Utility Costs	Residential Non Low Income	$3,226,106	$12,318,183	$21,179,207	$13,731,502	$16,518,424	$18,271,110	$27,074,190
	Residential Low Income	$3,079,030	$9,799,974	$10,271,789	$7,210,694	$5,027,986	$7,750,774	$8,868,375
	Residential Total	$6,305,136	$22,118,157	$31,450,996	$20,942,195	$21,546,410	$26,021,885	$35,942,565
	Non-Residential Total	$2,532,619	$25,229,344	$48,241,626	$47,776,661	$16,290,590	$27,987,115	$28,774,435
	Total	$8,837,755	$47,347,501	$79,692,622	$68,718,857	$37,837,000	$54,009,000	$64,717,000
First-Year kWh Saved	Residential Non Low Income	51,369,507	212,951,270	203,532,524	290,719,254	109,479,504	99,605,336	130,743,249
	Residential Low Income	1,471,350	6,838,650	9,038,000	6,772,000	6,374,000	8,145,000	19,870,000
	Residential Total	52,840,857	219,789,920	212,570,524	297,491,254	115,853,504	107,750,336	150,613,249
	Non-Residential Total	29,460,960	192,692,263	291,661,476	372,061,746	84,210,496	109,609,664	163,362,751
	Total	82,301,817	412,482,183	504,232,000	669,553,000	200,064,000	217,360,000	313,976,000
Utility $/kWh	Residential Non Low Income	$0.06	$0.06	$0.10	$0.05	$0.15	$0.18	$0.21
	Residential Low Income	$2.09	$1.43	$1.14	$1.06	$0.79	$0.95	$0.45
	Residential Total	$0.12	$0.10	$0.15	$0.07	$0.19	$0.24	$0.24

		PY1	PY2	PY3	PY4	PY5	PY6	PY7
	Non-Residential Total	$0.09	$0.13	$0.17	$0.13	$0.19	$0.26	$0.18
	Residential and Non-Residential Combined	$0.11	$0.11	$0.16	$0.10	$0.19	$0.25	$0.21

Figure 6-1: Utility Cost per First-Year kWh Saved – Residential Non-Low-Income

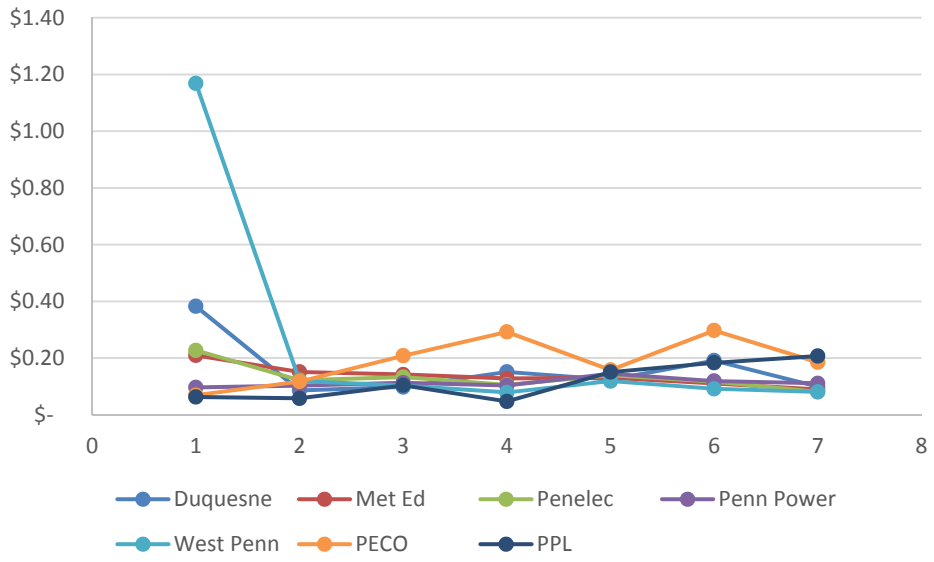


Figure 6-2: Utility Cost per First-Year kWh Saved – Residential Low-Income

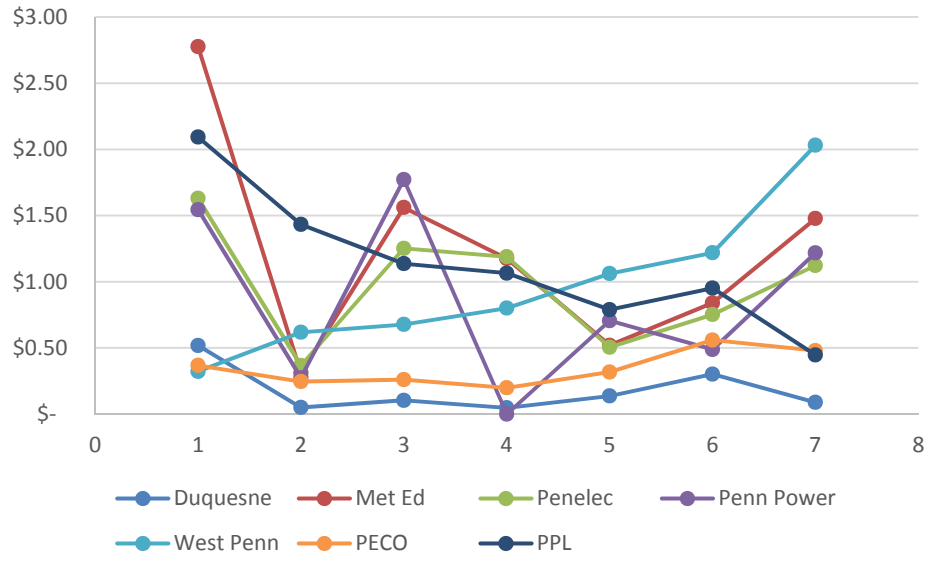


Figure 6-3: Utility Cost per First-Year kWh Saved – Residential Total

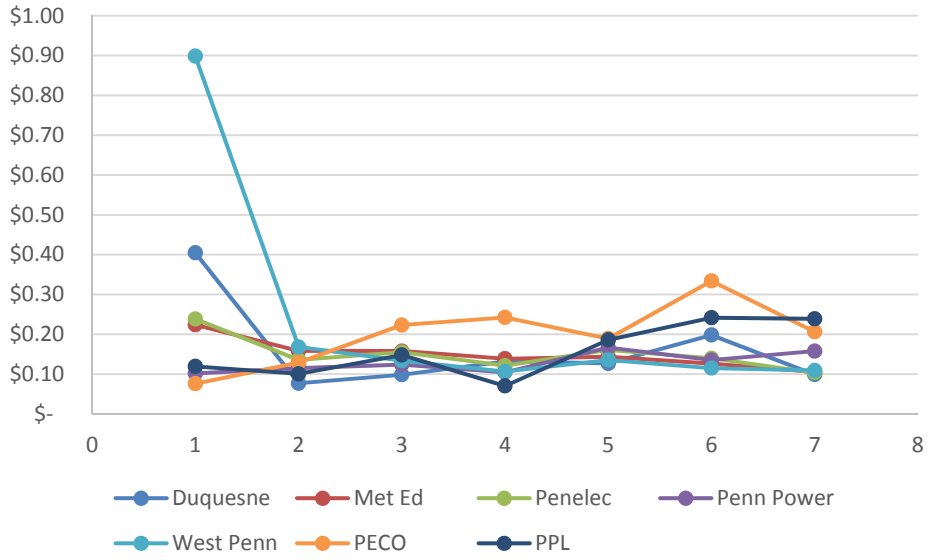


Figure 6-4: Utility Cost per First-Year kWh Saved – Non-Residential Total

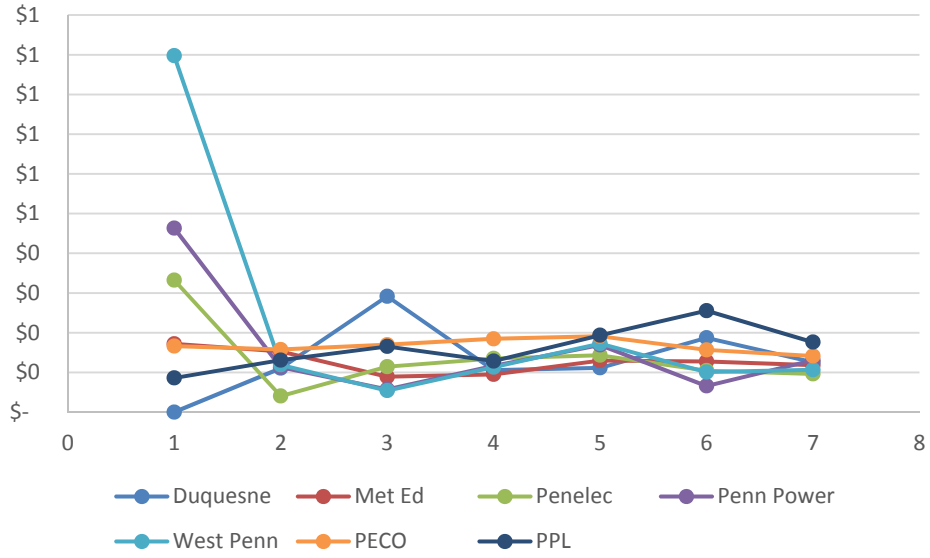


Figure 6-5: Utility Cost per First-Year kWh Saved – Total All Sectors

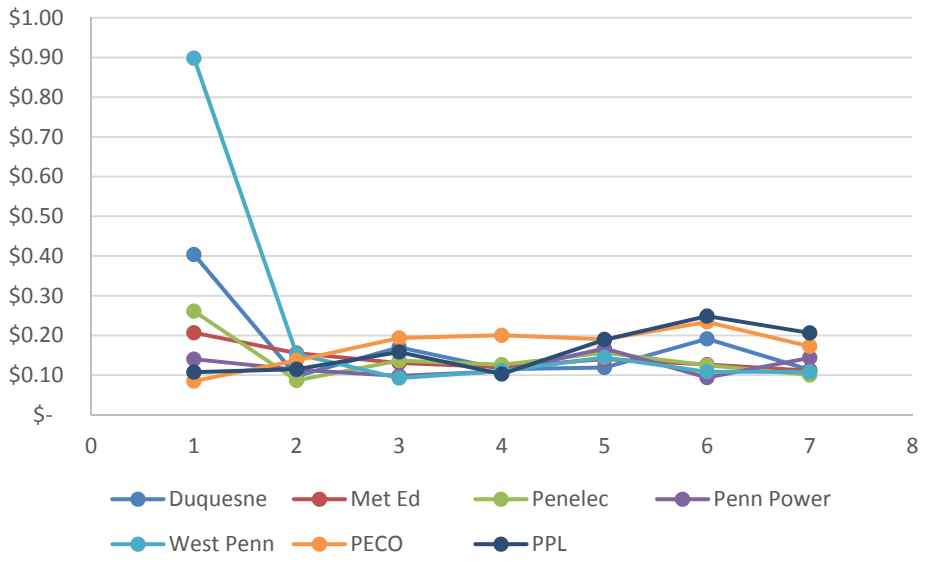
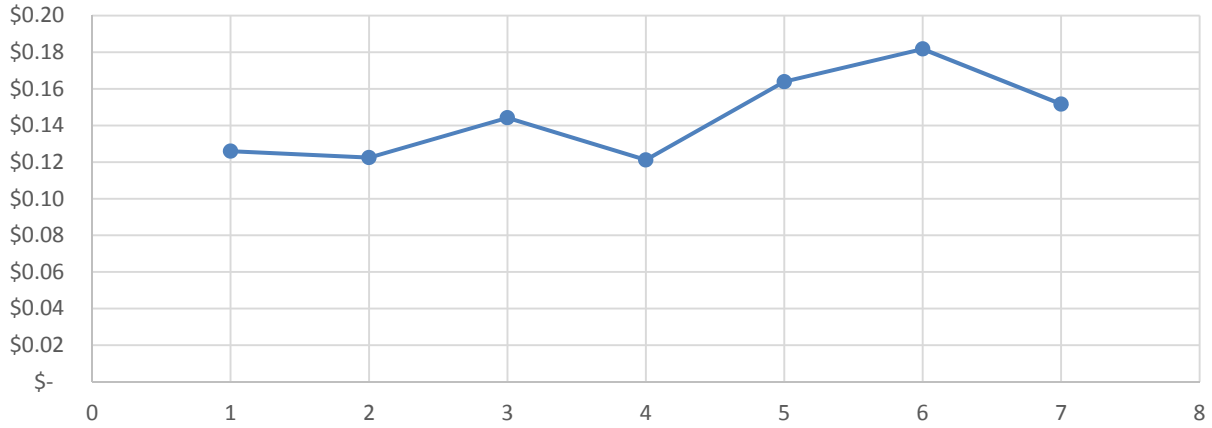


Figure 6-6: Utility Cost per First-Year kWh Saved – All EDCs Combined



6.2 Cumulative Annual Phase I and II Combined kWh Savings

Figure 6-7 shows the combined cumulative annual kWh savings at the end of Phases I and II (results added for both Phases) as a percentage of the total baseline kWh sales for 2010 for each EDC. The savings percentages are very close across the EDCs, with PECO having the highest at 6.88% and West Penn the lowest at 5.35%.

Figure 6-7: Combined Cumulative Annual kWh Savings as Percentage of 2010 Sales

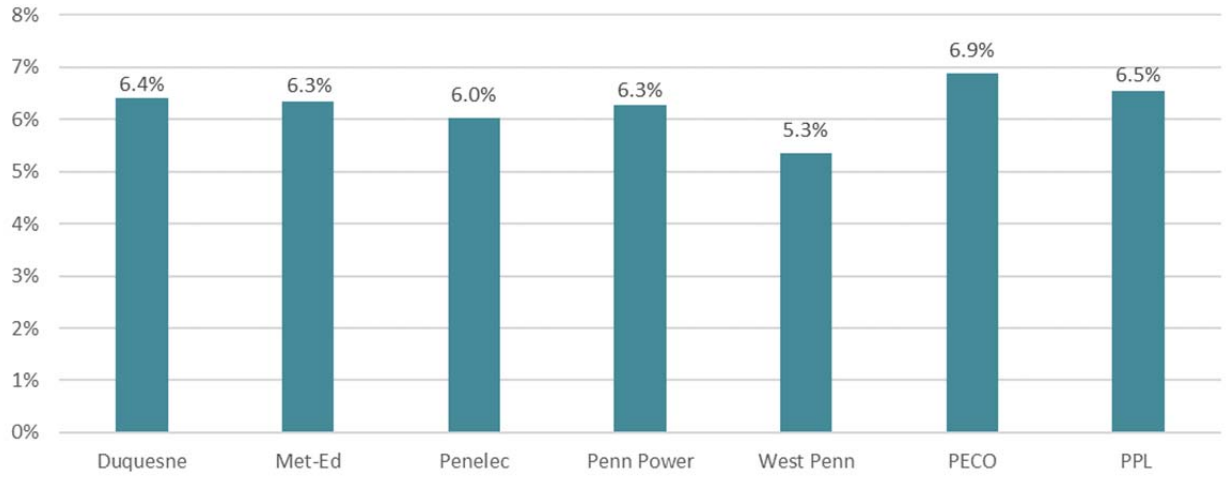
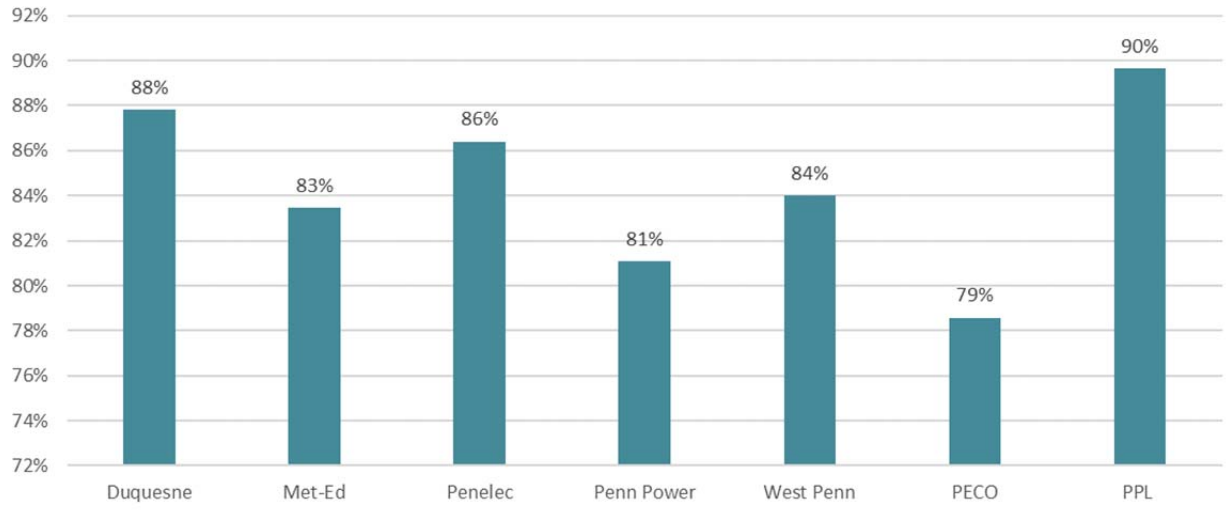


Figure 6-8 shows the cumulative spending for Phases I and II as a percentage of the Phase I and II budgets. These percentages range from 78.58% (PECO) to 89.65% (PPL).

Figure 6-8: Cumulative Utility Spending for Phases I and II as Percentage of Phase I and II Budgets



7 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The SWE Team, led by GDS, has worked diligently to guide the implementation of Act 129 from its inception and has improved the overall process through two phases of hard work from all parties involved including, the EDCs, TUS, evaluation contractors, program implementation contractors, and stakeholders. Highlights of Phase II are:

- *Finding 1 – All EDCs met their compliance targets for energy savings, low-income, and GNI carve-outs.*
- *Finding 2 –During Phase II, five of the seven Pennsylvania EDCs exceeded their Phase II savings targets without accounting for Phase I carryover savings. PPL and PECO had to make use of their Phase I carryover savings to meet their respective Phase II savings targets (as designed in their EE&C Plans), though their Phase II energy savings achievements were strong as well. It is important to note that PECO and PPL have no carry-over savings for Phase III.*
- *Finding 3 – The TRC ratio results were strong in each year of Phase II. The overall statewide TRC ratio was 1.7 in PY5, 1.6 in PY6, and 1.7 in PY7.*

It is notable that efficiencies were gained in many aspects of program delivery by the EDCs since Phase I, and likewise by the staff assigned to provide implementation and evaluation. Adjusting through the changes in the product delivery market and code legislation, the actors in the Act 129 program improved the cost-effectiveness of many parts of the portfolios and introduced a significant number of innovative pilot programs and measures. Some of these efforts are:

- Smart thermostat measure creation
- De facto Heating Pilot measure creation
- HVAC mini-split savings modification

Additionally, several studies were performed by the SWE during Phase II:

- Pennsylvania Statewide Residential and Commercial Baseline Study, April, 2014
- SWE Energy Efficiency Potential Study for Pennsylvania, February, 2015
- Distributed Generation Potential Study, April, 2015
- Demand Response Potential for Pennsylvania, February, 2015
- Residential Behavioral Program Persistence Study, December, 2015
- Statewide Commercial and Residential Light Metering Study, January, 2014

Please see Appendix E for a compendium of Phase II reports and memos for more information.

Recommendations

The SWE Team makes the following recommendations to the Commission to help maintain and improve future Act 129 activities. This consolidated list is based on the findings and recommendations in the Executive Summary.

1) The SWE Team reviewed EDC reported and evaluated savings and generally affirms their validity. The SWE Team does, however, note a few small errors in the calculations of reported MWh and MW savings for some of the EDCs. For example, some EDCs did not use the applicable Pennsylvania TRM values or algorithms when reporting gross verified savings for some energy efficiency measures. This report identifies where such errors have been made and makes recommendations on how they

should be corrected. The SWE Team recommends that any errors in reported PY5, PY6 or PY7 verified incremental or cumulative annual MWh or MW savings or reported benefit/cost calculations for an EDC be corrected[43] and that a revised EDC final Phase II annual report be filed with the Commission by May 31, 2017.[44]

2) In the SWE's PY6 report, the SWE recommended that net-to-gross (NTG) research be conducted for all market segments where an EDC offers Act 129 programs, including the residential low-income sector.[45] During PY7, six of the seven EDCs followed this recommendation. The EDCs conducted primary research and found that the NTG ratios (NTGRs) for their low-income programs ranged from 81% to 90%. This research shows that the NTGR for low-income programs is not 100%. An NTGR below 100% indicates that some of the program participants could have completed some of the upgrades on their own. This information is useful for program planning and design to ensure that measures are targeted to customers who cannot install them on their own. Going forward, the Phase II SWE Team recommends that NTG market research for residential low-income programs be conducted at least once in every Act 129 Phase. The Phase II SWE Team also recommends that the Commission consider setting the default NTGR ratio for Phase III for residential low-income programs at 90 percent given the NTGR research results in Phase II.

3) The overall TRC test benefit/cost ratio (B/C ratio), as reported by the EDCs and consolidated across each EDC for PY7, is 1.8. The net present value (NPV) savings to Pennsylvania ratepayers reported by the EDCs for PY7 is $443 million (~$1 billion in benefits minus ~$560 million in costs). In those instances, where calculation errors caused the NPV savings for an EDC's PY7 program portfolio to change by 1% or more, the SWE Team recommends that the EDC cost-effectiveness calculations be corrected and a revised EDC PY7 report be filed with the Commission by May 31, 2017.[46]

4) Based on the SWE Team audit activities conducted from PY5 to PY7, there still is evidence of high free-ridership for several EDC programs. For purposes of this report, the Phase II SWE defines high free-ridership as a rate above 50%. In the residential sector, free-ridership was highest for appliance and HVAC rebate and upstream lighting programs; it varied from moderate to high for appliance recycling; it was lowest for home performance and kit distribution programs. In the non-residential sector, free-ridership was highest in programs targeting small businesses, custom projects, and the GNI sector. When high free-ridership exists, the SWE Team recommends that EDCs should reexamine program design elements to determine whether free-ridership can be reduced in the future. All EDCs should continue to consider actions to reduce free-ridership in Phase III. In the non-residential sector, if any EDCs still allow customers to submit rebate applications after equipment purchase (and do not specify an eligibility time period), they should consider implementing a 90-day rebate eligibility clause for such purchases.[47]

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[43] This report provides information regarding any needed corrections to EDC annual reports for PY7.

[44] In February 2015 the PUC's TUS staff instructed the Phase II SWE project manager that in the event of an error with reported savings, an "EDC make reference and amendment in their subsequent report filings unless it is the final Phase II report that is needed for compliance, in which case you will prescribe a drop dead date after which it is too late to make modifications."

[45] Research conducted by SWE Team members in other jurisdictions indicates that the NTGR for low-income programs is often significantly different than 1.0. The SWE recommends that NTG research be conducted for the low-income sector in order to determine the net savings of programs targeted at this sector and to collect information to help in future planning and program design for Act 129 low-income programs.

[46] This report provides information regarding any needed corrections to EDC annual reports for PY7.

[47] Focusing on reducing program free-ridership rates, the SWE made this recommendation to the EDCs during several Phase II Program Evaluation Group (PEG) meetings. A 90-day rebate eligibility clause is recommended by the SWE to significantly reduce the possibility of granting rebates to program participants who have already installed qualifying measures without a rebate. The 90-day window of opportunity would be measured from the date of equipment purchase. Some of the EDCs already have implemented such eligibility requirements. Furthermore, the SWE recommends that additional research be conducted to determine the extent to which program participants who apply for

5) EDC process evaluations of home audit programs continued to show opportunities for greater conversion of audit participants to program participants. The SWE Team recommends that EDCs conduct research to track over time the percentage of home energy audits that result in purchases and installations of energy efficiency measures. Then the SWE can develop a comparison of these percentages across EDC audit programs. Having such comparative information across EDCs will help the SWE develop findings, best practices, and recommendations on program strategies that lead to the highest conversion rates from audit participants to program participants.

6) During Phase III, EDC database tracking systems should continue to adjust as necessary to capture sufficient measure detail so that the applicable TRM algorithms can be used to verify reported savings values and assumptions. The SWE Team found some instances in which the PY7 EDC tracking systems lacked the ability to capture these details. The SWE Team's specific recommendations for each EDC's data-tracking and reporting system are provided in Appendix A of this report.

7) During Phase II the percentage of participants in EDC residential low income programs receiving either a telephone or on-site inspection varied significantly among EDCs. Going forward, the Phase II SWE Team recommends that the TUS staff and Phase III SWE consider establishing clearer guidelines for the number of telephone and on-site inspections that need to be performed for residential low-income programs. The design of these guidelines will need to take into account differences in EDC low income programs. These guidelines should establish minimum requirements for the number and types of telephone and/or on-site inspections that need to be performed for low-income programs.

8) The SWE Team found that 9% of the verified savings in the non-residential sector in PY7 came from residential upstream lighting programs. This is a significant reduction from the 21% reported in PY5. The FirstEnergy companies already reported low amounts of cross sector savings from sales of high efficiency bulbs through its residential lighting programs. The other four EDCs reported substantial drops in the cross-sector savings associated with these upstream bulb programs as compared to levels in PY5. For Duquesne for PY7, the amount verified in this category was actually 0%. For PECO and PPL, the percentages verified were 14% and 12%, respectively, with those for the FirstEnergy companies ranging from 0.5% for Penn Power to 4.7% for Penelec and West Penn Power. The SWE Team recommends continued cross-sector sales analysis, as the findings show there are important shifts in the MWh and MW savings being reported in this category.

9) For all four EDCs under the FirstEnergy umbrella in Pennsylvania, the SWE found that kWh and kW savings calculations for PY7 for commercial and industrial (C/I) lighting projects were performed using a modified version of the 2015 Pennsylvania TRM Appendix C calculator. Use of the modified calculator makes it much more difficult for the SWE Team to review and verify the kWh and kW savings calculations for these types of energy efficiency projects. The Phase II SWE recommends that going forward the original Appendix C calculator be used.

10) SWE audit activities revealed that the EDCs that conducted process evaluations generally were consistent with the Phase II Act 129 Evaluation Framework but in some cases could have provided

a rebate two to three months after equipment purchase are free-riders. The SWE recommends that participant surveys ask how long the interval was between the purchase of the appliance and the submittal of the rebate application (if these data are not already in the EDC's program tracking system), and that analysis be done to determine the free-ridership rate for such participants as compared with participants who applied more quickly for a rebate. The SWE recommends that this research recommendation be discussed with PEG participants at a future meeting during Phase III. This research is necessary in order to provide Pennsylvania-specific information on whether the free-ridership rate increases as the length of time a participant takes to apply for a rebate (after a measure is installed) increases.

greater detail about methods and findings to support their conclusions. The SWE Team makes the following recommendations for improving process evaluations in the future:

a. EDC process evaluation reports should identify analysis methods, including level of analysis, and types of statistical tests performed.

b. When reporting response differences among subgroups, indicate whether the differences were statistically significant, and by what test.

c. Provide additional insights, when possible, into causes for programs struggling to meet participation and kWh/yr and kW savings targets.

d. Where possible, connect process evaluation recommendations to general conclusions based on multiple findings rather than to single findings.

e. Restrict the number of recommended actions identified in each process evaluation recommendation.

11) The SWE process evaluation audit activities for the PY7 programs found that the evaluation contractors made 175 Phase II process evaluation recommendations to the EDCs. Of this total, the EDCs' annual reports indicated that 103 (59%) were implemented (or accepted for planned implementation) by the EDCs, 53 (30%) were still being considered for implementation, and 19 (11%) were rejected by the EDCs. The 59% acceptance rate is considerably higher than that from PY5 (32%) and PY6 (36%). The 11% rejection rate also was higher than that from PY5 and PY6 (2% and 3%, respectively). In the PY6 SWE annual report, the SWE Team noted the high percentage of recommendations still under consideration, attributing it to the short interval between the dates that the evaluation contractors submitted their recommendations to the EDCs and the deadline for submitting the EDC annual reports. The SWE recommended that the EDCs establish priorities for the process evaluation recommendations so that the most important recommendations are resolved quickly. Additional information obtained for this Phase II SWE Final Report sheds more light on this issue. The SWE Team observed that in every program year of Phase II, the annual report for one EDC showed that no recommendations were yet accepted. Concerns about committing resources during a major information technology (IT) implementation that occurred throughout Phase II reportedly prevented the EDC from identifying recommendations as accepted or implemented in time for the annual report. This only partly explains the high overall percentage of recommendations that remained under consideration at the time of the annual reports, however. While that EDC had the highest percentage of Phase II recommendations under consideration, it also had the fewest recommendations to consider. Dropping that EDC out of the analysis had a minimal effect on the overall percentage of recommendations still under consideration. The purpose of having EDCs indicate the status of recommendations in their annual reports is to show whether the evaluation contractors have provided clear and actionable recommendations and whether the EDCs have given them due consideration. Therefore, the SWE Team recommends that instead of identifying each recommendation as implemented, under consideration, or rejected, the EDCs identify them as implemented, high priority for implementation, medium priority for implementation, low priority for implementation, or rejected.

12) The EDC PY5, PY6, and PY7 annual reports to the PUC show different participation rates across EDCs for similar types of programs. The SWE recommends that the TUS staff and the Phase III SWE conduct a study to examine this issue more thoroughly in order to understand the factors causing these different levels of participation, including whether the EDCs are calculating and reporting participation rates on the same basis. The results of this analysis can be used for two purposes:

a. to clarify how program participation levels and participation rates should be calculated and reported to the PUC; and,

b. to identify whether any EDC should consider modifying the design attributes (marketing strategy, delivery channels, incentive levels, education and outreach efforts, etc.) of a program in order to improve program efficiency and effectiveness. Such modifications or enhancements to these aspects of program design are very important when trying to improve participation rates.

13) Evaluations of home energy audit programs may show opportunities for greater conversion from audits to incented projects, with some evaluations identifying specific market barriers. Conversion of an energy audit participant to a program participant may not occur within the same program year. Going forward, the SWE recommends that EDC evaluation contractors should investigate whether customers who had energy audits in a given program are more likely than customers who did not receive an audit to carry out incented projects in later program years. Currently such data or information is not available for the EDC home energy audit programs. EDCs also should investigate ways to overcome identified barriers and in general increase follow-up outreach to audit participants to encourage conversion.

14) The process evaluation of PPL's residential lighting program (that offered only discounted LEDs throughout Phase II) found that disposal behavior for compact fluorescent light (CFL) bulbs remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of there being more recycling bins in diverse locations. The SWE recommends that if this is not already addressed by the EDCs, that the EDCs work together during Phase III to modify the education and outreach portion of residential lighting programs, in order to increase significantly the percentage of customers who dispose of CFLs in recycling bins.

15) The SWE Team found a few instances where EDCs did not use measure lives listed in the TRM in their calculations of the TRC test. The SWE recommends that the TRM be used as the primary source for measure life values when they are available and listed in the Pennsylvania TRM. In addition, the SWE recommends that errors in the use of measure lives be corrected in each EDC's final report for Phase II, if these corrections will cause the overall EDC portfolio TRC ratio for PY7 to change by more than plus or minus one percent.

16) The SWE Team recommends that EDCs provide additional documentation of the methodology and data used to calculate cross-sector residential lighting and low-income sales. In order to provide more foundation for the calculations of cross-sector sales estimates, the SWE recommends that each EDC should report the sample sizes used for the evaluation research, the distribution of intercept stores (name of store, size of store, etc.), distribution of weekend versus weekday intercept surveys, and time of year the intercept surveys were administered. This information would allow the SWE Team to understand whether there may have been any changes over time in the methodology used by EDCs to estimate cross-sector sales. Changing the methodology over time can affect the research results. The SWE wants to ensure that changes in estimates of such cross-sector sales of lighting products are driven entirely by changes to program design rather than changes in research methods and sampling techniques. Given the upstream residential lighting programs' significant contribution to each EDC's portfolio savings, the SWE Team recommends that the EDC evaluation contractors include additional details regarding the research methods in future annual reports as well as a discussion related to differences in parameter estimates. The Phase II SWE also recommends that the Phase III SWE consider developing guidelines or protocols for research methods to be used for determining cross sector sales.

17) The SWE recommends that thorough auditing of program applications for C/I measures be continued by EDCs, to ensure clarity of the project files for the subsequent SWE review.

18) The SWE Team found that all EDCs either used the approved common NTG research methods or used them with acceptable modifications. Some EDCs also used other acceptable methods where the SWE Team did not establish a common method. The SWE Team continues to recommend that, where applicable, the EDC evaluation contractor's report explicitly state how a given survey instrument differs from the common NTG method approved by the SWE and TUS, and why the EDC survey instrument, if different than the common method, would not produce a systematically different result from the result that would be achieved if the common method were used.

APPENDIX A | PY7 AUDIT ACTIVITIES AND FINDINGS

Appendix A provides the PY7 audit activities and findings for each EDC.

A.1 DUQUESNE LIGHT

This section summarizes Duquesne's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by Duquesne's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by Duquesne's evaluation contractor to conduct M&V of Duquesne's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve Duquesne's programs in the future.

A.1.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.1.1.1 Phase II Savings by Program

Table A-1 lists the Duquesne EE&C programs that yielded reported savings in PY7. Table A-2 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The upstream lighting program was the largest contributor of both energy and demand savings.

Table A-1: Duquesne EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector(s)
Residential: EE Program (REEP): Rebate Program	Residential
Residential: EE Program (Upstream Lighting)	Residential
Residential: School Energy Pledge	Residential
Residential: Appliance Recycling	Residential
Residential: Whole House	Residential
Residential: Low-Income EE	Low-Income
Residential: Low-Income EE (Upstream Lighting)	Low-Income
Residential: Low-Income EE (Home Energy Report)	Low-Income
Commercial Sector Umbrella EE	Non-Residential
Healthcare EE	Non-Residential
Industrial Sector Umbrella EE	Non-Residential
Chemical Products EE	Non-Residential
Mixed Industrial EE	Non-Residential
Office Building - Large EE	Non-Residential
Primary Metals EE	Non-Residential
Public Agency / Non-Profit	Non-Residential
Retail Stores - Small EE	Non-Residential

Programs Reporting PY7 Gross Savings	Sector(s)
Multifamily Housing Retrofit	Non-Residential
Small Commercial Direct Install	Non-Residential

Table A-2: Summary of Duquesne EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Residential: EE Program (REEP): Rebate Program	8,301	2%	1.089	2%
Residential: EE Program (Upstream Lighting)	109,372	29%	8.876	19%
Residential: School Energy Pledge	435	0%	0.028	0%
Residential: Appliance Recycling	6,229	2%	0.788	2%
Residential: Whole House	120	0%	0.012	0%
Residential: Home Energy Report Program	26,094	7%	0.000	0%
Residential: Low-Income EE	3,410	1%	0.424	1%
Residential: Low-Income EE (Upstream Lighting)	13,573	4%	0.833	2%
Residential: Low Income EE (Home Energy Report Program)	2,085	1%	0.000	0%
Commercial Sector Umbrella EE	7,747	2%	1.179	3%
Commercial Sector Umbrella EE (Upstream Lighting)	27,079	7%	7.591	17%
Healthcare EE	6,679	2%	0.486	1%
Industrial Sector Umbrella EE	1,751	0%	0.344	1%
Chemical Products EE	19,407	5%	2.550	6%
Mixed Industrial EE	13,888	4%	1.956	4%
Office Building - Large EE	36,879	10%	5.305	12%
Office Building - Small EE	838	0%	0.203	0%
Primary Metals EE	45,091	12%	5.307	12%
Public Agency / Non-Profit	21,964	6%	4.085	9%
Retail Stores - Small EE	7,468	2%	1.709	4%

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Retail Stores - Large EE	6,896	2%	1.546	3%
Multifamily Housing Retrofit	4,276	1%	0.404	1%
Small Commercial Direct Install	7,667	2%	0.904	2%
Total Portfolio	***377,248***	***100%***	***45.620***	***100%***

A.1.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-3. In PY7, the net energy savings were approximately 75% of the gross energy savings.

Table A-3: Summary of Duquesne EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	68,641	55,283	173,723	116,825
C/I	64,368	42,341	181,390	115,439
GNI	9,178	7,375	22,135	16,055
Total Portfolio	***142,187***	***104,999***	***377,248***	***248,319***

A.1.2 Total Resource Cost Test

Table A-4 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for Duquesne's PY7 individual programs and total portfolio according to the Duquesne TRC model provided to the SWE for review. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-4: Summary of Duquesne's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Residential EE Program	$26,015,654	$9,182,514	$16,833,140	2.83
School Energy Pledge	$8,252	$141,335	($133,083)	0.06
Appliance Recycling	$652,924	$489,749	$163,175	1.50
Whole House	$10,004	$370,397	($360,394)	0.03
Home Energy Reports	$1,292,138	$710,616	$581,522	1.82
Low-Income EE	$1,196,004	$453,848	$742,156	2.64
Commercial Sector Umbrella EE	$5,193,435	$2,426,126	$2,767,309	2.14

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Healthcare EE	$3,210,938	$1,580,628	$1,630,310	2.03
Industrial Sector Umbrella EE	$56,094	$101,625	($45,532)	0.55
Chemical Products EE	$15,169,346	$6,242,843	$8,926,502	2.43
Mixed Industrial EE	$3,532,819	$929,713	$2,603,106	3.80
Office Buildings EE	$6,496,345	$5,371,514	$1,124,831	1.21
Primary Metals EE	$15,184,961	$2,966,511	$12,218,450	5.12
Public Agency/Non-Profit	$7,136,617	$6,219,144	$917,473	1.15
Retail Stores EE	$41,619	$216,249	($174,630)	0.19
Multifamily Housing Retrofit	$878,354	$1,690,457	($812,104)	0.52
Small Commercial Direct Install	$1,584,438	$1,371,088	$213,350	1.16
Total Portfolio	**$87,659,941**	**$40,464,358**	**$47,112,879**	**2.16**

In summary, 12 of 17 Duquesne programs were found to be cost-effective and 5 were found to be non-cost-effective. Home Energy Reports, Commercial Sector Umbrella EE, Healthcare EE, and Chemical Products EE all transitioned to be cost-effective in PY7, likely due to increased participation offsetting fixed costs. Conversely, Retail Stores EE, which saw a significant decrease in participation, was not cost-effective in PY7. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Residential Energy Efficiency Program*
- *Residential Appliance Recycling Program*
- *Home Energy Reports*
- *Low-Income Energy Efficiency Program*
- *Commercial Sector Umbrella EE*
- *Healthcare EE*
- *Chemical Products EE*
- *Mixed Industrial*
- *Office Building EE*
- *Primary Metals EE*
- *Public Agency/Non-Profit*
- *Small Commercial Direct Install*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *School Energy Pledge Program*
- *Whole House EE*
- *Industrial Sector Umbrella EE*
- *Retail Stores EE*
- *Multifamily Housing Retrofit*

A.1.2.1 Assumptions and Inputs

Duquesne used a discount rate of 6.9% in its TRC model to discount program benefits and costs for all programs. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Duquesne reported a LLF of 6.9% for calculating energy and demand savings for all programs in PY7. [48] Table A-5 shows the discount rates and the energy and demand LLF values that Duquesne used for all programs in their TRC model.

Table A-5: Duquesne's Discount Rates and Line Loss Factors

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
Residential EE Program	Residential	6.9%	6.9%	6.9%
School Energy Pledge	Residential	6.9%	6.9%	6.9%
Appliance Recycling	Residential	6.9%	6.9%	6.9%
Whole House	Residential	6.9%	6.9%	6.9%
Home Energy Reports	Residential	6.9%	6.9%	6.9%
Low-Income EE	Low Income	6.9%	6.9%	6.9%
Commercial Sector Umbrella EE	Commercial	6.9%	6.9%	6.9%
Healthcare EE	Commercial	6.9%	6.9%	6.9%
Industrial Sector Umbrella EE	Industrial	6.9%	6.9%	6.9%
Chemical Products EE	Industrial	6.9%	6.9%	6.9%
Mixed Industrial EE	Industrial	6.9%	6.9%	6.9%
Office Buildings EE	Commercial	6.9%	6.9%	6.9%
Primary Metals EE	Industrial	6.9%	6.9%	6.9%
Public Agency/Non-Profit	Commercial	6.9%	6.9%	6.9%
Retail Stores EE	Commercial	6.9%	6.9%	6.9%
Multifamily Housing Retrofit	Commercial	6.9%	6.9%	6.9%
Small Commercial Direct Install	Commercial	6.9%	6.9%	6.9%

NOTE:
[a] Duquesne's PY6 annual report shows line losses as a multiplier (1.074).

Duquesne's B/C model assigned an EUL to each measure listed in Duquesne's TRC model. The details of the EULs were listed in Duquesne's Phase II Measure Table in the extract databases that were submitted to the SWE Team. The SWE Team spot-checked the measure lives in the Duquesne TRC model against the measure lives in the 2015 TRM and found no variances. The SWE notes that Duquesne corrected any inconsistencies detected in prior Phase II program years. The SWE Team also found the measure lives applied to custom measures not explicitly stated in the TRM to be reasonable.

As in prior Phase II program years, the evaluation contractor, Navigant, applied incremental costs at the measure level for both the residential and non-residential programs in the Duquesne TRC model. Navigant listed sources for the cost assumptions clearly in the TRC model as well as in Appendix B of

[48] Duquesne reported a line loss multiplier of 1.074, but SWE has converted to a line loss factor of 6.9% for consistency across the EDCs.

Duquesne's PY7 annual report. The incremental cost values came from a variety of sources, including the SWE incremental cost database, C/I Fluorescent Lighting Cost Study,[49] and actual invoice costs in Duquesne's Program Management and Reporting System (PMRS) database.

The TRC model drew the energy and demand impacts from the PMRS database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC analysis was based on ex post verified savings, so the model adjusted program impacts by an applicable realization rate. The model applied separate realization rates to energy and demand impacts. The SWE Team found no observable differences in the TRC model and the PY7 Annual Report for both verified gross energy and demand.

In PY7, the 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures, but did not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. The Duquesne TRC model uses an adjusted EUL to account for the dual baseline measures.

A.1.2.2 Avoided Cost of Energy and Capacity

The PY7 Duquesne TRC Models use the Phase II approved avoided costs of energy and capacity.[50] The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.1.2.3 Conclusions and Recommendations

The Duquesne TRC model is performing all of the B/C calculations in accordance with the 2013 TRC Order. The SWE Team review of the Duquesne TRC model found no calculation errors and believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.1.3 Status of Evaluation Activities

This section discusses the status of Duquesne EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.1.3.1 Status of Evaluation, Measurement, and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation Framework that was applicable for PY7 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology

[49] C/I Fluorescent Lighting Cost Study refer to primary pricing research conducted by Duquesne.

[50] In PY6, the SWE and Duquesne coordinated to make a minor adjustment to the avoided costs in the approved Duquesne EE&C plan. This adjustment shifted the stream of avoided costs in the EE&C plan into more appropriate program years. The PY7 TRC model follows this adjustment.

- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-6 displays key milestones completed by Duquesne and the SWE for the company's Phase II EM&V Plan. The table shows all of the key milestones relating to the Duquesne Phase II EM&V Plan that have occurred to date during Phase II, in order to provide a complete picture of the on-going refinement of this plan.

Table A-6: Key Milestones Reached for Duquesne's Phase II EM&V Plan

Date	Event
September 6, 2013	Duquesne submits first draft of Phase II evaluation plan to the PUC and SWE
October 13, 2013	SWE returns comments on the Duquesne evaluation plan to Duquesne
November 13, 2013	SWE sends a list of "items that be must addressed" to Duquesne
December 31, 2013	Duquesne submits revised Phase II evaluation plan to the PUC and SWE
January 9, 2014	Duquesne submits revised table for the evaluation plan for the Duquesne HER Program
March 21, 2014	SWE confirms that Duquesne's final Phase II evaluation plan is approved by the SWE
June 1, 2014	PY6 starts
July 21, 2015	Duquesne submits revisions to Duquesne PY6 EM&V Plan

Duquesne's draft EM&V Plan, submitted September 6, 2013, provided proposed evaluation objectives and ongoing evaluation activities for all of Duquesne's programs. The plan presented key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts for each of Duquesne's programs. The SWE Team reviewed the plan and submitted comments on it to Duquesne. Substantive recommendations for revisions to the plan were limited to a series of common tasks. The SWE's comments were summarized in the SWE's PY5 annual report to the PUC. The revisions to the Duquesne evaluation plan that were provided by the company on December 31, 2013 and January 9, 2014 were approved by the SWE Team.

Duquesne made three clarifications to its evaluation plan for PY6. The three clarifications were not formally submitted until PY6 had concluded, but they are mentioned here because of their relevance to the evaluation of PY6 program activity:

1) Duquesne clarified to the SWE that the company's C/I programs are grouped into three non-residential program groups (within two non-residential-sector market segments) based on shared characteristics. These groups, which have existed since Phase I of Act 129, are the Commercial Program Group, GNI Program Group, and Industrial Program Group. Each program group includes multiple subprograms. All programs have the same incentives and measures. The differences among programs are marketing channel and approach.

2) Duquesne clarified information about two new Act 129 programs: The Small Commercial Direct Install Program and the Multifamily Housing Retrofit Program. Duquesne explained that its PY6 evaluation plan indicated that these two new programs would be evaluated after the programs were launched.

3) Duquesne clarified to the SWE that sampling for the Commercial and GNI program group's project verification will be at the project level. The company clarified that sampling for the Industrial Program Group will be at the measure level. This sampling was implemented successfully for PY5 and was repeated for PY6. Non-residential sampling included stratification based on expected energy savings from PY5. In July 2015 Duquesne clarified to the SWE the sampling plan for the Industrial Program Group.

A.1.3.2 Measurement and Verification Activities and Findings

By the end of PY7, Duquesne had achieved 136% of its total Phase II energy savings compliance target, based on aggregated verified Phase II savings, and 185% of its energy savings compliance target if the Phase I carryover savings are included. Realization rates compare gross savings reported by the EDC with the verified gross savings determined by the EDC evaluation contractor through M&V activities. The calculation for realization rate is:

$$Realization\ Rate = \frac{\sum Verified\ Savings}{\sum Reported\ Savings}$$

Realization rates are calculated based on a census of all program participants or on a sample of program participants and applied to all program participants. A realization rate of 100% indicates that the EDC's evaluation contractor was able to verify all savings reported by the EDC. A realization rate of less than 100% indicates that reported savings were overestimated. A realization rate of more than 100% indicates that reported savings were underestimated.

Table A-7 summarizes the realization rates, and associated precision estimates, for energy and demand savings for each of Duquesne's energy efficiency programs in PY7. The realization rates and precision estimates are based on activities conducted by Navigant, on details provided in Duquesne's PY7 annual report, and on information obtained from the SWE Team's data requests and audit.

Table A-7: Duquesne Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY7

Program	Realization Rate – Energy	Achieved Sampling Precision – Energy[b]	Realization Rate – Demand	Achieved Sampling Precision – Demand
Residential: EE Program (REEP): Rebate Program	76%	12%	87%	8%
Residential: EE Program (Upstream Lighting)	102%	0%	102%	0%
Residential: School Energy Pledge	66%	16%	71%	18%

Program	Realization Rate – Energy	Achieved Sampling Precision – Energy[b]	Realization Rate – Demand	Achieved Sampling Precision – Demand
Residential: Appliance Recycling	101%	1%	101%	1%
Residential: Whole House	89%	6%	87%	6%
Residential: Low-Income EE	96%	2%	97%	2%
Residential: Low-Income EE (Upstream Lighting) [a]	101%	0%	101%	0%
Residential: Low-Income Home Energy Reports	102%	0%	NA	NA
Residential: Home Energy Reports	99%	0%	NA	NA
Commercial Sector Umbrella EE	103%	4%	113%	20.8%
Commercial Sector Umbrella EE (Upstream Lighting)	103%	4%	113%	20.8%
Healthcare EE	103%	4%	113%	20.8%
Industrial Sector Umbrella EE	99%	2%	94%	6.4%
Chemical Products EE	99%	2%	94%	6.4%
Mixed Industrial EE	99%	2%	94%	6.4%
Office Building – Large EE	103%	4%	113%	20.8%
Office Building – Small EE	103%	4%	113%	20.8%
Primary Metals EE	99%	2%	94%	6.4%
Public Agency / Non-Profit	85%	10%	74%	28.0%
Retail Stores – Small EE	103%	4%	113%	20.8%
Retail Stores – Large EE	103%	4%	113%	20.8%
Multifamily Housing Retrofit	85%	10%	74%	28.8%
Small Commercial Direct Install	103%	4%	113%	20.8%

NOTE:
[a] Commercial portion of upstream lighting program is shown separately, as in the Duquesne PY7 annual report.
[b] PY7 precision estimates are at the 85% confidence level.

The Duquesne residential programs saw improved results for both energy and demand realization rates in PY7 relative to PY6, and the overall residential energy realization rate increased slightly again for the third year in a row, from 98% in PY5 to 99% in PY6 to 100% in PY7. Realization rates for energy savings from Duquesne's residential programs in PY7 ranged from a low of 66% (School Energy Pledge) to a high of 102% (Low-Income Home Energy Reports). Realization rates for demand reductions ranged from 71% (School Energy Pledge) to 102% (Upstream Lighting). The consistently low realization rates for Duquesne's residential School Energy Pledge and REEP kits programs can be attributed to the consistently lower installation rates for the equipment included in the kits.

Neither Navigant nor Duquesne (nor Duquesne's CSP) administered any on-site inspections for the residential program M&V process. Per Duquesne's EM&V Plan, Section 3.2, the basic level of verification rigor was to be used for TRM deemed savings measures and for measures with rebates of less than

$2,000. The basic level of verification rigor included a telephone survey of a random sample of participants to verify participation and installation (except for the Upstream Lighting Program, where end-use customer participant information was unavailable). Table A-8 presents an overview of the M&V verification process and findings for residential programs.

Table A-8: Overview of Duquesne Residential Program M&V and Installation Rate

Program	Component	Inspections Entity (CSP, EDC, M&V, Other)	Telephone or On-Site	Sample Size – Participant (Part), Measure	Notes on Installation Rate
Residential: EE Program (REEP): Rebate Program	Rebate	M&V	Telephone	Part n=59, Measure n=84	One programmable thermostat not installed
	Kits	M&V	Telephone	Part n=25, Measure n=175	37% of CFLs not installed; 30% of smart strips not installed; 39% of LED nightlights not installed
	Lighting	N/A	N/A	N/A	N/A
Residential: School Energy Pledge (SEP)	All	M&V	Telephone	Part n=27, Measure n=216	30% of CFLs, 50% of limelights, and 30% of smart strips not installed
Residential Appliance Recycling (RARP)	All	M&V	Telephone	Part n=109, Measure n=115	Three additional refrigerators not in database were recycled
Residential: Whole House (WHEAP)	All	M&V	Telephone	Part n=22, Measure n=222	3% of CFLs not installed; 1 of 1 smart strip not installed
Residential: Low-Income EE (LIEEP)	Rebates/Kits/ RARP/SEP/ WHEAP	M&V	Telephone	Part n=96, Measure n=338	1 thermostat not installed; 29% of kits not installed; 2 additional refrigerators recycled; 37% of SEP kits not installed; 10% of WHEAP CFLs not installed
	Lighting	N/A	N/A	N/A	N/A

Program	Component	Inspections Entity (CSP, EDC, M&V, Other)	Telephone or On-Site	Sample Size – Participant (Part), Measure	Notes on Installation Rate
Residential: Home Energy Reports (includes Low-Income)	All	N/A	Billing Analysis	Census	N/A

A.1.3.2.1 Residential Programs

The discussion below provides an in-depth review of Navigant's M&V activities and findings for each of the residential programs.

The evaluation contractor's primary M&V efforts for REEP varied based on the program component. For efficiency kits and rebates, the primary M&V activity included a telephone survey of a random sample of participants, based on subprogram strata, to verify installations and estimate installation rates. The REEP rebates evaluation also included an application review for the same sample of phone verification participants. The non-lighting evaluation approach included random sampling of participants using a simple ratio estimator (a statistical parameter which is the ratio of the means of two variables) to review the measure and project qualification, verify participation and installation, verify deemed savings application, and then apply the sample population realization rate to the entire participant population. The upstream lighting component received database verification consistent with the SWE audit approach and verified the PMRS tracking database records against the implementer-based invoicing system (ECOVA) and included a complete baseline wattage review and TRM algorithm verification.

Similar to the results of the PY6 evaluation, the kits component of the program had the lowest realization rate, which is attributable to participants not installing some or all of the CFLs (n=4 of 15 did not install any), smart strips (n=4 of 15 are not using the measure), or LED nightlights (n=2 of 15 did not install). Installation rates for the kits have remained unchanged—at about 63%—since PY6. The achieved sample size fell well short of the EM&V planned sample size due to the low PY7 participation levels for this program. The energy savings realization rate for REEP (rebate, kits, and upstream components combined) has improved, climbing from 95% in PY5 to 99% in PY6 and 101% in PY7. The improvement can be attributed to the improvement in application of TRM savings within the PMRS database coupled with the shift in overall savings toward the upstream lighting component: in PY5, the upstream lighting component represented 82% of REEP savings, compared with 95% in PY6 and PY7.

The evaluation contractor's primary M&V efforts for SEP included a survey of a random sample of participants to verify installations and estimate realization rates. The approach included random sampling of participants using a simple ratio estimator to review the measure and project qualification, verify participation and installation, verify deemed savings application, and then apply the sample population realization rate to the entire participant population. The achieved sample size fell well short of the EM&V planned sample size due to the low PY7 participation levels for this program. The relatively low savings realization rate of SEP is due to participants not installing the CFLs and smart strips (n=8 out of 27) and LED limelights (n=14 out of 27). Though the energy savings realization rate for this program had declined from PY5 (73%) to PY6 (56%), it rebounded in PY7 (66%).[51]

[51] These realization rates are inclusive of both market and low-income SEP participants.

The evaluation contractor's primary RARP M&V efforts included a survey of a random sample of participants to verify removal or replacement and estimate realization rates. The approach included random sampling of participants using a simple ratio estimator to review the measure and project qualification, verify participation and installation, verify deemed savings application, and then apply the sample population realization rate to the entire participant population. The energy realization rate for this program has remained high, at 102% in PY5, 101% in PY6, and 101% in PY7.

The WHEAP is a relatively new program, with rollout first occurring in PY6. The evaluation contractor's primary M&V efforts included a survey of a random sample of participants to verify installations and estimate verification rates. The approach included random sampling of participants using a simple ratio estimator to review the measure and project qualification, verify participation and installation, verify deemed savings application, and then apply the sample population realization rate to the entire participant population. The achieved sample size fell well short of the EM&V planned sample size due to the low PY7 participation levels for this program. For the previous PY6 WHEAP impact evaluation, two strata were defined (exclusive of LIEEP participants): whole house small and whole house large. Based on the results of the PY6 evaluation, Navigant noted in the PY7 report that there wasn't the anticipated level of installation rate variation across these two strata. It was because of the lack of variation coupled with the smaller overall PY7 population size that Navigant chose to create a single-stratum sample for PY7.

The PY7 WHEAP evaluation found that a majority of WHEAP customers were low-income–consistent with PY6 results. Navigant reviewed CSP documentation against the PMRS system data to confirm the appropriate classification of participants as market-rate or low-income and noted that the classification as low-income was not always reflected in PMRS. Navigant reclassified participants and associated reported savings from WHEAP to LIEEP WHEAP where appropriate. The small evaluation sample[52] contained 50% more LIEEP participants than market-rate, for a combined sample size of only 22 participants (9 market-rate, 13 low-income). Because of the small sample size, Navigant decided to combine the market-rate and LIEEP participants into a single stratum, to increase the verification precision. The evaluation found WHEAP energy realization rates to be 89%, proving yet again that even with a direct installation program delivery, participants can be expected to remove some of the installed equipment. As an example, Navigant noted that one participant reported that only 1 of the 10 CFLs remained installed: some lamps had either broken or burned out.

The evaluation contractor's primary M&V efforts for LIEEP included a survey of a random sample of participants based on subprogram strata (equipment rebates, efficiency kits, SEP, RARP, and WHEAP) to verify installations and estimate installation rates.[53] The upstream lighting and HER components were evaluated separately. The upstream lighting component received database verification consistent with the SWE audit approach, and verified the PMRS tracking database records against the implementer-based invoicing system (ECOVA). The low-income HER component evaluation included the same overall HER approach, which included a billing analysis. The LIEEP-based percentage of upstream lighting CFLs was assigned based on the previous PY6 general population telephone survey (4.9% in PY6). In addition, 2.3% of all LEDs were assigned to LIEEP; the associated levels of savings and incentive costs were

[52] There were only 186 PY7 WHEAP participants (both market-rate and low-income), resulting in a small overall population from which to sample.
[53] The PY6 LIEEP evaluation excluded rebates. Rebates contributed very little to overall program savings.

allocated to LIEEP. The non-lighting approach included random sampling of participants using a simple ratio estimator, to review the measure and project qualification, verify participation and installation, verify deemed savings application, and then apply the sample population realization rate to the entire participant population.

The SEP component of the program had the lowest realization rate, attributable to participants not installing all three measures (CFLs, smart strips, and LED nightlights). The SEP component of LIEEP showed slightly lower installation rates (63%) relative to the stand-alone SEP (69%). The kits component of LIEEP had a lower installation rate in PY7 (71%) than in PY6 (90%) but was consistent with PY5 installation rates (69%). The overall energy savings realization rate for LIEEP has remained high, climbing from 94% in PY4 to 98% in PY6 and remaining at 98% in PY7.

As in WHEAP for market-rate customers, the low-income WHEAP component became active during PY6. WHEAP offers income-eligible customers whole home audits, free of charge, where auditors and assessors conduct examinations of home characteristics and offer recommendations to reduce energy consumption and improve home comfort. Additionally, WHEAP offers low-income participants direct-install measures at no charge. The LIEEP component of WHEAP showed consistent installation rates, as did the overall WHEAP program (89% overall). The LIEEP RARP verification effort confirmed that reported appliances were recycled along with two additional recycled refrigerators that were not logged in the PMRS system (versus one additional recycled refrigerator for market-rate RARP); the realization rate was 105%, accounting for the two additional recycled units.

The HER Program was launched in PY4 and targets high-use residential customers. The program included a total of over 225,400 participant enrollees, with just over 10% of participants (25,000) being low-income. Since the HER Program is considered a behavioral program, savings from delivery of the reports have a one-year lifetime for as long as the reports are being delivered. Only savings originating from the PY7 HER Program are counted toward Duquesne's compliance goals for Phase II, as opposed to previous Phase II HER participants (from PY5 or PY6).[54]

Navigant developed a linear fixed effects regression (LFER) model to estimate verified PY7 HER savings. Navigant used a census of three independent waves of participants who received reports starting in March of PY6: the first wave was households that were originally enrolled in the program during PY4 and still had active accounts with Duquesne, plus one market-rate and one low-income customer who began receiving reports at the same time. Because the program used a randomized control trial (RCT) experimental design, households were already randomized into treatment and control groups for an unbiased sample to evaluate savings. The HER electric energy verified realization rate was within 1% of the reported energy savings.

A.1.3.2.2 Non-Residential Programs

Realization rates for Duquesne's C/I programs' energy savings ranged from 85% to 103% in PY7. Realization rates for demand reductions from these programs ranged from 74% to 113%. Duquesne achieved the 15% precision requirement for kWh in all of its non-residential programs. It also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II.

[54] Section A.2.c.2 of the Commission's Phase II Final Implementation Order14.

Figure A-1 displays the frequency of each M&V approach performed by Navigant in PY7 for Duquesne's Commercial and GNI Program Groups evaluation sample and the verified energy savings associated with each M&V approach. The enhanced rigor used in the evaluations includes International Performance Measurement and Verification Protocol (IPMVP) Options A, B, C, and D. Option A combines the measurement of key parameters of retrofitted equipment with the use of stipulated values for other measurement parameters. Option B involves more robust measurement of the retrofitted system's continuous energy usage, typically through short-term power metering. Option C consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. Option D involves modeling energy performance of a facility before and after the efficiency measure is installed.

Figure A-1: Frequency of and Associated Energy Savings by M&V Approach – Commercial and GNI Program Groups

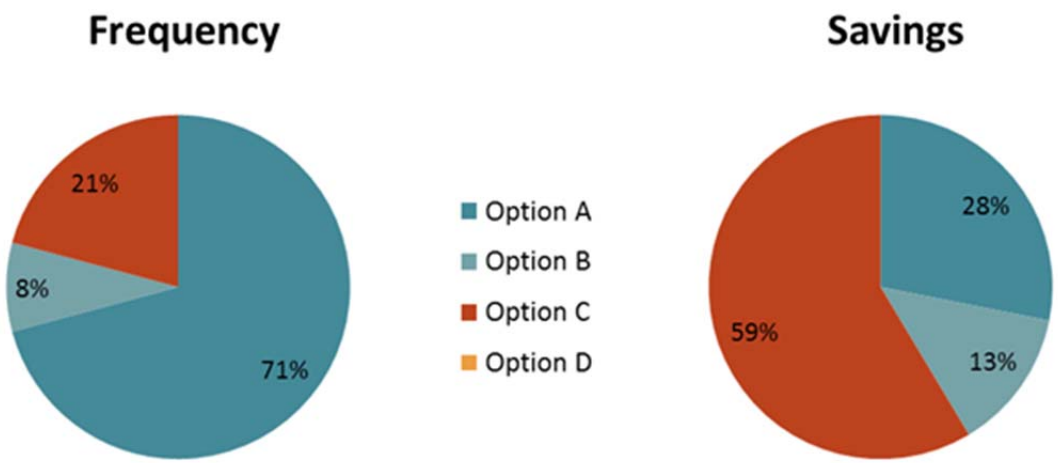


Figure A-1 indicates that Navigant used IPMVP Option A for 71% of the projects selected for sampling, yet these made up 28% of the total savings for the program. The majority of the savings were evaluated using Option C. All projects were evaluated with enhanced rigor.

Figure A-2 breaks out the share of projects evaluated and the associated verified savings using each M&V approach for the Industrial Program Group. IPMVP Option A was used for a majority of the projects in this program group, yet this only accounted for 11% of the savings. The majority of the savings (89%) were evaluated with Option B. All projects were evaluated with enhanced rigor.

Figure A-2: Frequency of and Associated Energy Savings by M&V Approach – Industrial Program Group

Two additional programs, the Small Commercial Direct Install Program and the Multifamily Housing Retrofit Program, received separate treatment in PY6 because they were new that year, but in PY7 they were evaluated as part of the Commercial Program Group.

A.1.3.3 Process Evaluation Activities and Findings

The process evaluation that Navigant conducted included a review of key program documents and databases, surveys of participants, surveys of those who opted not to receive HERs, and interviews with program staff. Table A-9 summarizes the data sources used and the key findings for each program.

Table A-9: Summary of Key Findings and Data Sources – Duquesne

Program	Key Findings	Data Sources
Residential Sector		
Residential Energy Efficiency Program (REEP)	– Rebate participants learned about rebates online, at retail stores, and from contractors. – Events and online information were the most influential sources of information. – Participants were generally satisfied with the rebate program. – Kit participants learned about the kits largely via online sources, family and friends, and email. – Kit participants were largely satisfied with the program. – Kit participants made five suggestions for ways to improve the program offerings or outreach.	– Program manager (n=1) – Rebate participants (n=59, 55 market rate and 4 low-income) – Kit participants (n=15)
Residential Appliance Recycling Program (RARP)	– Participants heard about the program largely through family and friends, television, or bill inserts. – Satisfaction was high among participants, except for the time it took to receive the incentive. Recipients were probably less satisfied with this component because of JACO's exit from the program. – Less than half of participants noted ways to improve the program. The most commonly cited ways were to improve rebate processing time and program advertising. – The cash incentive and convenience of participating	– Participants (n=109)

Program	Key Findings	Data Sources
	were the main reasons respondents chose to participate.	
School Energy Pledge Program (SEP)	– The program did not meet its program year goals and is being replaced in Phase III. – Satisfaction was high among participants. – Across Phase II, parents cited the information about the program supplied by their children as the reason they elected to participate. – Suggestions for improvements included offering more products in the kits, more education for students about reducing energy use, and increasing awareness of the program.	– Program manager (n=1) – Participants (n=27, 14 market rate and 13 low-income)
Whole House Energy Audit Program (WHEAP)	– Participants heard about the program from multiple sources. – Interactions with people knowledgeable about the program were more influential than items like bill inserts and ads. – Program satisfaction was generally high, and almost all respondents reported they would recommend the program to others. – Of those not satisfied with the program, two did not like the small size of the refrigerator, two did not see reductions in their bills, and one did not like the service received from the auditor. – Two respondents installed efficient equipment without an incentive because of their participation in the program. – Most participants could not recall their audit recommendations.	– Participants (n=22, 9 market rate and 13 low-income)
Residential Home Energy Report Program (HER)	– More than one-quarter of HER recipients could not recall receiving HERs. – More than one-third of HER recipients reported that the purpose of the HER was to compare their energy use to others, and slightly more than one-quarter reported that it was to persuade them to use less energy. – The large majority of respondents reported satisfaction with the HERs and described the reports as accurate. – HER recipients most commonly reported valuing the comparison of energy use to prior years and the energy savings tips. – HER recipients and those who opted out of receiving HERs reported making energy efficiency upgrades in the last 12 months. – Opt-out customers chose to opt out because they did not find the information valuable, felt shamed by the reports, or did not have time to read the reports.	– Participants (n=134, 59 market rate and 75 low-income) – Customers who opted out of receiving HERs (n=30)
Low-Income Sector		
Low-Income Energy Efficiency Program (LIEEP)	– Many low-income responses were combined with market-rate responses for each program. The exception was for REEP kits and RARP, where low-income responses were reported separately.	– Participants (n=25 REEP kits, 40 RARP)

Program	Key Findings	Data Sources
	– Satisfaction was high, and most REEP kit participants would recommend the program to others. – About two-thirds of kit recipients provided recommendations to improve the program, including improving advertising and providing a better nightlight.	
Non-Residential Sector		
Commercial and Industrial Programs	– Participants largely reported satisfaction with the program. A small subset noted dissatisfaction with the length of time to receive rebate checks, and one noted dissatisfaction with communication with the program staff.	– Participants (n=36)

A.1.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of Duquesne's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.1.4.1 Residential Program Audit Summary

Overall, the SWE Team identified only minor issues and concerns related to the installation rates, verification process, and application of TRM-based savings for Duquesne's residential programs. As an example, each of the residential program sections appears to contain an error in reporting Phase II versus PY7 results. The first table in each residential program section is titled "Phase II [Program Name] Reported Results by Customer Sector," yet the text above each table states "shows [Program Name] participation and savings for PY7." Since the table is reflecting Phase II results, it is likely that the "PY7" text needs to be updated to "Phase II."

As was the case for previous Phase II SWE audits, the PY7 audit process was aided by the comprehensive and well-documented worksheets provided by Duquesne's evaluation contractor, Navigant. The evaluation worksheets and documentation were extremely helpful and easy to follow, and were mostly consistent with the SWE Team's audit procedures. This allowed the SWE Team to focus on performing a detailed review and audit of the PY7 residential evaluation rather than spending time trying to interpret the data and analysis.

The SWE Team identified one area that could be improved, and these recommendations were made in PY6 as well. The first is to include a discussion regarding installation and verification (impact-related) findings to make it clear which measures or components of the programs require improvement. This was particularly the case for the REEP rebates program. This level of detail was missing from the PY6 evaluation report and continues to be missing from the PY7 report for some of the programs.

The results of the SWE Team's audits of five residential Duquesne programs—REEP, SEP, RARP, WHEAP, and HER—are discussed below.

A.1.4.1.1 Residential Energy Efficiency Program – Rebate, Kits, and Upstream Lighting

For the rebate and kits components of REEP, the SWE Team reviewed the evaluation contractor's methods and findings and decided that since step 1 of the annual audit, a desk review of a random sample of rebate applications, had not been performed by the SWE Team for the past several years, it

was warranted for PY7.[55] The SWE Team reviewed the evaluation contractor's analysis in the files "SWE DR Item 1 and 7 - DLC PY7 REEP Rebates_RR FR SO.xlsx" and verified that the methodology for measure savings and applicable TRM values used were valid. The SWE Team also reviewed the data tracked in Duquesne's PMRS database and tracking system to verify that Duquesne used the appropriate savings values and algorithms from the 2015 TRM. During this review, the SWE Team did not identify any discrepancies between the PMRS tracking system and the 2015 TRM.

The SWE Team identified one area of confusion in the REEP findings' tables. Table 2-2: REEP Sampling Strategy for PY7 reports that the achieved sample size for REEP rebates was 84, which is not the sum of participants surveyed as reported in the raw survey data. There were 84 rebates submitted for 59 unique participants, so it is likely that this is a simple data-entry error. The value "84" should be corrected to "59." Likewise, the Program Total for Achieved Sample Size also needs to be revised to account for this correction (updating the value to 74 from 99). These values likely need to be updated as well in Table 2-5: REEP Sampling Strategy for PY7 NTG Research. The PY6 annual report showed REEP sampling based on unique participants, not on overall number of measures installed for those participants.

The SWE Team verified the REEP kits savings calculations against the 2015 TRM. Navigant had correctly copied all of the applicable lighting and water savings measures and applied the appropriate assumptions from the TRM. There were no errors or recommended adjustments to the REEP kits based on the SWE Team review. While the kits were verified as being 100% accurate, the SWE Team did uncover a few data anomalies with the application review of REEP rebates. For the REEP application desk review, the SWE Team used the file "SWE DR Item 1 - DLC PY7 REEP Application Review.xlsx" and selected a random sample of 10 participants from the Navigant application review, and performed its own quality check on the applications. The measures reviewed included ductless mini-split heat pumps, central air conditioners, refrigerators and clothes washers, heat pump water heater, and an ENERGY STAR TV.

The SWE Team reviewed the applications and verified that the correct input assumptions were used for TRM-based savings. Navigant had identified and made adjustments to 51 of the 83 measures in its application review, resulting in a 104.8% energy realization rate. The SWE Team identified only one measure with incorrect verified savings: a "Refrigerator Manual Defrost" with 28 kWh savings. Navigant had reassigned the savings as 38 kWh based on reclassification of the measure as "3I. Refrigerator-freezers—automatic defrost with top-mounted freezer with an automatic icemaker without through-the-door ice service." The SWE Team reviewed the application and found that the evaluation's refrigerator correction was not properly assigned, as this purchase was a side-by-side with in-door ice, showing a 2015 TRM savings of 58 kWh. Incorporating this change into the realization rates (easily performed since Navigant had allowed dynamic realization rate estimation in its documentation) showed a 0.1% increase in the realization rate.

For the upstream lighting component of the program, the SWE Team reviewed the invoice data submitted by ECOVA to verify that the PMRS database and tracking system were reporting bulb counts correctly. The SWE Team found no discrepancy from the ECOVA invoices against the evaluation contractor analysis file "SWE DR Item 1 DLC PY7 Upstream Lighting Database from ECOVA.xlsx." The SWE Team was able to review this step easily since the evaluation contractor's analysis was included in

[55] Due to the presence of a comparable desk review administered by the evaluation contractor.

the ECOVA invoice file and the batch and transaction identification made cross-referencing intuitive. The SWE Team found a small discrepancy in the savings values reported in the PY7 compliance report against ECOVA totals. The quantity of bulbs was 0.2% greater in the ECOVA invoices than in the PMRS database and tracking system. This bulb quantity drives savings calculations, resulting in values that are slightly lower than what is reported in ECOVA database files. The SWE Team understands that the ECOVA database and invoices do not report returned units as timely as Duquesne is able to in the PMRS database and tracking system, explaining why ECOVA quantities are slightly greater. Since the discrepancy is so minor, the SWE Team does not recommend further review.

The SWE Team also reviewed the upstream lighting data tracked in Duquesne's PMRS database and tracking system, to verify that Duquesne was using the appropriate savings values and algorithms from the 2015 TRM. Similar to in the PY6 audit, the Duquesne evaluation contractor had performed a complete audit, including summarizing the total ex ante savings and bulb counts, and verifying the application of the TRM-based algorithms and baseline assumptions of all the bulbs (i.e., a census review). The file used by the SWE Team for this audit was titled "SWE DR Item 1 - DLC PY7 ECOVA TRM Comparison.xlsx."

The SWE Team reviewed 10 of the largest bulb sales to assess whether they received the correct TRM inputs (including baseline wattage, in-service rates, hours of use, and interactive effects). It did not identify any issues within the evaluation worksheet, as Navigant had correctly applied appropriate baseline wattages and other inputs to all audit-sampled bulbs.

A.1.4.1.2 Residential: School Energy Pledge Program

The SWE Team reviewed the evaluation contractor's methods and findings and determined that step 1 of the annual SWE audit, a desk review of a random sample of rebate applications, was not warranted due to the structure of SEP (only a pledge form is required for participation). Historical findings from PY2 through PY7 did not reveal discrepancies between pledges and PMRS database participation records. In fact, there hasn't been a single instance of an unverified pledge participant (though there have been instances of participants not installing portions of the kit) over the past several years. The SWE Team verified that participation and savings values were reported consistently in Duquesne's PMRS database and tracking system with values reported in the evaluation contractor's report.

The SWE Team reviewed the data tracked in Duquesne's PMRS database and tracking system to verify that Duquesne was using the appropriate savings values and algorithms from the 2015 TRM. There were no adjustments or changes made to the verified gross savings estimates reported by the evaluation contractor, nor were any issues or data anomalies found during the SWE audit process. The SWE Team also reviewed the calculations in the evaluation contractor's analysis files ("SWE DR Item 1 and 7 – DLC PY7 SEP_RR FR SO.xlsx") and found there were no adjustments or changes made to the realization rates for energy and demand.

The previous (PY6) recommendation provided by the SWE Team was to include "a brief discussion that helps identify specific measures or components of the program that are driving the verified realization rates," and the SWE Team found that the PY7 evaluation report included specific details on which measures were not being installed for step 3 of the evaluation process (installation verification). The level of detail included in this year's evaluation provided a clear explanation as to what was driving down realization rates, but still lacked any discussion for step 4, deemed savings verification, and if the overall realization rates were being driven by installation verification (step 3) or deemed savings

verification (step 4). The SWE Team determined through its review of the SEP evaluation worksheet (SWE DR Item 1 and 7 - DLC PY7 SEP_RR FR SO.xlsx, "TRM and PMRS Lookups" worksheet) that the realization rates were indeed driven entirely by the installation verification.

Similar to in PY6, there was a significant drop in kit participation in PY7 (from 289 to 125). Program participation appears to have stabilized, and the SWE Team is supportive of Duquesne's plans to evaluate any recommendations to SEP in Phase III of the program.

A.1.4.1.3 Residential: Appliance Recycling Program

The SWE Team reviewed the evaluation contractor's methods and findings and determined that step 1 of the annual SWE audit, a desk review of a random sample of JACO invoices, was not warranted due to the administration of a comparable desk review performed by the evaluation contractor, Navigant. The SWE Team reviewed the JACO-supplied database and cross-checked the freezer and refrigerator units against the PMRS database and verified the unit counts between these two data sources.

The evaluation contractor reported that the implementation contractor (JACO) ceased business operations during PY7 due to financial challenges, resulting in Duquesne having to end all RARP activities in Q3 of PY7. The SWE Team confirmed that there was zero participation for Q4, as reported in the PMRS database and tracking data.

The SWE Team confirmed that Duquesne used the correct values for energy savings from the 2015 TRM in the calculation of net savings. For the TRM review, the SWE Team verified the PMRS claimed savings against the 2015 TRM, and cross-checked that the values used by Navigant were consistent with the 2015 TRM as well. The review verified that the deemed savings matched the TRM, and if any additional EDC-collected inputs could have been leveraged for use in updating the TRM savings. The SWE Team found that the part-use factors calculated (94% for refrigerator, [n=122] and 100% for freezer [n=24]) were estimated from the participant survey, but ultimately were not applied to savings. As noted on page 144 of the 2015 TRM, "EDCs may elect to calculate an EDC specific part-use factor for a specific program year. In the event an EDC desires to calculate an EDC specific part-use factor, EDCs should use the methodology described in section 4.3 of the DOE, Uniform Methods Project protocol 'Refrigerator Recycling Evaluation Protocol', April 2013." It was not clear from the report why the part-use factor was calculated yet not applied to the PY7 realization rate. However, the evaluation contractor later clarified that the TRM value, based on a larger sample, was used instead, while the data on the Duquesne Light-specific part-use factor was collected to assist the SWE in its future updates of the TRM, as needed.

For realization rate estimation, the evaluation contractor analyzed telephone survey response verifications of appliances being recycled. The SWE Team reviewed the calculations for realization rates of energy and demand in the evaluation contractor's analysis file ("SWE DR Item 1 and 7 – DLC PY7 RARP_RR FR SO.xlsx") and found no adjustments or changes required. The evaluation contractor found one more recycled appliance than was reported in the PMRS data and tracking system (for market-rate participants), which resulted in a realization rate of over 100%. The data provided to the evaluation contractor by JACO showed that for this 1 participant of 109 surveyed, only one refrigerator was picked up by JACO. However, in the telephone survey verification, the participant reported that two refrigerators were picked up by JACO.

A.1.4.1.4 Residential: Whole House Energy Audit Program

The SWE Team reviewed the evaluation contractor's methods and findings and determined that step 1 of the annual SWE audit, a desk review of a random sample of audit invoices, was not warranted due to the administration of a comparable desk review performed by the evaluation contractor, Navigant. The SWE Team reviewed the evaluation contractor desk review file ("SWE DR Item 1 and 7 - DLC PY7 WHEAP_RR FR SO.xlsx") and cross-checked the reported units against the PMRS database and verified the unit counts and participant counts between these two data sources. Similar to in the SEP and REEP kits programs, WHEAP relied on lighting (CFLs and LED nightlights), small domestic hot water (faucet aerators, low-flow showerheads, and pipe wrap), and plug load (smart strip) measures to achieve energy savings. Ultimately, there were no adjustments or changes made to the verified gross savings estimates reported by the evaluation contractor, except to account for installation rates or disconnects between verified measure quantities and tracking database reported quantities.

The evaluation contractor reported realization rates that differed from the calculated values in the evaluation contractor desk review file. The evaluation contractor identified this discrepancy in the report, explaining that the discrepancy stems from the value for one respondent being correct in the CSP, but not in the PMRS. The SWE Team was unable to confirm this finding, yet accepts the effort of the evaluation contractor to rectify the issue.

The SWE Team confirmed that Duquesne (and Navigant's verification) used the correct values for energy savings of the direct-install measures from the 2015 TRM in the calculation of savings. Navigant noted, and the SWE Team agrees, that Duquesne is likely using a conservative savings estimate by not using the early replacement baseline conditions for lighting and defaulting to the TRM-based defaults when bulbs are directly installed by a contractor.[56] As noted throughout the 2015 TRM, EDC data gathering is allowed for input savings parameters, to more accurately depict the proper default savings for the WHEAP direct-install measures. Instead, the program relied on default values for faucet aerator (68.3 kWh, unknown room type) and assumed a consistent 4 feet of pipe wrap (40 kWh at 10 kWh per foot) for each pipe wrap installation.

Consistent with other program evaluations discussed above, the WHEAP section of the annual report did not include a summary reviewing the realization rate and overall findings. Again, the SWE Team determined, based on a review of the "TRM and PMRS Lookups" worksheet in the "SWE DR Item 1 and 7 - DLC PY7 SEP_RR FR SO.xlsx" file, that the overall realization rate was based on participant installation verification only and did not include any adjustments to account for step 4, deemed savings verification. Additionally, although a minor discrepancy, the description for "Step 3 – Participation and Installation Verification," included a note regarding two strata: "Telephone surveys were identical between the two strata." Since there was only a single stratum for PY7, this text is likely a holdover from the PY6 report and should be updated to reflect the PY7 sample stratification. Finally, the evaluation contractor's WHEAP excel file, in the "TRM and PMRS Lookups" worksheet, did not include the savings assumptions for additional WHEAP measures (which were outside the kits assumptions that were listed). These include the 9W and 14W candle bulb, the 16W R30 bulb, and the whole home water heater pipe wrap. The SWE Team was able to verify the reported per unit savings for these measures, but it would have been ideal for Navigant to have included its replication of the correct TRM savings for these measures as well.

[56] According to p. 18 of the 2015 TRM," For direct install programs where wattage of the existing bulb is known, and the existing bulb was in working condition, wattage of the existing lamp removed by the program may be used in lieu of the [EISA baseline] tables below."

A.1.4.1.5 Residential: Home Energy Reports Program

The SWE Team reviewed the approach Navigant used to develop the HER verified savings. As noted in Section A.1.3.1 above, Navigant developed a billing analysis using the treatment and control groups as defined by the original program design and implemented by the CSP, OPower. The SWE Team did not attempt to recreate the billing analysis, nor did it attempt rerunning the model to replicate the results. Rather, the SWE Team developed some key questions about the HER evaluations, generally checking if the evaluation design followed best practices, including following the recommended approach in the UMP.[57] The SWE Team's summary of the evaluation assessment for each of the associated audit questions is outlined below:

- ***Did the evaluation design use the RCT approach?***

Yes, the HER analysis followed the standard protocols as defined in the UMP. In fact, the UMP protocols were developed in part based on the findings from a SEE Action report that was referenced several times in the Duquesne report and formed the basis for Navigant's approach.[58]

- ***Were the length of the study and baseline periods sufficient (normally one year) and clearly identified?***

To determine if the length of the study and baseline periods were sufficient, the SWE Team had to contact Navigant to learn more about the research, since the report lacked the details necessary to answer these questions. After discussion with Navigant, the SWE Team learned that the analysis included a sufficient baseline period and length of study, though it would have been ideal to include this detail in the report, for full transparency.

- ***Did the model use a difference-in-differences approach and include interaction variables?***

Yes, Navigant developed an LFER, whereby the average daily consumption was a function of participant group (treatment versus control), if the utility bill was pre-or post-program start date, and the interaction was between these two variables (post treatment). Navigant validated the LFER model by including a post-program regression model, the results of which provided values consistent with those of the LFER model.

- ***Was there an equivalency check on the treatment-group versus control-group usage?***

An equivalency check ensures that there was no statistical difference for pre-program electric energy usage between the treatment and control groups. To determine if an equivalency check was performed, the SWE Team had to contact Navigant to learn more about the research, since the report lacked the details necessary to answer this question. After discussion with Navigant, the SWE Team learned that the analysis included an equivalency check, and received a detailed description of the analysis, though this was not included in the annual report. According to this analysis, Navigant concluded "that the differences in average daily energy use by month were not statistically significant using either month by month T-tests or the regression model, Navigant concludes that the March 2016 HER program households were randomly allocated to the treatment and control groups."

[57] Department of Energy and Cadmus, Uniform Methods Project, January, 2015; Chapter 17: Residential Behavior Protocol; http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf.
[58] State and Local Energy Efficiency Action Network. Evaluation, Measurement and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations. May 2012.

☐ *Were account closures properly handled?*

Account closures and changes in tenants at the same address should be excluded from the analysis, for both the control and treatment groups. Navigant indicated that account closures were excluded from the analysis and stated that these participants were "omitted from the regression analysis to estimate program effects but were included in the estimate of total program savings for the time prior to when they moved away."

☐ *Did the analysis control for double counting savings?*

For those HER participants who also participated in other Duquesne efficiency programs, the incremental savings associated with the program rebated equipment installation is considered double counting of savings, since the equipment savings are already being claimed by another program. Because both treatment- and control-group participants may have participated in other programs, the approach used to net out the double-counted savings is to estimate if the average treatment-group non-HER program savings exceeds the control-group non-HER program savings. In the Duquesne report, Navigant notes that "The verified ex-post energy savings for HER in PY7 and Phase II were 26,094 MWh, after accounting for double-counted savings with other Duquesne Light energy efficiency programs." While Navigant noted that it accounted for duplicate savings, the report lacked sufficient details on how this was accomplished. The SWE Team contacted Navigant to learn about how it accounted for duplicate savings. Navigant provided the following additional details regarding the savings double counting:

> *"Both treatment and control groups, using results of the double-counting analysis conducted as part of the evaluation of the PY4 program. Duquesne Light changed its account numbering system just prior to PY7 program initiation, and the evaluation team was not able to link account numbers for the purposes of matching participants with tracking data for other Duquesne Light residential programs. This meant that documentation of PY7 treatment and control group participation in other Duquesne Light programs in PY6 and PY7 could not be determined. Therefore, the team used the double-counting value obtained when the PY4 evaluation was conducted (just under 5%). Since the PY4 double-counting value was atypically high compared to other OPower program evaluations Navigant has evaluated (~1%), this was believed to be a very conservative assumption."*

The SWE Team agrees with Navigant that this was a conservative approach to address duplicative savings and does not have any concerns with its approach, given the constraints of not having account numbers to update the analysis for PY7.

☐ *Were savings within the commonly identified range (approximately 2% of annual usage)?*

Residential behavioral program evaluations should include the percentage of annual usage represented by the program savings. Savings claimed or evaluated by other HER programs have varied between 0.5% and 3% of annual usage.[59] The Duquesne report lacked any details on the claimed or realized savings as a percentage of annual usage. Navigant provided documentation to the SWE Team, which included a spreadsheet ("Duquesne HER PY7 Regression Outputs for SWE Data Request.xlsx") that detailed the relative savings percentages across the three waves of participants that were used for the regression. Savings ranged between 0.9% and 1.9% across the three waves, with the lowest estimate, 0.9%, showing

[59] S. Dimetrosky and K. Parkinson, July, 2013: IEPEC 2013 Conference: Are Savings from Behavior Programs Ready for TRM Prime Time?

the highest relative precision, of +/– 60%. This lack of precision was due to the second wave having the lowest participant count (less than half the count of the third wave). The report, in Table 6-3: PY7 HER Summary of Evaluation Results for Energy, shows 0% relative precision, which is the sampling precision but not the verified savings precision, which across the three waves appears to be between 14% and 60%.

- ***Did the evaluation report include sufficient details regarding the analysis, findings, and statistical significance?***

Overall, the Duquesne report did not include sufficient details on the HER analysis and findings. The SWE Team believes that Navigant followed best practices in the model design and analysis, but did not report the details and evidence that would allow the SWE Team to conclude that the HER analysis was comprehensive and robust. It was only through additional communication with Navigant that the SWE Team had sufficient analysis details to answer all of the team's questions and concerns. While there is often a balance between providing sufficient but not overwhelming amounts of analytic details, the SWE Team believes that Navigant was too conservative in its documentation of the HER billing analysis and should include the additional details noted above.

A.1.4.2 Low-Income Program and Audit Summary

The SWE Team reviewed the evaluation contractor's methods and findings and determined that step 1 of the annual SWE audit, a desk review of a random sample of rebate applications, was warranted since the past several audits have not included an application review.[60] The SWE Team reviewed the data tracked in Duquesne's PMRS database and tracking system to verify that Duquesne was using the appropriate savings values and algorithms from the 2015 TRM. The SWE Team confirmed that all verified per-measure savings, participant counts, and program energy and demand impacts were consistent with the 2015 TRM. The program evaluation found that ISRs, as determined through telephone participant surveys, for energy efficiency kits were considerably higher than those ISRs evaluated in PY6 (due to higher installation rates for all three measures). This audit found no adjustments or changes that should be made to the verified gross savings estimates reported by the evaluation contractor.

The SWE Team did catch a few minor errors in the annual report. The fourth row of Table 1-6: Phase II Low Income Sector Compliance (Percentage of Savings) likely carried over text from a previous report. The note "Sum of First Two Rows" likely should be updated to read "Sum of First Three Rows," since the values in corresponding columns line up this way. Additionally, Table 7-2: LIEEP Sampling Strategy for PY7 included an error for evaluation activity. An application review was listed as included for the low-income kits component, though this research activity was actually performed for the low-income rebates component.

Table 7-2: LIEEP Sampling Strategy for PY7 contained a few minor errors. The program name for one measure was incorrectly identified in the PMRS database and tracking system, and this error rippled through population counts, gross saving estimates, and gross demand savings. The Freezer Recycling – Replace measure was being captured under the LIEEP rebates program but should have been identified as the LIEEP RARP program. The low-income rebates population size needs to be updated to 139 from 152, and LIEEP RARP participation needs to be updated to 403 from 390. Likewise, reported gross energy

[60] Navigant had performed a comparable desk review for REEP, along with a telephone verification (for all components).

saving values need to be updated for the low-income rebates program. Last, gross demand savings values should to be updated to 0.048 from 0.046 in the LIEEP RARP, and from 0.009 to 0.007 in the LIEEP rebates program. The last minor errors found across the LIEEP programs were in Table 7-2: LIEEP Sampling Strategy for PY7. Achieved sample size values were off by a count of 1 for the low-income RARP and low-income WHEAP programs.

The SWE Team recommends including a discussion of realization rate calculations in the report because it was not clear why one calculation was ultimately decided on over another. Navigant provided the following statement when the discrepancy of two realization rates was brought to its attention: "the survey results should be combined with the application file review." This helped the SWE Team rectify realization rates. The audit found no adjustments or changes that should be made to the realization rate values.

The SWE Team did not review any site inspections or quality assurance/quality control (QA/QC) procedures from low-income installations, as neither Duquesne, its evaluation contractor, or any other Duquesne third-party vendor administered any on-site-based inspections or QA/QC procedures for this program during PY7. (As noted above, the evaluation contractor verified installations via a telephone survey.) All of the other EDCs conduct on-site inspections on a sample of installations for their low-income programs.[61] During PY6, the SWE Team considered on-site QA/QC unnecessary due to the specific structure and implementation model of the Duquesne low-income program. As has been previously noted by the evaluation contractor, Duquesne's LIEEP is similar to REEP (rebates, kits, and lighting), RARP, WHEAP, and SEP, except that participation in those programs by those who qualify as low-income is counted for LIEEP rather than the individual other residential programs. In PY7, even though Duquesne introduced a whole-home retrofit program similar to that of other EDCs in which on-site QA/QC inspection may be considered, the current Duquesne WHEAP program is a simple direct-install with lighting, small domestic hot water, and plug load measures. If the Duquesne program expands and offers more comprehensive retrofit measures (air sealing, insulation, HVAC, etc.), then on-site QA/QC will be more critical. The SWE should continue to monitor and assess the need to perform on-site inspections for the Duquesne low-income program.

The SWE Team verified that Duquesne was in compliance with the requirement that the number of energy conservation measures offered to low-income households be, at a minimum, proportionate to those households' share of the total energy usage in Duquesne's service territory. PY7 low-income program compliance was unchanged relative to PY6: Duquesne offered 14 types of measures to the low-income sector in PY7, which is consistent with the quantity offered in PY6. The number of measures offered through the low-income program represented 14.4% of the total number of types of measures offered across all customer sectors. This level substantially exceeds Duquesne's Act 129 compliance target of 8.4%.

A.1.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were performed in accordance with the applicable TRM, or by some other reasonable methodology. The SWE Team reviewed 11 of the sample projects submitted, which included interior and exterior lighting retrofits, variable frequency drives (VFDs),

[61] According to SWE research for EDC PY5 on-site inspections for the low-income programs, all of the other EDCs performed on-site inspections for low-income installations.

industrial process improvements, and efficient chillers. At this time, the SWE Team only requests that the clarity and orderliness of project files be maintained going into Phase III.

The SWE Team reviewed Duquesne's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-10, showing relative precision at the 85% confidence level.

Table A-10: Compliance across Sample Designs for Duquesne's PY7 Non-Residential Program Groups

Program Group	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Commercial	4%	21%	✓
Industrial	2%	6%	✓
GNI	9%	29%	✓

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups in PY7. Details about each program evaluation sample are presented below.

As part of the audit process, the SWE Team performed 10 ride-along site inspections of non-residential projects to oversee Duquesne's on-site evaluation practices. The projects selected for ride-along inspection encompassed lighting upgrades, chiller optimizations, and VFD installations. The SWE Team approved all 10 of the sampled project inspections. Details about all 10 projects and their associated findings are presented below.

The SWE Team performed a verified savings analysis on six submitted projects, checking for accuracy of the calculations, appropriateness of the evaluation method, and level of rigor selections. The SWE Team approved of Navigant's evaluation methodologies and savings calculations across all projects. The SWE Team found a very high level of organization of project files and a high degree of completeness and clarity among the site reports. The results of the verified savings analysis are presented below.

A.1.4.3.1 Project Files Review

The SWE Team review of non-residential projects completed by Duquesne in PY7 was done using project documentation files that Duquesne uploaded to the SWE Team SharePoint site quarterly. These files included project-level savings calculation workbooks, equipment invoices, customer incentive agreements, and post-inspection forms. The SWE Team reviewed 11 of the sample projects submitted, which included interior and exterior lighting retrofits, VFDs, industrial process improvements, and efficient chillers.

Table A-11 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-11: Duquesne PY7 Project File Review Summary

Project Number	Sector	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
0479510921.16.01	Commercial	Lighting retrofit and delamping	Yes	Yes	No	Yes	Yes	N/A
1348100890.20.01	Commercial	Lighting retrofit (LED)	Yes	Yes	No	Yes	Yes	N/A
2802720321.23.02	Industrial	Lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
5180200889.25.01	Industrial	Lighting retrofit (outdoor MH to LED)	Yes	Yes	No	Yes	Yes	N/A
6000006806.26.07	Commercial	Custom (2 centrifugal chiller retrofit, pump VFDs, and cooling tower fan VFDs)	Yes	Yes	No	Yes	N/A	Yes
8094410797.23.03	Industrial	Lighting retrofit (outdoor MH to LED)	Yes	Yes	No	Yes	Yes	N/A
0113630227.16.01	Commercial	Lighting retrofit (MH to T5)	Yes	Yes	No	Yes	Yes	N/A

Project Number	Sector	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
0490399186.18.01	Commercial	Lighting retrofit (inc. and hal. to LED)	Yes	Yes	No	Yes	Yes	N/A
4630110635.23.01	Industrial	Lighting retrofit (inc. to LED)	Yes	Yes	No	Yes	Yes	N/A
5443020177.16.01	Commercial	Lighting retrofit (MH to LED)	Yes	Yes	No	Yes	Yes	N/A
0332040586.24.19	Industrial	Custom (automated temperature control valves)	Yes	Yes	No	Yes	N/A	Yes

In PY6 the SWE Team review of Duquesne's project files was almost seamless, identifying only minimal inconsistencies across documentation, and only two issues detrimental to the SWE Team's understanding of the projects. Project files were found to be conclusive and organized, with few exceptions. In PY7 this continued, with no issues discovered in the course of the project file reviews. At this time, the SWE Team only requests that the clarity and orderliness of project files be maintained going into Phase III.

A.1.4.3.2 Sample Design Review

Duquesne's PY7 annual report provided detailed information about the sample design for the PY7 gross impact evaluation of non-residential programs. Programs in the non-residential sector were divided into three groups: commercial, industrial, and GNI. GNI programs were separated from the commercial programs and formed a single evaluation group because their contribution to the non-residential sector's savings was greater than 20% in PY6. This approach is aligned with the guidance in the Evaluation Framework. The Small Commercial Direct Install Program and the MFHR Program were new in PY6 and were sampled separately to ensure that their realization rates weren't too dissimilar from the rest of the Commercial Program Group. This was verified as true in PY6; thus for PY7 these programs are included in the Commercial and GNI Program groups as appropriate. Duquesne's evaluation contractor addressed three main evaluation groups for the non-residential sector's gross impact evaluation:

- Commercial Program Group
- Industrial Program Group
- GNI Program Group

Duquesne's targeted level of precision for each of the three evaluation groups was ±15% at the 85% confidence level. The SWE Team reviewed this approach and determined that it was appropriate and met the minimum annual confidence/precision level requirement in the Evaluation Framework.

A.1.4.3.2.1 Commercial Program Group

The Commercial Program Group includes an overall umbrella program and six market-segment programs: Office, Public Agency, Retail, Healthcare, Small Commercial Direct Install Program, and the MFHR Program. The stratification was based on a project's level of ex ante energy savings (kWh), and a simple random sample was selected from each stratum. Duquesne's PY7 commercial-sector sampling strategy is shown in Table A-12.

Table A-12: Duquesne's PY7 Sampling Strategy – Commercial Program Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Commercial – Large	1	85%/15%	1	1
Commercial – Medium	17	85%/15%	6	6
Commercial – Small	40	85%/15%	6	3
Program Total	**58**	**85%/15%**	**13**	**10**

Duquesne's evaluation contractor used a stratified ratio estimator calculated from the sample to adjust the ex ante energy and demand savings in Duquesne's PMRS data-tracking system and to calculate ex post savings for the Commercial Program Group. The achieved precision values in Table A-13 show that

Duquesne met the 85%/15% confidence/precision level for energy but not for peak demand. The Evaluation Framework requires that only ±15% precision be achieved for energy savings.

Table A-13: Observed Coefficients of Variation and Relative Precisions – Duquesne's Commercial Program Group

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Commercial – Large	0.00	0%	N/A	0%
Commercial – Medium	0.11	6%	0.48	27%
Commercial – Small	0.00	0%	0.00	0%
Program Total		**4%**		**21%**

A.1.4.3.2.2 Industrial Program Group

The Industrial Program Group includes an overall umbrella program and three market-segment programs: Primary Metals, Chemical Products, and Mixed Industrial. A single industrial project may have a large number of measures within the project, so sample selection was at the measure level instead of the project level. While on-site, the evaluation contractor verified as many additional completed measures as was feasible, as well as the measure initially selected in the sample. The SWE Team reviewed this approach and determined it was appropriate. Duquesne's PY7 sampling strategy for the Industrial Program Group is shown in Table A-14.

Table A-14: Duquesne's PY7 Sampling Strategy – Industrial Program Group

Stratum	Population (measures)	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Industrial – Large	6	85%/15%	5	4
Industrial – Medium	16	85%/15%	6	7
Industrial – Small	94	85%/15%	4	5
Program Total	**116**	**85%/15%**	**15**	**16**

The achieved precision values are shown in Table A-15. Duquesne met the 85%/15% confidence/precision level for both energy and peak demand.

Table A-15: Observed Coefficients of Variation and Relative Precision – Duquesne's Industrial Program Group

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Industrial – Large	0.05	2.7%	0.16	8.9%
Industrial – Medium	0.13	6.0%	0.47	22.0%
Industrial – Small	0.01	0.8%	0.00	0.2%
Program Total		**1.9%**		**6.4%**

A.1.4.3.2.3 GNI Program Group

The GNI Program Group was treated as its own evaluation group, in accordance with the Evaluation Framework, because savings exceeded 20% of the non-residential sector savings in the previous year. Similar to in the Commercial Program Group, the GNI Program Group sampling approach was at the project level. Two strata were defined in the GNI Program Group: small and large. The sampling strategy for the GNI Program Group is shown in Table A-16, and the achieved precision values are shown in Table A-17.

Table A-16: Duquesne's PY7 Sampling Strategy – GNI Program Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
GNI – Large	7	85%/15%	5	7
GNI – Small	55	85%/15%	8	7
Program Total	**62**	**85%/15%**	**13**	**14**

Table A-17: Observed Coefficients of Variation and Relative Precision – Duquesne GNI Program Group

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
GNI – Large	0.17	0%	0.91	57%
GNI – Small	1.01	59%	1.00	58%
Program Total		**9%**		**29%**

Duquesne's evaluation contractor used a stratified ratio estimator calculated from the sample to adjust the ex ante energy and demand savings in Duquesne's PMRS data-tracking system and to calculate ex post savings for the GNI Program Group. The achieved precision values in Table A-17 show that Duquesne met the 85%/15% confidence/precision level for energy but not for peak demand. This is an improvement over PY6, where the 15% relative precision target was met for demand but not for energy.

A.1.4.3.3 Ride-Along Site Inspections

Table A-18 summarizes the SWE Team's PY7 ride-along site inspections of Duquesne's non-residential project installations. The Duquesne PY7 site inspection findings are categorized into two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluation contractor savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table A-18: Duquesne's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
5354550495.25.01	Lighting	Occupancy sensors were discovered at the site inspection.	Eval	The verified savings accounted for the addition of the occupancy sensors and the SWE Team had no further recommendations.
8777310842.19.01	Lighting	Minor discrepancies concerning the fixture count were discovered on-site.	Eval	The verified savings accounted for the change in fixture count and the SWE Team had no further recommendations.
8000650287.19.01	HVAC (chillers, VFDs)	Generally, all retrofitted equipment and controls were verified as reported and inputs to the energy savings calculations reflected what was found on-site.	Eval	The SWE Team had no recommendations based on its review of this project.
0304430541.16.01	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
9302070578.20.01	HVAC (chillers, VFDs, HTX)	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
6000006806.26.07	HVAC (chillers, VFDs)	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
0449510785.16.01	Lighting	Occupancy sensors were discovered at the site inspection.	Eval	The verified savings accounted for the addition of the occupancy sensors and the SWE Team had no further recommendations.
3113581629.18.01	HVAC (pump VFDs)	Upon inspection, it was discovered that the VFDs were not being used as the program rules dictate and were only being used for soft starts.	Pro	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.

Project ID	Technology	Finding	Finding Type	Resolution
7844100128.16.01	HVAC (retro-commissioning)	At the site visit it was discovered that not all of the retro-commissioning measures were fully completed.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
1415560639.21.01	HVAC (retro-commissioning)	At the site visit it was discovered that not all of the retro-commissioning measures were completed.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.

A.1.4.3.4 Verified Savings Review

The SWE Team requested a subset of sampled projects for detailed review and generally found that appropriate M&V methods were used. The SWE Team was impressed with the level of organization of project files and the completeness and clarity of the site reports. Table A-19 provides an overview of the SWE Team's verified savings review.

Table A-19: Overview of Duquesne Projects Included in SWE Team Verified Savings Review

Program	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	Evaluation Activity	IPMVP Method
Commercial – medium	2111340135.20.01	546,945	88.87	Site inspection, file review, metering	Option A
Industrial – large	6058860790.23.01	1,085,481	96.74	Site inspection, file review, metering	Option A
Industrial – medium	1737650740.23.01	121,262	14.15	Site inspection, file review, analysis of trending data	Option A
Commercial – small	3000672792.17.01	48,819	6.21	Site inspection, file review	Option A
Commercial – GNI	4493770854.21.01	1,915,267	0.00	Site inspection, file review, analysis of trending data	Option B and C
Commercial – multifamily	9805860054.51.01	19,631	1.87	Site inspection, file review	Option A

Project 2111340135.20.01 generated 546,945 kWh in energy savings and 88.87kW in demand savings. The project involved a lighting retrofit where 1,819 fixtures were replaced with LEDs in a hotel. Navigant performed on-site verification of the installed equipment quantities, locations, and controls schedules. Metering was required as savings were greater than 500,000 kWh, so light loggers were deployed. Navigant used the metered HOU and CF values and provided a completed Appendix C Lighting calculator. The lower verified savings values (kWh realization rate of 87%) resulted primarily from Navigant's use of metered HOU. The high kW realization rate was due to an incorrect, low ex ante value listed in the tracking system.

Project number 6058860790.23.01 involved a new construction lighting project wherein 1,218 LEDs and 619 occupancy sensors were installed in a refrigerated warehouse. The space-by-space method was used to determine the minimum lighting power density for the baseline. Metering was performed since the expected savings were greater than 500,000 kWh, in order to determine HOU for the fixtures. The

reported fixture wattages and configurations were installed as reported. The kWh and kW realization rates of 103% and 118%, respectively, were due to a different savings factor determined through metering as well as a small error in the tracking database.

Project number 1737650740.23.01 involved compressed air leak remediation as well as the installation of four no-loss condensate drains an industrial facility. In attempting to schedule a site visit for the project, Navigant discovered that the factory had been shut down.

Project number 3000672792.17.01 involved a lighting retrofit project wherein 118 fixtures were retrofitted with LEDs at a gas station. Karpinski performed on-site verification of the installed equipment quantities, locations, and controls schedules. All fixtures were confirmed to have 8,760 hours of operation. No values of kWh and kW were changed, resulting in realization rates of 100%.

Project number 4493770854.21.01 involved retro-commissioning the HVAC system at a hospital. The project included economizer optimization, controls upgrades, chiller plant optimization, chilled water temperature reset, condenser water temperature reset, and VFD installation. The evaluation contractor verified correct operation of all retro-commissioning measures. The SWE agrees with the analysis and level of rigor.

Project number 9805860054.51.01 involved interior and exterior lighting retrofit at a multifamily building. Following the site verification visit, Navigant used the TRM Appendix C tool to calculate an updated ex post savings estimate. The SWE agrees with the analysis and level of rigor, except the kWh value listed in the calculator (19,631 kWh) doesn't match the ex post value presented in the project report (19,822 kWh). This is less than a 1% difference, so no correction is necessary.

A.1.4.4 Net-to-Gross and Process Evaluation Audit Summary

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in the PY7 annual report to determine whether they were consistent with the reporting template provided by the SWE. The SWE Team's audit of the process reports also included a review of process-related methods and research activities to determine whether they were consistent with the approved evaluation plan, and a review of the linkage between findings, conclusions, and recommendations.

Overall, the process evaluations appeared to be consistent with the evaluation plan. The sampling approaches for the process evaluation activities were appropriate. The participant surveys either attempted a census or used a simple or stratified random sampling approach. Each participant sample achieved at least 85/15 confidence/precision at the program level as per the evaluation plan.[62] For other research activities—the in-depth interviews with program staff, implementers, or other program actors—the sampling was purposive. In a few instances, participants or measures in certain strata were over- or underrepresented in the sample. The PY7 annual report does not discuss implications of this over- or underrepresentation on reported findings.

[62] The REEP market-rate kit respondent survey did not achieve 85/15 confidence/precision, but the survey did reach the intended objective of 15 completed surveys. When the market-rate kit recipients (n=15) are combined with the low-income kit recipients (n=40), the results achieve 85/15 confidence/precision.

The report provided a comprehensive overview of the process evaluation key findings and recommendations. The SWE Team noted some areas in which the reporting, while following SWE guidelines, could be improved. Such areas included consistently identifying in tables and graphs when multiple responses are allowed, reporting data from scaled responses, and reporting categorized open-ended responses. The SWE Team considered these to be relatively minor issues. Details are in Appendix B.1. Two items that are discussed in the appendix are also worth noting here:

- There were limited conclusions and recommendations related to process results even though several programs (WHEAP, HER, and LIEEP) are struggling to meet their savings objectives. Additional insights, particularly from participants, into why some of these programs are struggling to meet objectives would be valuable.
- When pointing out differences between groups such as a difference between market-rate and low-income respondents, Navigant did not comment on statistical significance. Therefore, in several cases it is not clear whether the differences seen fall within the bounds of what would be expected. If sample sizes were not designed to make group comparisons, then Navigant should note that in the report.

The report documents included a summary of methods and findings, a table of recommendations, and a description of the status of prior recommendations. The report generally included sufficient detail for the SWE Team and others to assess the methods, findings, conclusions, and recommendations.

Detailed summaries of the SWE Team's review of the process evaluation by program are contained in Appendix B.1.

Table A-20 summarizes the results of the SWE Team's audit of Navigant's NTG assessment of the Duquesne programs.

Table A-20: Summary of SWE Team Review of Duquesne NTG Evaluations

Elements Reviewed in the Duquesne Annual Report	SWE Findings
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Yes, with exceptions noted
NTG method used – the common method or another	Common method, with acceptable modifications
NTG common method applied correctly	Yes

The following subsections present detailed discussions of the SWE Team's NTG audits of Duquesne programs in PY7 and summarize the findings, specifically the audit of NTG reporting and related files. The results are provided for residential, low-income, and non-residential programs.

A.1.4.4.1 Residential Programs

Navigant estimated NTG for four residential programs: REEP, RARP, SEP, and WHEAP. Navigant did not estimate NTG for the Residential HER Program, since free-ridership and participant spillover are already incorporated in the impact analysis. As in the PY5 and PY6 evaluations, Navigant used the SWE common approach, with one slight deviation: Navigant incorporated a "delay factor" into residential NTG calculations that adjusted free-ridership scores by how long respondents reported they would have delayed their program-qualifying activity. The SWE Team believes this modification would not introduce a systematically different result from the common method and is thus consistent with the intent of the

common method. However, the SWE Team suggests that evaluation reports explicitly state how a given instrument differs from the common method and why it would not produce a systematically different result.

Navigant used a hybrid approach to estimate NTGR for REEP: Navigant used PY6 results for the upstream lighting component of the program, and conducted primary data collection and analysis for rebate and kit measures. Navigant used a savings-weighted approach to combine these various estimates into program-level free-ridership, spillover, and NTGR for PY7.

Navigant summarized the NTG methodology in the Duquesne PY7 annual report. The detailed methods reported in the PY7 annual report were typically sufficiently clear.

Navigant provided the SWE Team with most of its NTG calculations, together with the raw survey data, in Excel workbooks. The workbook revealed a typo in the RARP chapter: RARP NTGR is 32%, not 34% as reported in the workbook. Navigant confirmed via email that 32% is the correct value.

Table A-21 summarizes the SWE Team's review of the NTG activities by program. The SWE Team found Navigant's description of the NTG methods to be relatively clear and the application of the SWE common methods to be error-free. However, the workbooks provided did not include the calculations that combined strata estimates into program-level estimates.

Table A-21: Summary of NTG Audit of Duquesne's Residential Programs

Program	NTG Method	Review Comments
Residential Energy Efficiency Program (REEP)	The common method was used for downstream components, with acceptable modifications. Navigant used the PY6 values for PY7 upstream lighting NTG.	The detailed methods reported in the PY7 annual report were sufficiently clear.
Residential Appliance Recycling Program (RARP)	The common method was used.	Navigant used the common method to estimate NTG. The final kWh net savings that included adjustments to net savings based on each scenario were included in the workbook. FR was calculated correctly at the participant level. Navigant reported two different NTGRs – 32% in the Overview of Portfolio chapter and 34% in the RARP chapter. The Excel workbook reports the NTGR to be 32%; thus 34% is a typo.
School Energy Pledge Program (SEP)	The common method was used, with acceptable modifications.	The detailed methods reported in the PY7 annual report were sufficiently clear. Navigant made acceptable adjustments to the FR intention calculations, including adjustments for number of items installed and for plans to purchase at a later date.

Program	NTG Method	Review Comments
Whole House Energy Audit Program (WHEAP)	The common method was used, with acceptable modifications.	The detailed methods reported in the PY7 annual report were sufficiently clear. Navigant made acceptable adjustments to the FR intention calculations, including adjustments for number of items installed and for plans to purchase at a later date. Market rate and low-income participants were analyzed together when calculating NTGR for WHEAP.
Residential Home Energy Report (HER) Program	Not estimated; impact analysis accounts for FR and SO.	Navigant did not estimate NTGR, as the randomized control trial (RCT) approach to impact analysis results in net savings.

Table A-22 summarizes NTG findings from the Duquesne annual report. The NTGR was greatest for SEP and lowest for RARP.

Table A-22: Summary of NTG Estimates for Duquesne's Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Residential Energy Efficiency Program (REEP)	0.54	0.23	0.69	99
	Residential Appliance Recycling Program (RARP)	0.72	0.04	0.32	109
	School Energy Pledge Program (SEP)	0.31	0.19	0.87	27
	Whole House Energy Audit Program (WHEAP)	0.33	0.06	0.73	22
Not calculated	Residential Home Energy Report (HER) Program	N/A	N/A	N/A	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] The sample sizes provided at least 85/15 confidence/precision.

A.1.4.4.2 Low-Income Residential Programs

LIEEP participants were low-income participants within each of the residential programs described above (see Section A.1.4.4.1). Therefore, the comments in Section A.1.4.4.1 also apply here.

Table A-23 summarizes the SWE Team's review of the low-income NTG activities. The SWE Team found Navigant's description of the NTG methods to be relatively clear and the application of the SWE common methods to be error-free. However, the SWE Team's review of Navigant's NTG data files revealed some reporting errors, which Navigant confirmed via email. Table A-24 shows the corrected values.

Table A-23: Summary of NTG Audit of Duquesne's Low-Income Program

Program	NTG Method	Review Comments
Low-Income Energy Efficiency Program (LIEEP)	The common method was used for downstream components, with acceptable modifications. Navigant used a method informed by the common method to estimate upstream lighting NTG.	Participants were low-income participants within each program, so the comments in Table A-21 apply here as well. Navigant misprinted spillover, NTGR, and sample size in the PY7 report.

Table A-24 shows the NTG ratio as reported in the Duquesne PY7 annual report.

Table A-24: Summary of NTG Estimates for Duquesne's Low-Income Program

Approach	Program	Free-ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Low-Income Energy Efficiency Program (LIEEP)	0.26	0.10	0.83	162

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] The sample size provided at least 85/15 confidence/precision.

A.1.4.4.3 Non-Residential Programs

Navigant estimated NTG values for the Commercial Program Group and Industrial Program Group. Navigant used the SWE Team's common method for estimating NTG. Navigant thoroughly summarized the NTG methodology in the PY7 annual report. Navigant provided most of its NTG calculations to the SWE Team, together with the raw data, in Excel workbooks. However, the SWE Team's review of Navigant's NTG data files revealed some reporting errors (free ridership and NTG values were 0.01 different than originally reported), which Navigant confirmed via email. Table A-26 shows the corrected values.

Table A-25 summarizes the SWE Team's review of the NTG methodology by program. The SWE Team found Navigant's description of the NTG methods to be relatively clear and the application of the SWE common methods to be error-free.

Table A-25: Summary of NTG Audit of Duquesne's Non-Residential Programs

Program	NTG Method	Review Comments
Commercial Program Group	The common method was used.	The detailed methods reported in the PY7 annual report were sufficiently clear.
Industrial Program Group	The common method was used.	The detailed methods reported in the PY7 annual report were sufficiently clear.

Table A-26 shows the NTG estimates reported in the Duquesne PY7 annual report.

Table A-26: Summary of NTG Estimates for Duquesne's Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Commercial Program Group	0.33[b]	0.00	0.67[b]	38
	Industrial Program Group	0.32	0.00	0.68	18

NOTES:
[a] The sample sizes provided at least 85/15 confidence/precision.
[b] Navigant misprinted the value in the PY7 annual report. The value reported in this table is the actual value.

A.1.5 Statewide Evaluator Final Recommendations

The SWE Team has the following recommendations for Duquesne's EE&C programs going forward:

- Future evaluation efforts should include sufficient details regarding HER billing analysis, both the methods and analysis, so the SWE Team can more fully assess the evaluation outcome.
- The kit programs (SEP, REEP, WHEAP) appear to be lacking two key installation rate adjustments:
  - The kits programs do not currently account for future installations credited to the program, even though these programs often received a reduction in verified savings of 10%–40% due to installation rate adjustments. Future research for these programs, evaluations, and TRMs should consider longer-term installation of these measures.
  - Since the kits program have shown a consistently low installation rate, future iterations of the TRM or the claimed gross ex ante savings should be adjusted for some assumed ISR. Otherwise evaluations will continue to show a lower realization rate for these programs.
- The SWE and Duquesne's evaluation contractor should continue to monitor and assess the need to perform on-site inspections for the Duquesne low-income program should the program expand to offer more comprehensive retrofit options.
- It appears that Duquesne's upstream lighting contractor (ECOVA) has continued to modify the lightbulb lumen look-up table and associated logic used in its PMRS system to match the TRM tables and logic. Even with the updates, the evaluation contractor revised the baseline wattages of a fairly significant number of records (7%), resulting in an increase of approximately 1.3% in verified savings. The SWE Team continues to recommend that Duquesne have its evaluation contractor (currently Navigant) validate the logic and tables used for the lighting (and other programs) in its system very early in each program year to ensure consistency with the current-year TRM. Furthermore, in future annual reports, the evaluation contractor should include greater detail regarding PMRS validation and the records and assumptions that are inconsistent with the TRM, to highlight which bulb types in particular are divergent from the TRM.
- Although the audit did not identify any serious installation, verification, or TRM savings issues and validated Navigant's evaluation efforts for the annual report, the annual report lacked a discussion relative to the final adjusted savings rates (realization rates) and whether the adjustments made to the verified savings were attributable to deemed savings or installation verification.
- Understanding that there is a balance between data-collection requirements and cost, the SWE Team continues to encourage Duquesne to investigate the cost of having its CSP log baseline equipment and other installation parameters (installation location, actual installed quantity or length), to more accurately reflect the savings for high-impact measures. There is likely significant

savings potential that Duquesne is stranding by relying on TRM defaults rather than on EDC data collection.

- With the new and differently implemented WHEAP, track the awareness of and implementation rate for REEP rebates among WHEAP participants, to determine whether the link between the two programs is being made effectively to participants.
- If it is cost-effective, consider using the REEP and Low-Income Energy Efficiency Program (LIEEP) to introduce LEDs to participants in addition to one or more CFLs, as LEDs may result in lower free-ridership.
- If Phase III activities shift from promoting primarily CFLs to LEDs, consider updating or changing Wattley, the Watt Choices image, to look less like a CFL.

A.2 MET-ED

This section summarizes Met-Ed's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by Met-Ed's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by Met-Ed's evaluation contractor to conduct M&V of Met-Ed's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve Met-Ed's programs in the future.

A.2.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.2.1.1 Phase II Savings by Program

Table A-27 lists the Met-Ed EE&C programs that yielded reported savings in PY7.

Table A-28 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Home Performance program was the largest contributor of energy savings.

Table A-27: Met-Ed EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector
Appliance Turn-In	Residential
Efficient Products	Residential
Home Performance	Residential
Low Income	Low-Income
Small C/I Equipment	Non-Residential
Small C/I Buildings	Non-Residential
Large C/I Equipment	Non-Residential
Large C/I Buildings	Non-Residential
Gov./Institutional	GNI

Table A-28: Summary of Met-Ed EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Appliance Turn-In	14,253	4%	2.20	5%
Efficient Products	89,130	24%	9.90	22%
Home Performance	111,045	30%	11.04	24%
Low Income	6,463	2%	0.51	1%
Small C/I Equipment	49,750	14%	8.31	18%
Small C/I Buildings	10,319	3%	1.78	4%
Large C/I Equipment	82,254	22%	10.77	24%
Large C/I Buildings	4,576	1%	1.05	2%
Gov./Institutional	445	0%	0.09	0%
Total Portfolio	***368,235***	***100%***	***45.66***	***100%***

A.2.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved by Met-Ed in PY7 are provided in Table A-29. In PY7, the net energy savings were approximately 75% of the gross energy savings.

Table A-29: Summary of Met-Ed EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	95,631	76,184	213,247	149,254
C/I	52,941	34,043	121,331	84,281
GNI	22,848	14,754	33,657	21,787
Total Portfolio	***171,420***	***124,981***	***368,235***	***255,322***

A.2.2 Total Resource Cost Test

Table A-30 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for Met-Ed's PY7 individual programs and total portfolio. The SWE found no inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-30: Summary of Met-Ed's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$2,027,118	$759,029	$1,268,089	2.67
Efficient Products	$14,154,579	$9,169,910	$4,984,669	1.54
Home Performance	$12,517,714	$5,509,591	$7,008,122	2.27
Low Income	$560,899	$1,658,800	($1,097,900)	0.34
Small C/I Equipment	$15,763,826	$14,310,761	$1,453,065	1.10
Small C/I Buildings	$3,334,422	$1,730,301	$1,604,121	1.93
Large C/I Equipment	$23,092,556	$14,588,272	$8,504,284	1.58
Large C/I Buildings	$3,028,375	$1,859,332	$1,169,043	1.63
Gov./Institutional	$81,837	$247,056	($165,219)	0.33
Total Portfolio	**$74,561,326**	**$49,833,052**	**$24,728,274**	**1.50**

Seven of Met-Ed's nine programs offered were found to be cost-effective and two were non-cost-effective. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Residential Appliance Turn-In*
- *Energy Efficient Products*
- *Residential Home Performance*
- *Small C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Equipment*
- *Small C/I Energy Efficient Buildings*
- *Large C/I Energy Efficient Buildings*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *Residential Low-Income*
- *Government and Institutional*

The SWE notes that the C/I Energy Efficient Buildings programs transitioned to cost-effective programs in PY7. The improved cost-effectiveness is likely the result of increased participation in PY7 resulting in savings and benefits that could outweigh the program's fixed costs. Overall, programs with large amounts of energy and demand savings generally had high TRC ratios. This signifies that the programs garnering the most savings were also the most cost-effective programs in PY7.

A.2.2.1 Assumptions and Inputs

One TRC model template was shared across all four FirstEnergy companies. Despite the similar model, the TRC model calculations were handled independently for each of the four EDCs. The Met-Ed iteration of the FirstEnergy TRC model used a discount rate of 7.52% to compare the NPV of program benefits that will occur later in a measure's lifetime to the up-front costs of installation of implementation. This value matches the EDC's EE&C plan on file. Different values of LLF were used for different sectors, as shown in Table A-31.

Table A-31: Met-Ed's PY7 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF	Demand LLF
Appliance Turn-In	Residential	7.52%	7.18%	7.18%
Efficient Products	Residential	7.52%	7.18%	7.18%
Home Performance	Residential	7.52%	7.18%	7.18%
Low Income	Residential	7.52%	7.18%	7.18%
Small C/I Equipment	Non-Residential	7.52%	5.0%	5.0%
Small C/I Buildings	Non-Residential	7.52%	5.0%	5.0%
Large C/I Equipment	Non-Residential	7.52%	5.0%	5.0%
Large C/I Buildings	Non-Residential	7.52%	5.0%	5.0%
Gov./Institutional	Non-Residential	7.52%	5.0%	5.0%

In the residential sector, measure lives were reported on a measure-by-measure basis. The SWE Team spot-checked some of these measure lives and found them to be consistent with the 2015 TRM.[63] In the non-residential sector, the TRC model applied an EUL at the stratum level rather than at the measure level.

Similarly, the model assigned incremental costs at the measure level in the residential sector and at the stratum level in the non-residential sector in the model. The residential-sector incremental costs primarily were derived from the SWE incremental cost database, the Met-ED EE&C plan and the project invoices. The sources for non-residential sector incremental costs included the SWE cost database, sampled project invoices, the Database for Energy Efficient Resources (DEER) 2008 incremental cost database, and the EDC EE&C plan.[64] The FirstEnergy TRC model relied on the evaluation samples as a basis for calculating incremental participant costs for non-residential programs. Those sampled values were weighted to apply to the remainder of the program. The SWE Team examined this approach and found it reasonable and appropriate.

The TRC model drew the energy and demand impacts from the tracking database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC model analysis was based on ex post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

[63] The SWE notes a single exception; the FirstEnergy TRC model understates the EUL of the Room AC measure, using a 4-year measure life instead of the TRM value of 9 years.
[64] The DEER 2008 incremental cost database is available for download at http://www.deeresources.com.

The 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures beginning June 1, 2016, but does not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. In the Met-Ed TRC model, a measure's lifetime was separated into two parts: the first year, and the remaining lifetime. The removed equipment was treated as the baseline for the first year, with the baseline shifting to the code-required baseline for the remainder of the measure's life. The model calculated the measure's lifetime savings as the sum of these two parts.

A.2.2.2 Avoided Cost of Energy and Capacity

Consistent with prior Phase II program years, the PY7 FirstEnergy TRC Models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.2.2.3 Conclusions and Recommendations

The FirstEnergy TRC model is performing all of the B/C calculations in accordance with the 2013 TRC Order. The SWE Team review of the Met-Ed TRC model found no calculation errors and believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.2.3 Status of Evaluation Activities

This section discusses the status of Met-Ed's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.2.3.1 Status of Evaluation, Measurement and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation Framework that was applicable for PY6 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-32 displays key milestones completed by FirstEnergy and the SWE for FirstEnergy's Phase II EM&V Plan. FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs.

Table A-32: Key Milestones Reached for Met-Ed's Phase II EM&V Plan

Date	Event
September 19, 2013	FirstEnergy EDCs submit first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on the FirstEnergy evaluation plan to FirstEnergy
November 13, 2013	SWE sends a list of "items that be must addressed" to FirstEnergy EDCs
February 19, 2014	FirstEnergy EDCs submit revised Phase II evaluation plan to the PUC and SWE
June 1, 2014	PY6 starts
December 17, 2014	FirstEnergy EDCs provide email with additional information on the approach used by ADM for the PY6 evaluation of Met-Ed's Appliance Turn-In Program
January 5, 2015	FirstEnergy EDCs send email to SWE with clarification of sampling approach for the evaluations of the residential low-income program components (direct-install, giveaway, and low income low use kit components)

The initial EM&V Plan for all FirstEnergy companies, submitted on September 19, 2013, detailed proposed evaluation objectives and activities for nine programs across two sectors. Key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts were presented for each of the nine programs. After reviewing the plan, the SWE Team returned 34 comments on October 15, 2013. Many of the SWE Team's comments demonstrated the SWE Team's agreement with details of the FirstEnergy EDCs' plan. Most of the remaining comments concerned report formatting and minor clarifications that did not propose changes to the plan; substantive recommendations for revisions to the plan arose in only two areas:

- Frequency of EDC data gathering in partially deemed measures
- Definition of high-impact measures in C/I programs

FirstEnergy EDCs provided revisions to the plan on February 19, 2014, and the SWE Team approved the revised version as the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all PY6 and PY7 EM&V activities.

A.2.3.2 Measurement and Verification Activities and Findings

Realization rates compare gross savings reported by the EDC with the verified gross savings determined by the EDC evaluation contractor through M&V. Table A-33 summarizes M&V findings based on activities conducted by the Met-Ed evaluation contractor. The summary is based on details provided in Met-Ed's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table A-33 presents realization rates and relative precision values for verified energy and demand savings for each of Met-Ed's residential and non-residential energy efficiency programs in PY7.

Table A-33: Met-Ed Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY7

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	109.4%	8.00%	107.9%	7.3%
Efficient Products	137.0%	1.8%	110.3%	3.6%
Home Performance	93.3%	3.4%	78.1%	3.4%
Low-Income	105.5%	9.0%	113.0%	8.9%
Small C/I Equipment	88.6%	12.3%	109.9%	12.6%
Small C/I Buildings	85.4%	13.7%	80.7%	13.2%
Large C/I Equipment	105.6%	11.4%	104.0%	12.0%
Large C/I Buildings	98.1%	10.5%	86.2%	13.4%
Government/Institutional	59.2%	11.1%	27.1%	11.3%

NOTES:
[a]Relative precision values are at the 85% confidence level.

A.2.3.2.1 Residential Programs

The energy realization rates for Met-Ed's residential programs ranged from 93.3% to 137.0%. The demand realization rates ranged from 78.1% to 113.0%. Met-Ed achieved the 15% relative precision requirement at the 85% confidence level for both energy and demand for all residential programs.

The Appliance Turn-In Program was evaluated through customer verification surveys to determine the fraction of refrigerators, freezers, and room air conditioners that were drawing power before retirement, as well as the other parameters necessary to determine the expected useful life (EUL) from the TRM regression equation. The program realization rate is mostly a function of the difference between the ex ante and ex post EULs, the latter of which used actual PY7 collection data.

The evaluations of the upstream lighting and products portions of the Efficient Products Program involved reviews of sales invoices, a review of the tracking and reporting system, and a detailed review of CSP energy and demand savings calculations. The appliance portion and the HVAC equipment/tune-up portion were evaluated through an invoice review, customer surveys, and a review of the energy and demand calculations with reference to the ENERGY STAR database.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The home energy audit kits were evaluated using the tracking and reporting (T&R) system as well as online and phone surveys to determine the delivery and installation rates for each measure. The kit receipt rates and measure in-service rates (ISRs) have been shown to fluctuate among EDCs, primarily due to statistical variations, and therefore average statewide ISRs are used for all four FirstEnergy companies. The new construction portion of the program was evaluated through an engineering review of a sample of projects in the portfolio. Energy and demand savings for this program were determined through REM/Rate software calculations, and the review focused on whether the modeling was performed correctly (including baseline assumptions) and if the results were reasonable. The prescriptive, low-cost direct-install portion was evaluated by reviewing the T&R system and sample

invoices to check if the TRM calculations were performed correctly and if the invoices matched the information in the database. For comprehensive weatherization jobs, those that saved more than 2 MWh/yr were evaluated through billing analysis, and those saving under 2 MWh/yr received an invoice review. The HER portion was reviewed and duplicated by the evaluation contractor, producing results consistent with the implementation CSP's. The contractor then conducted its own full evaluation of the savings using a lagged seasonal regression model and adjusting for dual participation.

A.2.3.2.2 Low-Income Programs

The evaluation contractor reviewed the tracking data and on-site verification forms and results to determine ISRs for the WARM direct-install measures. For giveaway events, the evaluation contractor reviewed the tracking database and applied the ISR from the 2015 TRM. There were no LILU energy kits distributed in PY7.

A.2.3.2.3 Non-Residential Programs

Realization rates for Met-Ed's non-residential programs' energy savings ranged from 59.2% to 105.6% in PY7. Realization rates for demand reductions from these programs ranged from 27.1% to 109.9%. The lowest realization rates were from the GNI Program, which tends to have low participation rates, non-standard lighting HOU, and self-installation by customers, resulting in inaccurate ex ante savings. Met-Ed achieved the 15% precision requirement for kWh in all of its non-residential programs. It also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II of Act 129.

Figure A-3 shows the frequency of each M&V approach performed by ADM in PY7 for Met-Ed's Small C/I Equipment Program evaluation sample and the verified energy savings associated with each M&V approach. ADM used both basic and enhanced levels of rigor to evaluate projects in the sample. Basic rigor includes surveys, desk reviews, and simple on-site verification (no logging). Enhanced rigor includes the following options, as recorded by ADM. The first consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. The second general approach is on-site verification with logging. This may be light logger deployment or more robust measurement of the retrofitted system's continuous energy usage. The third general approach involves modeling energy performance of a facility before and after the efficiency measure is installed with an energy simulation.

Figure A-3: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Equipment Program

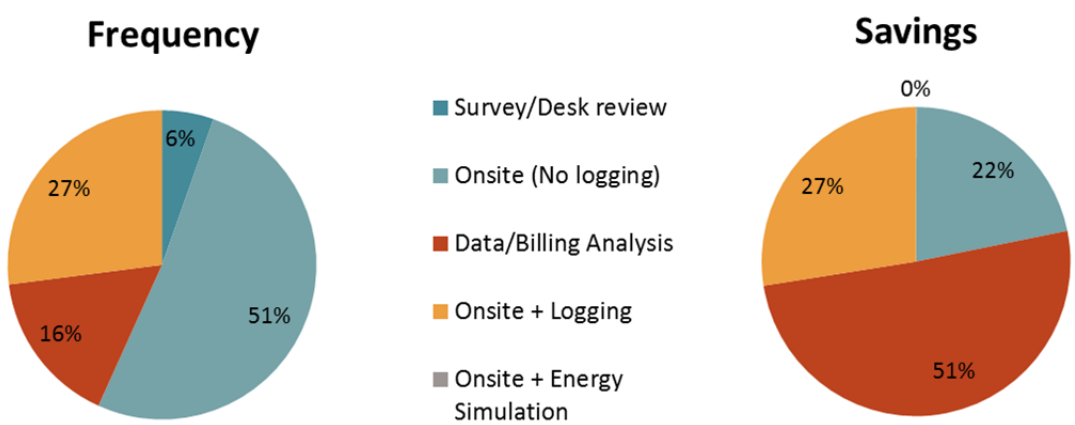


Figure A-4 indicates that 57% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 22% of the energy savings. This suggests that basic rigor was appropriately used, predominately for projects with smaller savings. Likewise, the more expensive enhanced rigor methods were reserved for a smaller number of projects, but these projects contributed a large majority (78%) of the program's energy savings. The SWE Team supports this "value of information" approach, whereby more expensive evaluation techniques are reserved for projects that account for the greatest share of program savings.

Figure A-4 shows the frequency of each M&V approach used in the Small C/I Buildings Program and the energy savings associated with each method. Data/billing analysis was the only enhanced rigor approach used for this program, and it accounted for 22% of savings. These values are presented excluding CFL kits, which skew the percentages toward survey/desk review.

Figure A-4: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Buildings Program

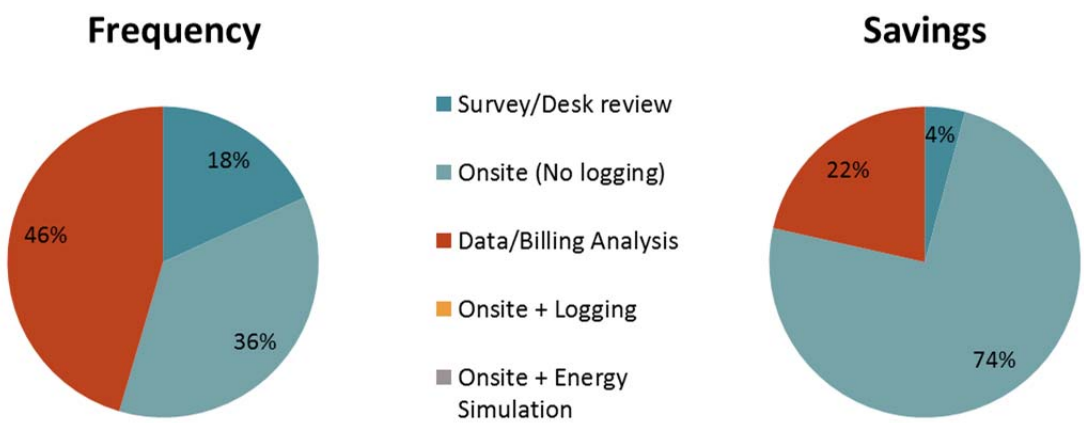


Figure A-5 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (53%), and these projects accounted for a large majority of the savings (75%). Basic rigor was limited to those projects with less savings.

Figure A-5: Frequency of and Associated Energy Savings by M&V Approach – Large C/I Equipment Program

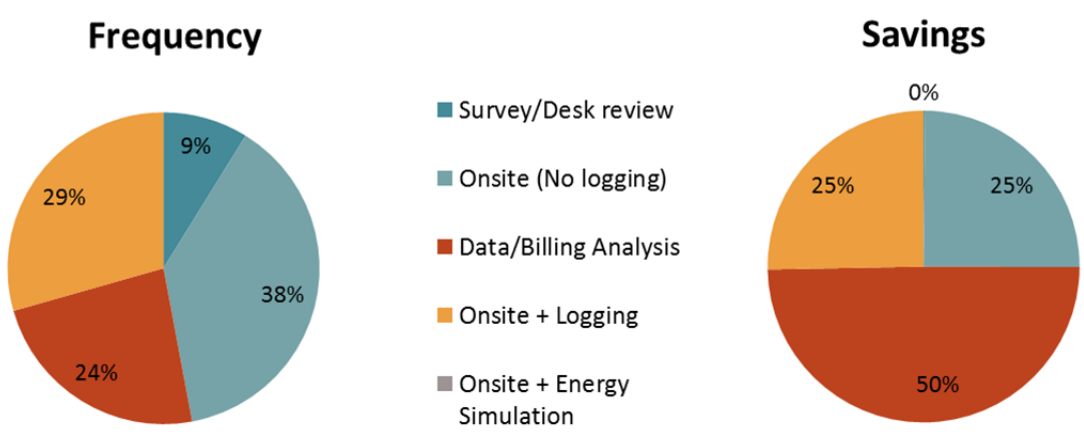


Figure A-6 shows the frequency of each M&V method used in the Large C/I Buildings Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (73%), and these projects accounted for most of the savings (85%).

Figure A-6 Frequency of and Associated Energy Savings by M&V Approach – Large C/I Buildings Program

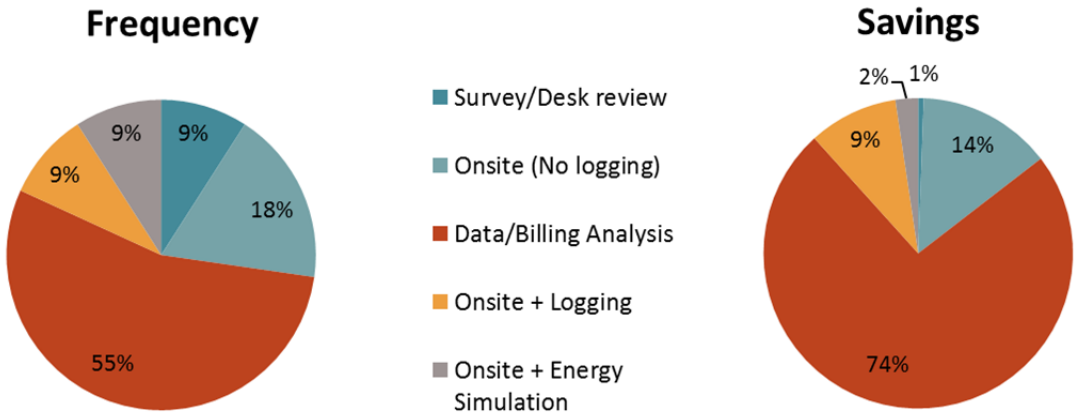
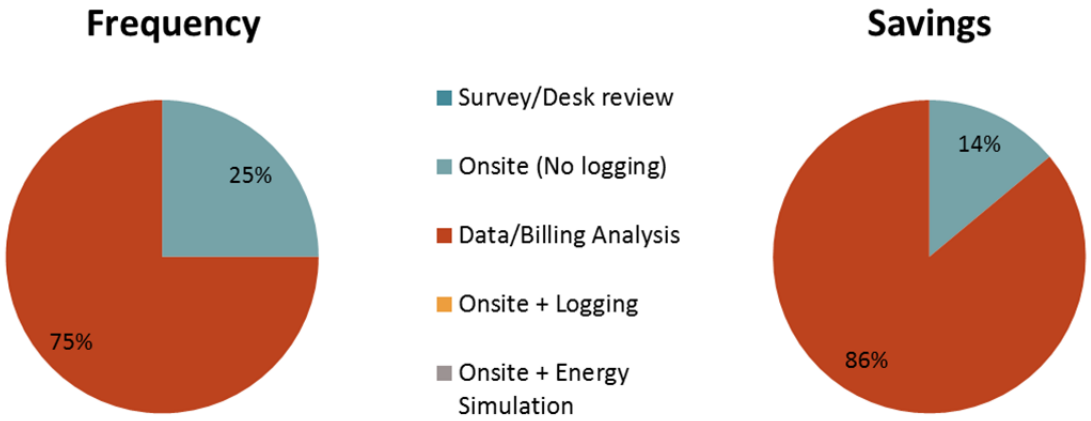


Figure A-7 shows the frequency of each M&V method used in the Government and Institutional Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (75%), and these projects accounted for 86% of the savings.

Figure A-7: Frequency of and Associated Energy Savings by M&V Approach – Government and Institutional Program



A.2.3.3 Process Evaluation Activities and Findings

The ADM/Tetra Tech team conducted limited process evaluation activities during PY7. Tetra Tech conducted interviews with participating retailers for the Energy Efficient Products program's upstream lighting and electronics components; interviews with homebuilders and raters for the Home Performance program; interviews with participating contractors; and participant surveys for the non-residential Energy Efficient Buildings programs (Small and Large). Table A-34 summarizes the data sources Tetra Tech used and its key findings for each program.

Table A-34: Summary of Key Findings and Data Sources – FirstEnergy

Program	Key Findings	Data Sources
Residential Sector		
Energy Efficient Products	– High satisfaction with the program and the array of eligible measures among participating retailers. – Retailers have close working relationships with the program implementers. – Level of program activities varies by retail and individual stores within chains, but there are stores that held program-sponsored events, with signage and staff trained to promote energy efficiency among customers. – Participating stores are preferentially placing LEDs in prominent locations and have less shelf space dedicated to incandescent lamps than do nonparticipating stores. – Some participants suggested the program to be more flexible to midyear changes in measure eligibility and that it leverage market intelligence to adapt to the rapidly changing lighting market.	– Interviews with participating retailers in upstream lighting and electronics components
Home Performance	– Moderate level of program satisfaction among builders. Commonly cited dissatisfactions are paperwork and logistical burdens (coordination with raters, time lag between application and receipt of rebates). – Nonparticipating builders are primarily concerned about incremental costs and documentation burden for application. – Participating builders perceive declining value of the ENERGY STAR New Home certification. Many of them are creating their own energy efficient packages. – Raters are satisfied with the program. Their common challenge is to appeal to builders for their service value.	– Interviews with participating and nonparticipating homebuilders and raters
Non-Residential Sector		
Energy Efficient Buildings (Small and Large)	– Participants in the custom component are highly satisfied with the program. – Participants in the kit component are satisfied, but they suggest upgrading lamps to LEDs. – Contractors are actively communicating with potential customers about savings opportunities, ROI, and NEB. – Contractors reported challenges with paperwork requirements, preapproval wait times, understanding eligibility requirements, and frequent QA inspections.	– Interviews with participating contractors – Participant surveys

A.2.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of Met-Ed's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.2.4.1 Residential Program Audit Summary

A.2.4.1.1 Residential Lighting Program

For PY7, residential upstream lighting accounted for a majority of the reported savings in Met-Ed's Efficient Products Program. The SWE Team reviewed the database and tracking system submitted by Met-Ed and its evaluation contractor to verify that the correct savings algorithms and deemed savings values were used in the program. The SWE Team also reviewed 10 invoices and product data sheets covering many different bulb types, from standard CFLs to decorative LEDs and floodlight bulbs. Due to the format of the tracking database, the SWE Team easily confirmed that the 2015 TRM was appropriately used for the calculations to quantify the program savings. The SWE Team also verified that FirstEnergy's evaluation contractor correctly noted any discrepancies in the census data and accounted for any adjustments in the verified savings data.

A.2.4.1.2 Appliance Turn-In Program

The SWE Team reviewed the spreadsheets and database used to calculate Met-Ed's verified gross savings. Unlike in previous years where the evaluation contractor simply used the deemed unit energy consumptions (UECs) from the TRM, in PY7 the contractor calculated a utility-specific UEC from the PY7 appliance recycling customer database. The SWE Team confirmed that the UECs were calculated correctly using the 2015 TRM regression coefficients and PY7 Met-Ed customer data, and that they were used correctly in determining annual kWh and kW savings. Because of a difference in how gross savings are calculated in the 2015 TRM, it was not necessary to account for refrigerator replacement. This is taken into account only in the net savings calculations. The Excel worksheets documented calculations clearly and were easy to follow.

A.2.4.1.3 Efficient Products Program

The SWE Team thoroughly reviewed the data-tracking and reporting system containing the savings calculation and rebate invoice information for all of the Efficient Products Program strata. Additionally, it checked the proper use of the 2015 TRM in calculating the savings for each of the product types. The SWE found that the heat pump water heater (HPWH) savings calculations strayed slightly from the TRM, but in an acceptably conservative fashion. According to the TRM, the HVAC interactive effect penalty only needs to be taken into account when the HPWH is installed in conditioned space and not when the default F_{derate} value is used. The evaluation contractor assumed both, which made the kWh estimates slightly conservative.

A.2.4.1.4 Home Performance Program

The SWE Team audited each operational component of the Home Performance Program: whole house direct install, home energy audit conservation kits, new homes, and HERs (the school conservation kits component did not operate in PY7). The HERs accounted for a majority (66%) of the Home Performance Program savings in PY7. The SWE Team verified that the correct 2015 TRM savings were used for all measures in the home energy audit conservation kits and that the FirstEnergy statewide receipt rate and ISRs were correctly applied to the items.

For the whole house direct-install component, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The HER component received a full evaluation for the first time in Phase II in PY7. Due to the one-year measure life, it was unnecessary to evaluate this component in the other years. The SWE

reviewed the independent analysis performed by the evaluation contractor and verified that it was done correctly. There was good consistency between the results of the three analyses performed (OPower's, ADM's replication of OPower, and ADM's), and the overall realization rate was 90%.

A.2.4.2 Low-Income Program and Audit Summary

The SWE Team reviewed the two distribution branches of the Low-Income Program operational in PY7 (direct install and giveaway) to ensure that the savings were correctly calculated using the 2015 TRM and that the realization rates were correctly determined and applied appropriately. Met-Ed's evaluation contractor provided a complete database of direct-install measures, which included a pivot table that ranked measures by individual measure contribution to total program kWh savings. Using this, the SWE Team verified the calculations for five measures with the greatest overall impact and verified five randomly selected measures. The SWE Team also confirmed that kWh and kW calculations for the estimations of savings for the giveaway program were implemented per the 2015 TRM.

Finally, the SWE Team verified that Met-Ed was in compliance with the requirement that the number of energy conservation measures offered to low-income households be proportionate to those households' share of the total energy usage in Met-Ed's service territory. Met-Ed offered six types of measures to the low-income sector in PY7, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 8.8%.

A.2.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were performed in accordance with the applicable TRM, or by some other reasonable methodology. The SWE Team reviewed nine projects in Met-Ed's PY7 non-residential programs across various measures, including lighting, compressed air, VFDs, refrigeration, pumps, and motors. Project documentation was complete and thorough, with ample notes and explanation where necessary. One major addition in PY7 was a consistent site-specific cover page included in each project, where previously there may not have been. This was very helpful to the SWE. At this time, the SWE Team only recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for lighting projects moving forward.

The SWE Team reviewed Met-Ed's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-35, showing relative precision at the 85% confidence level.

Table A-35: Compliance across Sample Designs for Met-Ed's PY7 Non-Residential Program Groups

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Small C/I Equipment	12.3%	12.6%	✓
Small C/I Buildings	13.7%	13.2%	✓
Large C/I Equipment	11.4%	12.0%	✓
Large C/I Buildings	10.5%	13.4%	✓
Government/Institutional	11.1%	13.3%	✓

Met-Ed met the goal of 15% precision at the 85% confidence level for energy for all non-residential program groups. Details concerning each program evaluation sample can be found below.

As part of the audit process, the SWE Team performed 17 ride-along site inspections of non-residential projects to oversee Met-Ed's on-site evaluation practices. The projects included lighting, HVAC, and transformer upgrades. The SWE Team approved all of the sampled project inspections and ex post calculations. However, the SWE Team recommends that Met-Ed only use the SWE-supplied Appendix C calculator for lighting projects moving forward. Details of all 17 projects and their associated findings from ride-along site inspections are presented below.

The SWE Team performed a verified savings analysis on four submitted projects, checking for accuracy in calculations and the appropriateness of the evaluation method and level of rigor selections. Previously, the SWE commented that it "would like to see better organization and presentation in the project files," and there was significant improvement in this respect for PY7. Project folders were well organized and there was a report for each project detailing M&V methodology and results. The results of the verified savings analysis are presented below.

A.2.4.3.1 Project Files Review

The SWE Team reviewed nine projects in Met-Ed's PY7 non-residential programs across various measures, including lighting, compressed air, VFDs, refrigeration, pumps, and motors. The submitted files included project-level savings calculation workbooks, application forms, measure installation confirmation, equipment specification sheets, invoices, post-installation inspection reports, and other supporting documents. Project documentation was complete and thorough, with ample notes and explanation where necessary. One major addition in PY7 was a consistent site-specific cover page included in each project, where previously there may not have been. This was very helpful to the SWE.

Table A-36 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-36: Met-Ed PY7 Project File Review Summary

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-348926	Small C/I Equipment	Installation of energy efficient freezer and refrigerator reach-in cases	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-263557	Small C/I Buildings	Interior and exterior lighting, 1 ASHP, 2 VFDs, and 2 motors	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-375049	Large C/I Equipment	Parking lot HPS to LED conversion	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-263530	Large C/I Buildings	In-unit and common area lighting and controls, exterior lighting and controls, new hot water and chilled water pumps and VFDs, new make-up air units, and controls on electric resistance heaters	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-682449	Large C/I Buildings	Lighting (new construction)	Yes	Yes	No	Yes	Yes	N/A

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-419599	Small C/I Buildings	Lighting and VFDs	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-424328	Large C/I Equipment	Lighting (refrigerated LED)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-422326	Large C/I Equipment	Custom (compressed air leak repair)	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-493348	Small C/I Buildings	Lighting (LED)	Yes	Yes	No	Yes	Yes	N/A

In PY6 the SWE Team was pleased with Met-Ed's project files and identified only minimal issues. Project files were found to be conclusive and organized, with few exceptions. This was the case in PY7 as well, and was aided by the more standardized project file format and consistent inclusion of a site-specific cover page. At this time, the SWE Team only recommends that in the interest of transparency, only the supplied Appendix C calculator be used for lighting projects moving forward.

A.2.4.3.2 Sample Design Review

Met-Ed's PY7 annual report provides detailed information about the sample design of the PY7 gross impact evaluation of non-residential programs. Met-Ed's non-residential programs were the Small C/I Energy Efficient Equipment Program, Small C/I Energy Efficient Buildings Program, Large C/I Energy Efficient Equipment Program, Large C/I Energy Efficient Buildings Program, and Government and Institutional Program.

A.2.4.3.2.1 Small C/I Energy Efficient Equipment Program

In PY7, this program was divided into two components: equipment incentives and appliance recycling. Lighting measures contributed the majority of the gross energy savings for the program.

Stratified ratio estimation was used to estimate savings for the program, and stratified random sampling was used for sample design by the evaluation contractor. For large lighting projects in the evaluation sample, Met-Ed's evaluation contractor designed an on-site sampling strategy that targeted ±20% precision at the 90% confidence level for the physical counting of fixtures. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then stratified based on energy savings at the measure level. The assumed coefficient of variation (Cv) used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-37. The data show that Met-Ed met the SWE Team requirements of 85/15 confidence/precision for both energy and peak demand.

Table A-37: Met-Ed PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	28	26.1%	6	6	26.1%	26.1%
Lighting – 3	78	28.2%	6	6	28.2%	28.2%
Lighting – 4	422	23.7%	9	9	23.7%	23.7%
Custom – certainty	3	0.0%	3	3	0.0%	0.0%
Custom – 2	6	65.7%	1	1	65.7%	65.7%
Custom – 3	44	27.3%	6	6	27.3%	27.3%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
HVAC and DHW – 1	7	43.0%	2	2	43.0%	43.0%
HVAC and DHW – 2	36	49.5%	2	2	49.5%	49.5%
Appliance Turn-In – 1	58	71.4%	1	1	71.4%	71.4%
Kitchen/appliances – 1	12	68.9%	1	1	68.9%	68.9%
Program Total	**694**	**12.8%**	**37**	**37**	**12.3%**	**12.6%**

A.2.4.3.2.2 Small C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-38. The precision levels for energy and for demand met the SWE Team requirements.

Table A-38: Met-Ed PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	4,494	11.3%	40	47	10.4%	10.4%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	4	0.0%	4	2	36.0%	36.0%
Custom – 2	11	28.7%	4	3	35.5%	35.5%
Custom – 3	129	28.7%	6	6	28.7%	28.7%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**4,638**	**13.3%**	**54**	**58**	**13.7%**	**13.2%**

A.2.4.3.2.3 Large C/I Energy Efficient Equipment Program

The evaluation contractor used stratified ratio estimation to estimate savings for the program and stratified random sampling for sample design. All lighting projects that were expected to have more

than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then was stratified based on energy savings at the measure level. The Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-39. The data show that Met-Ed met the SWE Team requirements of 85/15 confidence/precision for energy and peak demand for this program.

Table A-39: Met-Ed PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	10	34.8%	3	3	34.8%	34.8%
Lighting – 3	31	29.5%	5	5	29.5%	29.5%
Lighting – 4	148	28.8%	6	6	28.8%	28.8%
Custom – certainty	13	0.0%	13	11	8.5%	8.5%
Custom – 2	4	62.4%	1	1	62.4%	0.0%
Custom – 3	53	30.6%	5	5	30.6%	30.6%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	14	36.8%	3	3	36.8%	36.8%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**273**	**10.7%**	**36**	**34**	**11.4%**	**12.0%**

A.2.4.3.2.4 Large C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design

strategy and the achieved precision values for energy and demand are shown in Table A-40. The precision levels for energy and for demand met the SWE Team requirements.

Table A-40: Met-Ed PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	18	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	3	0.0%	3	3	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	13	21.6%	6	6	21.6%	21.6%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In-1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**34**	**10.8%**	**9**	**9**	**10.5%**	**13.4%**

A.2.4.3.2.5 Government and Institutional Program

This program had three categorical components in PY7: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. The sampling strategy was identical to that in the Large C/I and Small C/I Energy Efficient Equipment programs. Detailed information on the sample design and the achieved precision values for each stratum are shown in Table A-41.

Table A-41: Met-Ed's PY7 Sampling Strategy and Achieved Precision – Government and Institutional Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	3	29.4%	2	2	29.4%	29.4%
Lighting – 4	6	29.4%	3	4	20.8%	20.8%
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	8	14.7%	6	6	14.7%	14.7%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**17**	**12.8%**	**11**	**12**	**11.1%**	**11.3%**

A.2.4.3.3 Ride-Along Site Inspections

Table A-42 summarizes the SWE Team's PY7 ride-along site inspections of Met-Ed's non-residential project installations. For PY7, all Met-Ed PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluation contractor savings calculations or reports.

Table A-42: Met-Ed's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-475458	Lighting (refrigerated)	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-372852	Lighting	Minor differences in the application fixture count were discovered at the site inspection.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.
PRJ-368467	Lighting	At the site visit it was discovered that differences in the HOU existed, as well as control discrepancies. Additionally, the Appendix C calculator was not used correctly, although the final Ex Post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-481137	Lighting (refrigerated)	Major differences in the application fixture count were discovered at the site inspection.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.
PRJ-369334	Lighting	Minor differences in the application fixture count were discovered at the site inspection.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.
PRJ-360609	Lighting	Minor differences in the application fixture count were discovered at the site inspection.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.
PRJ-376140	Lighting	At the site visit it was discovered that there were minor differences in the fixture count. Additionally, the Appendix C calculator was not used correctly, although the final ex post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-515267	Lighting	Minor differences in the application fixture count were discovered at the site inspection.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.
PRJ-270159	HVAC (economizers)	Billing analysis data were determined to be insufficient and a like project was used to create a regression model.	Eval	The SWE Team had no recommendations based on its review of this project.

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-415327	Lighting	At the site visit it was discovered that there were minor differences in the fixture count. Additionally, the Appendix C calculator was not used correctly, although the final ex post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-407740	Transformers	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-409448	Transformers	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-375049	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-306423	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-518906	Lighting	At the site visit it was discovered that there were minor differences in the fixture count. Additionally, the Appendix C calculator was not used correctly, although the final ex post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-518945	Lighting	At the site visit it was discovered that there were minor differences in the fixture count. Additionally, the Appendix C calculator was not used correctly, although the final ex post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-819595	Lighting	At the site visit it was discovered that there were minor differences in the fixture count. Additionally, the Appendix C calculator was not used correctly, although the final ex post analysis is correct.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.

A.2.4.3.4 Verified Savings Review

The SWE Team reviewed a subset of Met-Ed's sampled sites and found appropriate rigor in the evaluation contractor's M&V methods. Previously, the SWE commented that it "would like to see better organization and presentation in the project files," and there was significant improvement in this respect for PY7. Project folders were well organized, and there was a report for each project detailing M&V methodology and results. Table A-43 shows the energy and demand savings for projects chosen for review by the SWE Team, as well as the M&V approach selected for site evaluation.

Table A-43: Verified Savings and M&V Methods for SWE Team–Sampled Met-Ed Projects

Program	Project Number	Stratum	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	M&V Method
Small C/I Equipment	CR_PRJ-394737	Custom – certainty	2,161,448	267.38	Metered data analysis
Small C/I Equipment	CR_PRJ-471704	Lighting – 3	303,346	35.27	On-site verification + logging
Large C/I Equipment	CR_PRJ-504667	Custom – certainty	1,197,481	244.52	EMS data analysis
Large C/I Equipment	CR_PRJ-562230	Lighting – 2	371,385	33.25	On-site verification + logging

Project CR_PRJ-394737 involved lighting retrofits at a manufacturing facility in Annville, PA. ADM performed a site visit to verify the types and quantities of installed fixtures and installed 11 light loggers throughout the facility. The results were used to estimate annual operating hours for each space type and to generate final verified kWh and kW savings values. The SWE Team agrees with the level of rigor used in evaluating this project.

Project CR_PRJ-471704 involved LED lighting retrofits at an industrial baking facility in York, PA. ADM performed a site visit to verify the types and quantities of installed fixtures and installed five light loggers throughout the facility. The results verified 24/7 operation of all fixtures except those with occupancy sensors. The SWE Team agrees with the level of rigor used in evaluating this project.

Project CR_PRJ-504667 involved upgrading chillers to new models with VFDs at a hospital in Reading, PA. ADM was able to obtain energy management system (EMS) data, including kW readings and daily ton-hours. Verified savings were very similar to ex ante savings, with a realization rate of 106%. The SWE Team agrees with the analysis and verified savings for this project.

Project CR_PRJ-562230 involved indoor and outdoor LED lighting retrofits at a car dealership in Nazareth, PA. The evaluation contractor performed a site visit to verify the types and quantities of installed fixtures and installed six light loggers throughout the facility. The results were used to estimate annual operating hours for each space type and to generate final verified kWh and kW savings values. The SWE Team agrees with the level of rigor used in evaluating this project.

A.2.4.4 Net-to-Gross and Process Evaluation Audit Summary

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in the PY7 annual report to determine whether they were consistent with the reporting template provided by the SWE. The SWE Team's audit of the process reports also included a review of process-related methods and research activities to determine whether they were consistent with the approved evaluation plan, and a review of the linkage between findings, conclusions, and recommendations.

Overall, the process evaluations appeared to be consistent with the evaluation plan. The sampling approaches for the process evaluation activities were appropriate. The report provided a comprehensive overview of the process evaluation key findings and recommendations. The SWE Team identified one main area in which reporting could have been improved. Specifically, Tetra Tech interviewed trade allies for both the Home Performance program (builders and raters) and Energy Efficient Buildings programs (contractors), but there was no discussion of the populations or sample sizes of these groups. The SWE recommends including the information to help readers understand how widely the findings are represented.

The report documents included a summary of methods and findings, a table of recommendations, and a description of whether or not the EDC was implementing or considering the recommendations.

The report generally included sufficient detail for the SWE Team and others to assess the methods, findings, conclusions, and recommendations. Detailed summaries of the SWE Team's review of the process evaluation by program are in Appendix B.

The remainder of this section summarizes the activities and key findings of the SWE Team's NTG audits of Met-Ed's programs in PY7.

Table A-44 summarizes the results of the SWE Team's audit of ADM/Tetra Tech's NTG assessment of the FirstEnergy EDC programs.

Table A-44: Summary of SWE Team Review of FirstEnergy NTG Evaluations

Elements Reviewed in Annual Report	SWE Findings
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Yes, with exceptions noted
NTG method used – the common method or another	Common method, except for upstream components
NTG common method applied correctly	Yes

The following subsections present detailed discussions of the SWE Team's NTG audits of the FirstEnergy EDC programs in PY7, including a summary of Met-Ed's program-level NTG values that FirstEnergy's evaluation contractor reported. The results are provided for residential, low-income, and non-residential programs.

A.2.4.4.1 Residential Programs

ADM/Tetra Tech estimated NTG for three residential programs: The Appliance Turn-In Program, Residential Energy Efficient Products Program, and Home Performance Program. ADM/Tetra Tech used

primary data collection to estimate NTG for the Appliance Turn-In Program. They relied primarily on PY6 results to estimate PY7 NTG for the Residential Energy Efficient Products Program and the Home Performance Program with the exception of upstream lighting. ADM/Tetra Tech reported using the SWE Team's common method for NTG estimation for the Appliance Turn-In Program. ADM/Tetra Tech also used the common method for the Residential Energy Efficient Products and Home Performance programs in the PY6 evaluation, which was the basis for PY7 NTG results. There was not a common method suggested for upstream lighting NTG that was evaluated in PY7.

For the Appliance Turn-In Program, ADM/Tetra Tech used primary data collection (participant surveys) to estimate NTG for both refrigerator and freezer strata. However, Table 2-5 of the Met-Ed PY7 annual report reveals that ADM/Tetra Tech did not collect any room air conditioner (RAC) participant sample. ADM/Tetra Tech did not acknowledge this lack of RAC sample in the body of the report, nor did they explain how they arrived at a 50% NTGR for the RAC stratum. The SWE Team assumes the RAC stratum NTGR is a non-evidence-based and arbitrary assignment. While acknowledging that RAC savings are a minor component of the program, the SWE Team disagrees with the arbitrary assignment of 50% NTGR and recommends simply not reporting NTG values for unevaluated strata, or using empirical evidence-based values from previous evaluations as a proxy.

For the upstream components of the Residential Energy Efficient Products Program, ADM/Tetra Tech did not provide clear details or data that revealed how they used retailer interview and participant survey data to estimate NTG values for those strata. With the exception of the interview and survey data used to calculate NTG for upstream components of the Residential Energy Efficient Products Program, ADM/Tetra Tech provided Excel workbooks with the raw data from their NTG research and the SPSS syntax files used to calculate the NTGRs from the raw data. From the workbooks and syntax, the SWE Team was able to verify that ADM/Tetra Tech used the SWE common methods. However, the Excel workbooks revealed that the FirstEnergy PY7 reports included some misprinted NTG values, and ADM/Tetra Tech confirmed via email that the values in question were indeed typos. Specifically, ADM/Tetra Tech erroneously reported the refrigerator stratum free-ridership values as the program total free-ridership values for the Appliance Turn-In Program. In its summary tables, the SWE Team reports the accurate NTG values, which explain any discrepancies between the values in this report and the FirstEnergy PY7 annual reports.

For the Residential Energy Efficient Products Program, the reported program-level NTG values reflect both downstream and upstream program components: upstream lighting NTG is derived from surveys with six participating customers and five retail chains, upstream electronics NTG is derived from surveys with two retail chains, and NTG for downstream components is estimated from participant survey data. ADM/Tetra Tech used the same upstream lighting NTG values for each EDC, implying that the six surveyed participating customers represented all EDCs. Although this approach was consistent with the SWE-approved evaluation plan, the SWE Team recommends that ADM/Tetra Tech acknowledge in the PY7 annual report that they used the same upstream lighting participant sample and resulting NTG value for each EDC. Furthermore, the SWE Team cautions basing NTG estimates off such a small sample.

For the Home Performance Program, ADM/Tetra Tech weighted PY6 strata results by Phase II gross lifetime MWh savings to calculate a new NTG estimate for PY7; however, they erroneously reported using Phase III savings (ADM/Tetra Tech confirmed via email that reference to Phase III was a typo and they used Phase II savings). Since ADM/Tetra Tech did not estimate NTG for the new construction stratum in PY6, they applied an assumed NTGR of 50% for the new construction strata in PY7. The SWE Team disagrees with the arbitrary assignment of 50% NTGR and recommends simply not reporting NTG

values for unevaluated strata, or using empirical evidence-based values from previous evaluations as a proxy. ADM/Tetra Tech did not estimate NTGR for HERs, as the impact analysis provides a net savings value for that stratum.

Table A-45 summarizes the SWE Team's review of the NTG activities by program.

Table A-45: Summary of NTG Audit of Met-Ed's Residential Programs

Program	NTG Method	Review Comments
Appliance Turn-In	The common method was used. NTG was assumed to be 50% for the RAC stratum.	ADM/Tetra Tech reported using the common method for Appliance Turn-In to estimate NTG, but did not explain their use of the method in detail. Given negligible RAC savings under the program, ADM/Tetra Tech did not include in its EM&V Plan estimating NTG for the RAC component, and assigned an NTGR of 50% instead. While acknowledging that RAC savings are a minor component of the program, the SWE Team disagrees with this non-evidence-based assignment of 50% NTGR. ADM/Tetra Tech did not estimate SO. ADM erroneously reported the refrigerator stratum FR value as the program total FR value.
Efficient Products	PY6 results (which used the common method) were combined with upstream retailer interview and participant survey data.	ADM/Tetra Tech used PY6 results for downstream components and surveys/interviews with participants/retailers for upstream components. ADM/Tetra Tech did not explain how they analyzed surveys/interviews with participants/retailers to produce NTG values for upstream strata. The same upstream lighting participant sample was used for all four FirstEnergy EDCs: although participating retailers also informed NTG estimates, the SWE Team contends that the small participant sample may limit accurate NTG estimation.
Home Performance	PY6 (common method-based) strata results were reweighted with Phase II gross lifetime MWh savings. NTG was assumed to be 50% for new construction stratum. NTG was not estimated for HERs; impact analysis accounts for FR and SO.	ADM/Tetra Tech did not estimate NTG for the Home Energy Review component, as the impact analysis provides a net savings value for that component. ADM/Tetra Tech did not estimate NTG for the New Homes component, and assigned an NTGR of 50% instead. The SWE Team disagrees with this non-evidence-based assignment of 50% NTGR. ADM/Tetra Tech erroneously reported using Phase III savings; they confirmed via email that they used Phase II savings.

Table A-46 summarizes NTG findings from the PY7 Met-Ed annual report. NTGR was greatest for Home Performance and lowest for Appliance Turn-In.

Table A- 46: Summary of NTG Estimates for Met-Ed's Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Appliance Turn-In	0.75[c]	0.00	0.26	71
Partially estimated	Energy Efficient Products	0.38	0.05	0.67	137
	Home Performance	0.36	0.06	0.70	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All sample sizes are for the downstream NTG research using the common method. All provided at least 85/15 confidence/precision.
[c] ADM/Tetra Tech misprinted the program-level FR value in the PY7 annual report. The value reported in this table is the actual FR value.

A.2.4.4.2 Low-Income Residential Programs

ADM/Tetra Tech reported NTG for all three low-income program components: Direct Install, LILU (Low Income, Low Use Program) Kits, and Giveaway events. ADM/Tetra Tech estimated program-level free-ridership, spillover, and NTGR by weighting program-component NTG values by Phase II gross lifetime MWh. However, they erroneously reported using Phase III savings (ADM/Tetra Tech confirmed via email that they used Phase II savings). ADM/Tetra Tech used primary data collection and analysis to estimate NTG for the Direct Install component. They reported using the SWE Team's common method to estimate NTG for Direct Install; however, they did not describe their use of the method in detail. Since LILU was not active in PY7 and ADM/Tetra Tech lacked Giveaway participant contact information, ADM/Tetra Tech applied the NTG values from the Home Performance Program's Home Energy Audit kits as a proxy estimate for both LILU kits and Giveaway events.

While the SWE Team believes that this approach, of using inactive program components that achieved no savings in PY7, would unnecessarily penalize the EDC in a situation where net savings are counted, this is not the case here. Therefore, the SWE Team has no problem with the application of this proxy for the Giveaway stratum.

Table A-47 summarizes the SWE Team's review of Met-Ed's low-income NTG methodology.

Table A-47: Summary of NTG Audit of Met-Ed's Low-Income Program

Program	NTG Method	Review Comments
Residential Low-Income Program	The common method was used for Direct Install. The NTGR from the Home Performance Program's Home Energy Audit kits was applied as a proxy estimate for LILU and Giveaways.	The description of the Direct Install NTGR method lacked detail. The SWE Team approves of ADM/Tetra Tech's proxy estimate approach for Giveaways but does not agree with the proxy application for LILU, as it was inactive in PY7.

Table A-48 shows the NTG estimates reported in Met-Ed PY7 the annual report.

Table A-48: Summary of NTG Estimates for Met-Ed's Low-Income Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Residential Low-Income Program	0.33	0.16	0.83	43

NOTE:
[a] The sample provided at least 85/15 confidence/precision.

A.2.4.4.3 Non-Residential Programs

ADM/Tetra Tech estimated NTG for five non-residential programs: The Small C/I Equipment Program, Large C/I Equipment Program, Small C/I Buildings Program, Large C/I Buildings Program, and Government and Institutional Program. ADM/Tetra Tech noted that, because of the small number of participants in the Government and Institutional Program, the report shows NTG statistics combined across the four FirstEnergy EDCs. While ADM/Tetra Tech used primary data collection to estimate NTG for both C/I Buildings programs, it used PY6 NTG results to estimate PY7 NTG for the other three non-residential programs. ADM/Tetra Tech reported using the SWE Team's common method for NTG estimation for all five programs, but did not explain their use of the method in detail. ADM/Tetra Tech did not describe the NTG methods in detail in the PY7 annual report, but it did cite the relevant SWE memoranda. ADM/Tetra Tech provided Excel workbooks with the raw data from their NTG research and the SPSS syntax files used to calculate the NTGRs from the raw data. A review of selected workbooks and syntax verified that ADM/Tetra Tech used the SWE common method and applied it correctly. However, the Met-Ed PY7 report included a misprinted spillover value, which ADM/Tetra Tech confirmed via email was indeed a typo. Specifically, ADM/Tetra Tech erroneously reported spillover to be 0% for the Small C/I Buildings Program instead of 1%. In its summary tables, the SWE Team reports the accurate spillover value, which explains any discrepancies between the values in this report and the Met-Ed PY7 annual report (note: this typo was not present in any of the other FirstEnergy PY7 annual reports).

Table A-49 summarizes the SWE Team's review of Met-Ed's NTG methodology by program.

Table A-49: Summary of NTG Audit of Met-Ed's Non-Residential Programs

Program	NTG Method	Review Comments
Small C/I Equipment	PY6 (common method-based) strata NTG results were reweighted with Phase II gross lifetime MWh savings.	The SWE Team agrees with ADM/Tetra Tech's reweighting approach, as it is methodologically superior to simply reusing PY6 NTG values.
Large C/I Equipment	PY6 (common method-based) strata NTG results were reweighted with updated strata savings values.	Same comments as for Small C/I Equipment.
Small C/I Buildings	The common method was used.	ADM/Tetra Tech reported using the common method, but did not explain their use of the method in detail. ADM/Tetra

Program	NTG Method	Review Comments
		Tech erroneously reported SO to be 0% instead of 1%.
Large C/I Buildings	The common method was used.	ADM/Tetra Tech reported using the common method, but did not explain their use of the method in detail. Due to a small population size, ADM/Tetra Tech did not collect a kit recipient sample, and used the Small C/I Buildings kit NTG value as a proxy.
Government and Institutional	PY6 (common method-based) strata NTG results were reweighted with Phase II gross lifetime MWh savings.	Same comments as for Small C/I Equipment.

Table A-50 shows the NTG estimates reported in the Met-Ed PY7 annual report.

Table A-50: Summary of NTG Estimates for Met-Ed's Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Small C/I Equipment	0.45	0.11	0.66	N/A
	Large C/I Equipment	0.34	0.05	0.72	N/A
	Small C/I Buildings	0.32	0.01[c]	0.69	122
	Large C/I Buildings	0.62	0.01	0.39	11
	Government and Institutional	0.38	0.11	0.73	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All collected samples provided at least 85/15 confidence/precision.
[c] ADM/Tetra Tech misprinted the SO value in the PY7 annual report. The value reported in this table is the actual SO value.

A.2.5 Statewide Evaluator Final Recommendations

The SWE Team has the following recommendations for Met-Ed's EE&C programs going forward:

- The SWE Team recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for C/I lighting projects moving forward
- Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and customers more quickly if project documentation is incomplete.
- As the Home Performance – New Construction measure becomes more streamlined or as incentives change, attempt to attract builders who began with the program but dropped out.

A.3 PENELEC

This section summarizes Penelec's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by Penelec's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by Penelec's evaluation contractor to conduct M&V of Penelec's

EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve Penelec's programs in the future.

A.3.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.3.1.1 Phase II Savings by Program

Table A-51 lists the Penelec EE&C programs that yielded reported savings in PY7. Table A-52 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Home Performance program was the largest contributed to energy savings.

Table A-51: Penelec EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector
Appliance Turn-In	Residential
Efficient Products	Residential
Home Performance	Residential
Low Income	Low-Income
Small C/I Equipment	Non-Residential
Small C/I Buildings	Non-Residential
Large C/I Equipment	Non-Residential
Large C/I Buildings	Non-Residential
Gov./Institutional	GNI

Table A-52: Summary of Penelec EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Appliance Turn-In	12,857	3%	1.82	4%
Efficient Products	91,250	25%	8.51	19%
Home Performance	96,807	26%	8.44	19%
Low Income	9,789	3%	0.74	2%
Small C/I Equipment	55,842	15%	9.52	21%
Small C/I Buildings	9,037	2%	1.28	3%
Large C/I Equipment	80,030	22%	12.69	29%
Large C/I Buildings	11,923	3%	1.14	3%
Gov./Institutional	974	0%	0.17	0%
Total Portfolio	***368,508***	***100%***	***44.31***	***100%***

A.3.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-53. In PY7, the net energy savings were approximately 75% of the gross energy savings.

Table A-53: Summary of Penelec EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	87,654	67,978	203,250	141,295
C/I	62,923	48,030	133,294	101,814
GNI	13,821	10,674	31,964	22,760
Total Portfolio	***164,398***	***126,682***	***368,508***	***265,869***

A.3.2 Total Resource Cost Test

Table A-54 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for Penelec's PY7 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-54: Summary of Penelec's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$1,853,722	$684,756	$1,168,966	2.71
Efficient Products	$16,750,305	$5,256,891	$11,493,414	3.19
Home Performance	$9,804,123	$3,981,534	$5,822,590	2.46
Low Income	$904,934	$2,224,122	($1,319,188)	0.41
Small C/I Equipment	$16,434,826	$13,600,602	$2,834,224	1.21
Small C/I Buildings	$1,084,175	$2,161,898	($1,077,723)	0.50
Large C/I Equipment	$29,083,880	$20,529,419	$8,554,462	1.42
Large C/I Buildings	$2,128,165	$1,021,166	$1,106,999	2.08
Gov./Institutional	$199,858	$492,730	($292,871)	0.41
Total Portfolio	**$78,243,989**	**$49,953,117**	**$28,290,873**	**1.57**

In summary, six of Penelec's nine programs offered were found to be cost-effective and three were non-cost-effective. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Residential Appliance Turn-In*
- *Energy Efficient Products*
- *Residential Home Performance*

- *Small C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Buildings*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *Residential Low-Income*
- *Small C/I Energy Efficient Buildings*
- *Government and Institutional*

The SWE notes the Small C/I Energy Efficient buildings program transitioned to a non-cost-effective program in PY7. The decreased cost-effectiveness is largely the result of limited participation in PY7. Overall, programs with large amounts of energy and demand savings generally had high TRC ratios. This signifies that the programs garnering the most savings were also the most cost-effective programs in PY7.

A.3.2.1 Assumptions and Inputs

One TRC model template was shared across all four FirstEnergy companies. Despite the similar model, the TRC model calculations were handled independently for each of the four EDCs. The Penelec iteration of the FirstEnergy TRC model used a discount rate of 7.92% to compare the NPV of program benefits that will occur later in a measure's lifetime with the up-front costs of installation of implementation. This value matches the EDC's EE&C plan on file. Different values of LLF were used for different sectors, as shown in Table A-55.

Table A-55: Penelec's PY7 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF	Demand LLF
Appliance Turn-In	Residential	7.92%	9.45%	9.45%
Efficient Products	Residential	7.92%	945%	9.45%
Home Performance	Residential	7.92%	9.45%	9.45%
Low Income	Residential	7.92%	945%	9.45%
Small C/I Equipment	Non-Residential	7.92%	7.2%	7.2%
Small C/I Buildings	Non-Residential	7.92%	7.2%	7.2%
Large C/I Equipment	Non-Residential	7.92%	7.2%	7.2%
Large C/I Buildings	Non-Residential	7.92%	7.2%	7.2%
Gov./Institutional	Non-Residential	7.92%	7.2%	7.2%

In the residential sector, measure lives were reported on a measure-by-measure basis. The SWE Team spot-checked some of these measure lives and found them to be consistent with the 2015 TRM.[65] [66]. In

[65] The SWE notes a single exception; the First Energy TRC Model understates the EUL of the Room AC measure, using a 4-year measure life instead of the TRM value of 9 years.
[66] The SWE notes a single exception; the First Energy TRC Model understates the EUL of the Room AC measure, using a 4-year measure life instead of the TRM value of 9 years.

the non-residential sector, the TRC model applied an EUL at the sampled project/stratum level rather than at the measure level.

Similarly, the model assigned incremental costs at the measure level in the residential sector and at the stratum level in the non-residential sector in the model. The residential-sector incremental costs primarily were derived from the SWE incremental cost database, the Penelec EE&C plan, and the project invoices. The sources for non-residential sector incremental costs included the SWE cost database, sampled project invoices, the DEER 2008 incremental cost database, and the EDC EE&C Plan.[67] The FirstEnergy TRC model relied on the evaluation samples as a basis for calculating incremental participant costs for non-residential programs. Those sampled values were weighted to apply to the remainder of the program. The SWE Team examined this approach and found it reasonable and appropriate.

The TRC model drew the energy and demand impacts from the tracking database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC model analysis was based on ex post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

The 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures beginning June 1, 2016, but does not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. In the Penelec TRC model, a measure's lifetime was separated into two parts: the first year, and the remaining lifetime. The removed equipment was treated as the baseline for the first year, with the baseline shifting to the code-required baseline for the remainder of the measure's life. The model calculated the measure's lifetime savings as the sum of these two parts.

A.3.2.2 Avoided Cost of Energy and Capacity

Consistent with prior Phase II program years, the PY7 FirstEnergy TRC models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.3.2.3 Conclusions and Recommendations

The FirstEnergy TRC model is performing all of the B/C calculations in accordance with the 2013 TRC Order. The SWE Team review of the Penelec TRC model found no calculation errors and believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.3.3 Status of Evaluation Activities

This section discusses the status of Penelec's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.3.3.1 Status of Evaluation, Measurement, and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation

[67] The DEER 2008 incremental cost database is available for download at http://www.deeresources.com.

Framework that was applicable for PY6 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-56 displays key milestones completed by FirstEnergy and the SWE for FirstEnergy's Phase II EM&V Plan. FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs.

Table A-56: Key Milestones Reached for Penelec's Phase II EM&V Plan

Date	Event
September 19, 2013	FirstEnergy EDCs submit first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on the FirstEnergy evaluation plan to FirstEnergy
November 13, 2013	SWE sends a list of "items that be must addressed" to FirstEnergy EDCs
February 19, 2014	FirstEnergy EDCs submit revised Phase II evaluation plan to the PUC and SWE
June 1, 2014	PY6 starts
December 17, 2014	FirstEnergy EDCs provide email with additional information on the approach used by ADM for the PY6 evaluation of Penelec's Appliance Turn-In Program
January 5, 2015	FirstEnergy EDCs send email to SWE with clarification of sampling approach for the evaluations of the residential low-income program components (direct-install, giveaway, and low income low use kit components)

The initial EM&V Plan for all FirstEnergy companies, submitted on September 19, 2013, detailed proposed evaluation objectives and activities for nine programs across two sectors. Key evaluation

issues, impact evaluation details, process evaluation details, sampling plans, and key contacts were presented for each of the nine programs. After reviewing the plan, the SWE Team returned 34 comments on October 15, 2013. Many of the SWE Team's comments demonstrated the SWE Team's agreement with details of the FirstEnergy EDCs' plan. Most of the remaining comments concerned report formatting and minor clarifications that did not propose changes to the plan; substantive recommendations for revisions to the plan arose in only two areas:

- Frequency of EDC data gathering in partially deemed measures
- Definition of high-impact measures in C/I programs

FirstEnergy EDCs provided revisions to the plan on February 19, 2014, and the SWE Team approved the revised version as the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all PY6 and PY7 EM&V activities.

A.3.3.2 Measurement and Verification Activities and Findings

Realization rates compare gross savings reported by the EDC with the verified gross savings determined by the EDC evaluation contractor through M&V. Table A-57 summarizes M&V findings based on activities conducted by the Penelec evaluation contractor. The summary is based on details provided in Penelec's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table A-57 presents realization rates and relative precision values for verified energy and demand savings for each of Penelec's residential and non-residential energy efficiency programs in PY7.

Table A-57: Penelec Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY7

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	97.3%	8.4%	96.6%	7.9%
Efficient Products	140.7%	1.8%	87.2%	2.4%
Home Performance	95.7%	3.8%	75.1%	3.8%
Low-Income	103.8%	9.1%	105.1%	9.1%
Small C/I Equipment	88.3%	14.2%	106.2%	14.9%
Small C/I Buildings	99.7%	8.9%	91.3%	8.5%
Large C/I Equipment	100.1%	13.7%	104.2%	12.9%
Large C/I Buildings	97.2%	13.7%	82.4%	12.9%
Government/Institutional	90.2%	15.0%	97.9%	18.5%

NOTE:
[a] Relative precision values are at the 85% confidence level.

A.3.3.2.1 Residential Programs

The energy realization rates for Penelec's residential programs ranged from 95.7% to 140.7%. The demand realization rates ranged from 75.1% to 105.1%. Penelec achieved the 15% relative precision requirement at the 85% confidence level for both energy and demand for all residential programs.

The Appliance Turn-In Program was evaluated through customer verification surveys to determine the fraction of refrigerators, freezers, and room air conditioners that were drawing power before retirement, as well as the other parameters necessary to determine the EUL from the TRM regression equation. The program realization rate is mostly a function of the difference between the ex ante and ex post EULs, the latter of which used actual PY7 collection data.

The evaluations of the upstream lighting and products portions of the Efficient Products Program involved reviews of sales invoices, a review of the tracking and reporting system, and a detailed review of CSP energy and demand savings calculations. The appliance portion and the HVAC equipment/tune-up portion were evaluated through an invoice review, customer surveys, and a review of the energy and demand calculations with reference to the ENERGY STAR database.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The home energy audit kits were evaluated using the T&R system as well as online and phone surveys to determine the delivery and installation rates for each measure. The kit receipt rates and measure ISRs have been shown to fluctuate among EDCs, primarily due to statistical variations, and therefore average statewide ISRs are used for all four FirstEnergy companies. The new construction portion of the program was evaluated through an engineering review of a sample of projects in the portfolio. Energy and demand savings for this program were determined through REM/Rate software calculations, and the review focused on whether the modeling was performed correctly (including baseline assumptions) and if the results were reasonable. The prescriptive, low-cost direct-install portion was evaluated by reviewing the T&R system and sample invoices to check if the TRM calculations were performed correctly and if the invoices matched the information in the database. For comprehensive weatherization jobs, those that saved more than 2 MWh/yr were evaluated through billing analysis, and those saving under 2 MWh/yr received an invoice review. The HER portion was reviewed and duplicated by the evaluation contractor, producing results consistent with the implementation CSP's. The contractor then conducted its own full evaluation of the savings using a lagged seasonal regression model and adjusting for dual participation.

A.3.3.2.2 Low-Income Programs

The evaluation contractor reviewed the tracking data and on-site verification forms and results to determine ISRs for the WARM direct-install measures. For giveaway events, the evaluation contractor reviewed the tracking database and applied the ISR from the 2015 TRM. There were no LILU energy kits distributed in PY7.

A.3.3.2.3 Non-Residential Programs

Realization rates for Penelec's non-residential programs' energy savings ranged from 88.3% to 100.1%. Realization rates for demand reductions from these programs ranged from 82.4% to 104.2%. Penelec achieved the 15% precision requirement for kWh in all of its non-residential programs. It also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II of Act 129.

Figure A-8 shows the frequency of each M&V approach performed by ADM in PY7 for Penelec's Small C/I Equipment Program evaluation sample and the verified energy savings associated with each M&V approach. ADM used both basic and enhanced levels of rigor to evaluate projects in the sample. Basic rigor includes surveys, desk reviews, and simple on-site verification (no logging). Enhanced rigor includes the following options, as recorded by ADM. The first consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this

approach. The second general approach is on-site verification with logging. This may be light logger deployment or more robust measurement of the retrofitted system's continuous energy usage. The third general approach involves modeling energy performance of a facility before and after the efficiency measure is installed with an energy simulation.

Figure A-8: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Equipment Program

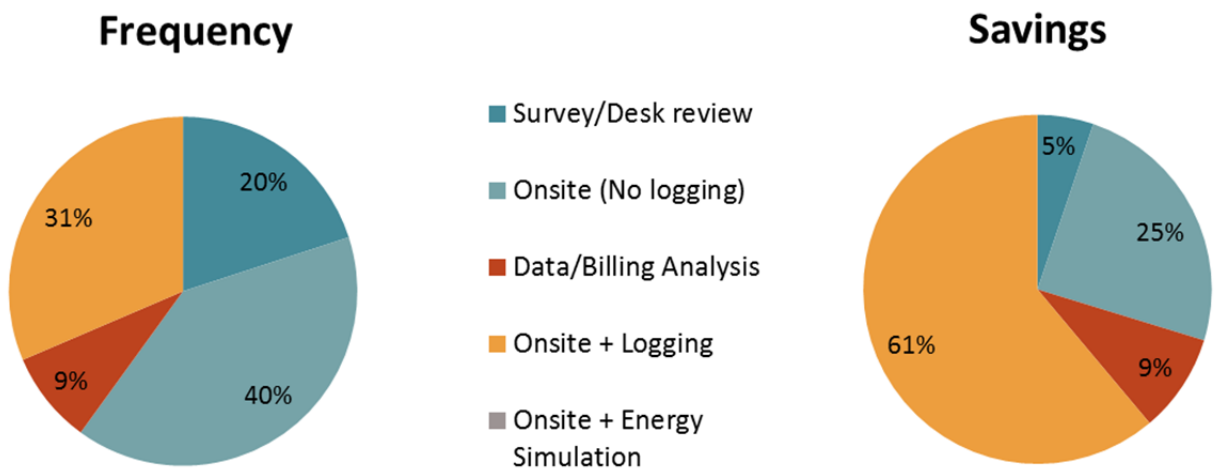


Figure A-8 indicates that 60% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 30% of the energy savings. This suggests that the use of basic rigor was appropriately apportioned, predominately for projects with smaller savings. Likewise, the more expensive enhanced rigor methods were reserved for a smaller number of projects, but these projects contributed a majority (70%) of the sample's energy savings. The SWE Team supports this "value of information" approach, whereby more expensive evaluation techniques are reserved for projects that account for the greatest share of program savings.

Figure A-9 shows the frequency of each M&V method used in the Small C/I Buildings Program and the energy savings associated with each method. Data/billing analysis was the only enhanced rigor approach used for this program, and associated projects accounted for 89% of savings.

Figure A-9: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Buildings Program

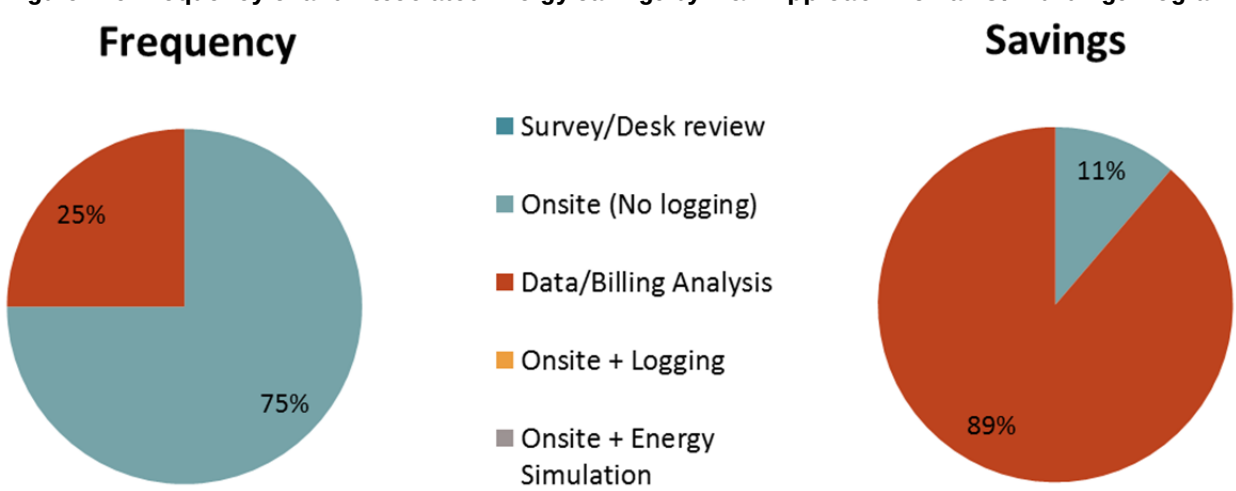
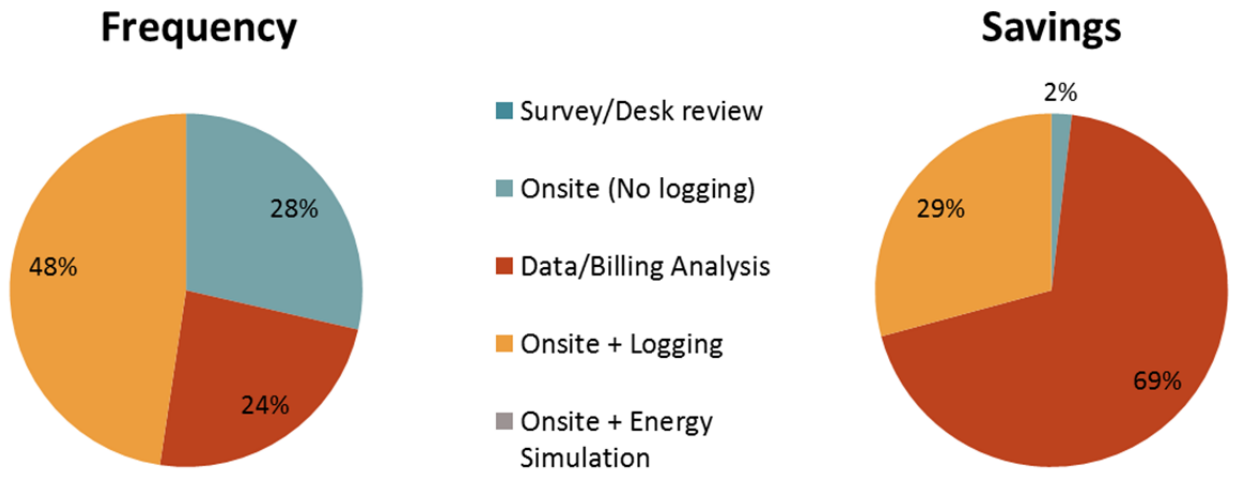


Figure A-10 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (72%), and these projects accounted for almost all the savings (98%). Basic rigor was appropriately limited to those projects with less savings.

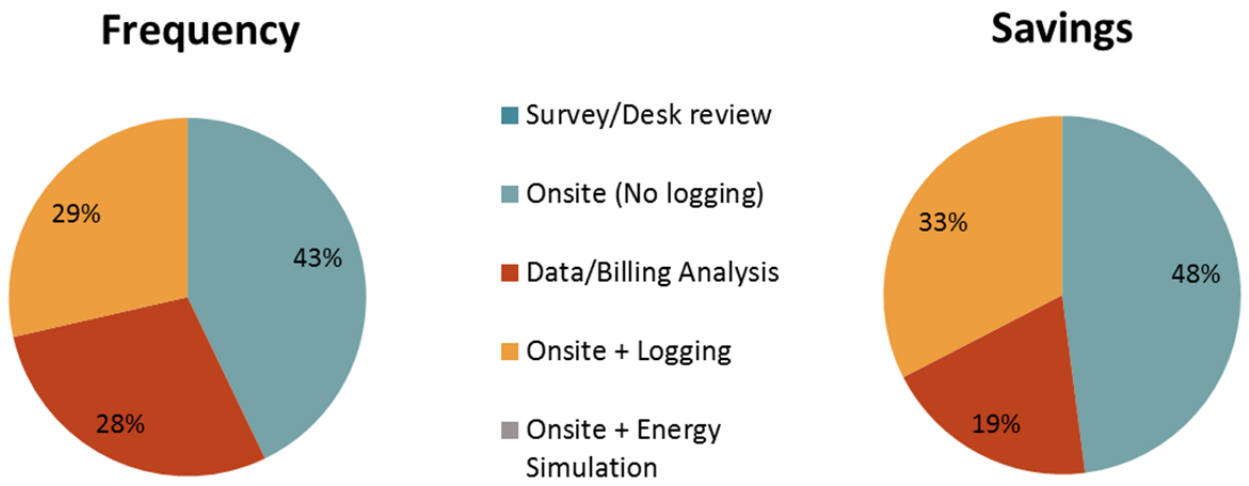
Figure A-10: Frequency of and Associated Energy Savings by M&V Approach – Large C/I Equipment Program



The Large C/I Buildings Program had only five verified projects in PY7, of which four reported savings. All four used enhanced rigor. Data and billing analysis were used to evaluate projects accounting for 100% of savings.

Figure A-11 shows the frequency of each M&V method used in the Government and Institutional Program and the energy savings associated with each method. Basic rigor was used for 43% of the projects, and these projects accounted for a slight minority of the savings (48%).

Figure A-11: Frequency of and Associated Energy Savings by M&V Approach – Government and Institutional Program



A.3.3.3 Process Evaluation Activities and Findings

FirstEnergy's evaluation contractor, ADM, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penelec, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Refer to Section A.2.3.3 for an overview of ADM's process evaluation activities and findings.

A.3.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of Penelec's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.3.4.1 Residential Program Audit Summary

A.3.4.1.1 Residential Lighting

For PY7, residential upstream lighting accounted for a majority of the reported savings in Penelec's Efficient Products Program. The SWE Team reviewed the database and tracking system submitted by Penelec and its evaluation contractor to verify that the correct savings algorithms and deemed savings values were used in the program. The SWE Team also reviewed 10 invoices and product data sheets covering many different bulb types, from standard CFLs to decorative LEDs and floodlight bulbs. Due to the format of the tracking database, the SWE Team easily confirmed that the 2015 TRM was appropriately used for the calculations to quantify the program savings. The SWE Team also verified that FirstEnergy's evaluation contractor correctly noted any discrepancies in the census data and accounted for any adjustments in the verified savings data.

A.3.4.1.2 Appliance Turn-In Program

The SWE Team reviewed the spreadsheets and database used to calculate Penelec's verified gross savings. Unlike in previous years where the evaluation contractor simply used the deemed UECs from the TRM, in PY7 the contractor calculated a utility-specific UEC from the PY7 appliance recycling customer database. The SWE Team confirmed that the UECs were calculated correctly using the 2015 TRM regression coefficients and PY7 Penelec customer data and that they were used correctly in determining annual kWh and kW savings. Because of a difference in how gross savings are calculated in the 2015 TRM, it was not necessary to account for refrigerator replacement. This is taken into account only in the net savings calculations. The Excel worksheets documented calculations clearly and were easy to follow.

A.3.4.1.3 Efficient Products Program

The SWE Team thoroughly reviewed the data-tracking and reporting system containing the savings calculation and rebate invoice information for all of the Efficient Products Program strata. Additionally, it checked the proper use of the 2015 TRM in calculating the savings for each of the product types. The SWE found that the HPWH savings calculations strayed slightly from the TRM, but in an acceptably conservative fashion. According to the TRM, the HVAC interactive effect penalty only needs to be taken into account when the HPWH is installed in conditioned space and not when the default F_{derate} value is used. The evaluation contractor assumed both, which made the kWh estimates slightly conservative.

A.3.4.1.4 Home Performance Program

The SWE Team audited each operational component of the Home Performance Program: whole house direct install, home energy audit conservation kits, new homes, and HERs (the school conservation kits component did not operate in PY7). The HERs accounted for a majority (65%) of the Home Performance Program savings in PY7. The SWE Team verified that the correct 2015 TRM savings were used for all measures in the home energy audit conservation kits and that the FirstEnergy statewide receipt rate and ISRs were correctly applied to the items.

For the whole house direct-install component, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The HER component received a full evaluation for the first time in Phase II in PY7. Due to the one-year measure life, it was unnecessary to evaluate this component in the other years. The SWE reviewed the independent analysis performed by the evaluation contractor and verified that it was done correctly. There was good consistency between the results of the three analyses performed (OPower's, ADM's replication of OPower, and ADM's), and the overall realization rate was 93%.

A.3.4.2 Low-Income Program and Audit Summary

The SWE Team reviewed the two distribution branches of the Low-Income Program operational in PY7 (direct install and giveaway) to ensure that the savings were correctly calculated using the 2015 TRM and that the realization rates were correctly determined and applied appropriately. Penelec's evaluation contractor provided a complete database of direct-install measures, which included a pivot table that ranked measures by individual measure contribution to total program kWh savings. Using this, the SWE Team verified the calculations for five measures with the greatest overall impact and verified five randomly selected measures. The SWE Team also confirmed that kWh and kW calculations for the estimations of savings for the giveaway program were implemented per the 2015 TRM.

Finally, the SWE Team verified that Penelec was in compliance with the requirement that the number of energy conservation measures offered to low-income households be proportionate to those households' share of the total energy usage in Penelec's service territory. Penelec offered six types of measures to the low-income sector in PY7, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 10.2%.

A.3.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were being performed in accordance with the applicable TRM, or by some other reasonable methodology. The SWE Team reviewed nine projects in Penelec's PY7 non-residential programs across various measures, including interior and exterior lighting, refrigeration, energy audits, and PC power management. In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for lighting projects moving forward.

The SWE Team reviewed Penelec's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-58, showing relative precision at the 85% confidence level.

Table A-58: Compliance across Sample Designs for Penelec's PY7 Non-Residential Program Groups

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Small C/I Equipment	14.2%	14.9%	✓
Small C/I Buildings	8.9%	8.5%	✓
Large C/I Equipment	12.9%	12.9%	✓
Large C/I Buildings	13.7%	12.9%	✓
Government/Institutional	15.0%	18.5%	✓

Penelec met the goal of 15% precision at the 85% confidence level for energy for all non-residential program groups. Details concerning each program evaluation sample are provided below.

As part of the audit process, the SWE Team performed one ride-along site inspection of a non-residential project to oversee Penelec's on-site evaluation practices. Since Penelec uses the same evaluation contractor (ADM) as the other FirstEnergy companies, and site inspections among FirstEnergy territories are performed by the same ADM staff, the SWE has confidence that the ride-along site inspections performed by the SWE in other FirstEnergy territories accurately represent performance for the Penelec territory. The Penelec project for which the SWE conducted a ride-along involved VFDs on water circulation pumps at a waste-treatment facility. The SWE Team approved the verified savings and had no additional recommendations. Results from the site inspection and other FirstEnergy ADM inspections are summarized below.

The SWE Team performed a verified savings analysis on three submitted projects, checking for accuracy in calculations and appropriateness of the evaluation method and level of rigor. The SWE Team found appropriate rigor in the evaluation contractor's M&V methods. There was significant improvement in the presentation of M&V methodology and results in PY7 with the inclusion of a site-level report for each project file. The discussion below presents more detailed results of the verified savings analysis.

A.3.4.3.1 Project Files Review

The SWE Team reviewed nine projects in Penelec's PY7 non-residential programs across various measures, including interior and exterior lighting, refrigeration, energy audits, and PC power management. The submitted files included project-level savings calculation workbooks, application forms, measure installation confirmations, equipment specification sheets, invoices, post-installation inspection reports, and other supporting documents. In general, the submitted project files provided thorough documentation for SWE Team review.

Table A-59 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-59: Penelec Project File Review Summary

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-325348	Small C/I Equipment	Installation of energy efficient freezer and refrigerator reach-in cases.	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-378132	Small C/I Buildings	PC power management	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-424362	Large C/I Equipment	1,000W MH pole lights and wall pack and egress lighting replaced with GE LED Evolve area, wall pack, and egress fixtures	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-372212	Small C/I Equipment	Reach-in-freezer case T12 retrofit with LEDs	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-552737	Large C/I Equipment	Energy audit	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-613582	Large C/I Equipment	Lighting (inc. to LED)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-578886	Large C/I Equipment	Lighting (exterior)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-615133	Large C/I Equipment	Lighting (new construction)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-636707	Large C/I Equipment	Lighting (exterior)	Yes	Yes	No	Yes	Yes	N/A

There was one discrepancy between the savings in the lighting calculator in CR_PRJ-424362 and the reported savings in the tracking system, but after contacting the evaluation contractor, the SWE determined this was not an error but a correction from a previous program year.

In PY6, the SWE Team review of Penelec's project files revealed cause for concern as several instances arose where the TRM was not followed appropriately in ex ante calculations. The SWE Team provided the following three recommendations:

1) SWE Team-provided calculators should be used properly; if SWE Team–provided calculators are unavailable for a given measure, custom calculators should be crafted carefully per the governing TRM equations and requirements.

2) More thorough audits of applications should be performed to ensure that valid savings are not lost or overstated due to minor oversights.

3) More organized documentation should be kept on record to ensure that all requested materials are submitted.

In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the supplied Appendix C calculator be used for lighting projects moving forward.

A.3.4.3.2 Sample Design Review

Penelec's PY7 final annual report provides detailed information about the sample design of the PY7 gross impact evaluation of non-residential programs. Penelec's non-residential programs were the Small C/I Energy Efficient Equipment Program, Small C/I Energy Efficient Buildings Program, Large C/I Energy Efficient Equipment Program, Large C/I Energy Efficient Buildings Program, and Government and Institutional Program.

A.3.4.3.2.1 Small C/I Energy Efficient Equipment Program

In PY7, this program was divided into two components: equipment incentives and appliance recycling. Lighting measures contributed the majority of the gross energy savings for the program.

Stratified ratio estimation was used to estimate savings for the program, and stratified random sampling was used for sample design by the evaluation contractor. For large lighting projects in the evaluation sample, Penelec's evaluation contractor designed an on-site sampling strategy that targeted ±20% precision at the 90% confidence level for the physical counting of fixtures. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then stratified based on energy savings at the measure level. The assumed Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-60. The data show that Penelec met the SWE Team requirements of 85%/15% confidence/precision for both energy and peak demand.

Table A-60: Penelec PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	32	29.6%	5	5	29.6%	29.6%
Lighting – 3	86	28.3%	6	6	28.3%	28.3%
Lighting – 4	470	22.5%	10	10	22.5%	22.5%
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	7	43.0%	2	2	43.0%	43.0%
Custom – 3	60	23.7%	8	8	23.7%	23.7%
HVAC and DHW – 1	2	50.9%	1	1	50.9%	50.9%
HVAC and DHW – 2	63	71.4%	1	1	71.4%	71.4%
Appliance Turn-In – 1	55	71.3%	1	1	71.3%	71.3%
Kitchen/appliances – 1	18	70.0%	1	1	70.0%	70.0%
Program Total	**793**	**13.9%**	**35**	**35**	**14.2%**	**14.9%**

A.3.4.3.2.2 Small C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-61. The precision levels for energy met the SWE Team requirements detailed in the Evaluation Framework.

Table A-61: Penelec's PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	3,934	11.3%	40	65	8.9%	8.9%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	0	N/A	0	0	0.0%	0.0%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
Custom – 2	1	0.0%	1	1	0.0%	0.0%
Custom – 3	13	36.5%	3	3	36.5%	36.5%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**3,948**	**10.4%**	**44**	**69**	**8.9%**	**8.5%**

A.3.4.3.2.3 Large C/I Energy Efficient Equipment Program

In PY7 this program consisted mostly of equipment upgrades and custom at industrial facilities. The evaluation contractor used stratified ratio estimation to estimate savings for the program and stratified random sampling for sample design. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then was stratified based on energy savings at the measure level. The Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-62. The data show that Penelec met the SWE Team requirements of 85%/15% confidence/precision for energy and peak demand for this program.

Table A-62: Penelec's PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	4	0.0%	4	4	0.0%	0.0%
Lighting – 2	5	64.4%	1	1	64.4%	64.4%
Lighting – 3	17	47.8%	2	2	47.8%	47.8%
Lighting – 4	92	35.2%	4	4	35.2%	35.2%
Custom – certainty	7	0.0%	7	5	17.2%	17.2%
Custom- – 2	11	68.6%	1	1	68.6%	68.6%
Custom – 3	23	38.8%	3	3	38.8%	38.8%
HVAC and DHW – 1	3	58.8%	1	1	58.8%	58.8%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**162**	**11.4%**	**23**	**21**	**12.9%**	**12.9%**

A.3.4.3.2.4 Large C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. However, no kits were distributed in PY7. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-63. The precision levels for energy and for demand met the SWE Team requirements.

Table A-63: Penelec's PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	1	0.0%	1	1	0.0%	0.0%
Custom – 2	2	50.9%	1	1	50.9%	50.9%
Custom – 3	5	39.4%	2	2	39.4%	39.4%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**8**	**13.4%**	**4**	**4**	**13.7%**	**12.9%**

A.3.4.3.2.5 Government and Institutional Program

This program had three categorical components in PY7: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. Detailed information on the sample design and the achieved precision values for each stratum are shown in Table A-64. The precision levels for energy met the SWE Team requirements, but demand precision was slightly over 15%. This is permissible in Phase II.

Table A-64: Penelec's PY7 Sampling Strategy and Achieved Precision – Government and Institutional Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	1	0.0%	1	1	0.0%	0.0%
Lighting – 3	2	0.0%	2	2	0.0%	0.0%
Lighting – 4	11	28.7%	4	4	28.7%	28.7%
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**14**	**14.1%**	**7**	**7**	**15.0%**	**18.5%**

A.3.4.3.3 Ride-Along Site Inspections

Table A-65 summarizes the SWE Team's PY7 ride-along site inspections of Penelec's non-residential project installations. For PY7, all Penelec PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluation contractor savings calculations or reports.

Table A-65: Penelec's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-787966	VFDs	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.

A.3.4.3.4 Verified Savings Review

The SWE Team reviewed a subset of Penelec's sampled sites and found appropriate rigor in the evaluation contractor's M&V methods. There was significant improvement in the presentation of M&V methodology and results in PY7 with the inclusion of a site-level report for each project file. Table A-66 shows the energy and demand savings for projects the SWE Team chose to review, as well as the M&V approach selected for site evaluation.

Table A-66: Verified Savings and M&V Methods for SWE Team–Sampled Penelec Projects

Program	Project Number	Stratum	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	M&V Method
Large C/I Equipment	CR_PRJ-350683	Custom – certainty	11,462,920	1,417	EMS data analysis (CHP)
Large C/I Equipment	CR_PRJ-364757	Lighting – 4	133,467	15.24	On-site + logging
Large C/I Equipment	CR_PRJ-441629	Lighting – certainty	1,305,240	149	On-site + logging

Project CR_PRJ-350683 was a combined heat and power (CHP) project at a manufacturing facility in Altoona, PA. The old compressors had been oversized for the situation and were inefficient. As-built CHP output from the EMS was provided to the evaluation contractor by the site, and the total energy and demand savings were determined through statistical analysis. ADM performed two site visits and confirmed installation and nameplate specs of the system. The SWE Team agrees with the level of rigor used in evaluating this project.

Project CR_PRJ-364757 involved a lighting retrofit of 59 fixtures at an industrial facility in Oil City, PA. Interior, uncooled metal halide fixtures were replaced with T5 fixtures. The evaluation contractor deployed two lighting loggers that confirmed 8,760 HOU. There were no differences between the ex ante and ex post values.

Project CR_PRJ-441629 involved a lighting retrofit of 500 fixtures at a manufacturing facility in Erie, PA. Interior, uncooled 400W metal halide fixtures were replaced with 160W LED fixtures. The evaluation contractor deployed seven lighting loggers that confirmed 8,760 HOU. There were no differences between the ex ante and ex post values.

A.3.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penelec, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described in Section A.2.4.4 pertains to all four FirstEnergy utilities, including Penelec.

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation contractors, ADM/Tetra Tech, used the same evaluation methods for all four EDCs. See Section A.2.4.4 for a description of the SWE Team's review of the FirstEnergy EDC NTG evaluation, which applies to all four of FirstEnergy's Pennsylvania EDCs.

Table A-67 summarizes NTG findings from the Penelec PY7 annual report.

Table A-67: Summary of NTG Estimates for Penelec's Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Residential					
Estimated	Appliance Turn-In[c]	0.66	0.00	0.34	59
	Efficient Products	0.38	0.02	0.65	131
	Home Performance	0.34	0.04	0.70	N/A
Low-Income					
Estimated	Residential Low-Income Program	0.26	0.09	0.82	44
Non-Residential					
Estimated	Small C/I Equipment	0.38	0.12	0.75	N/A
	Large C/I Equipment	0.26	0.07	0.81	N/A
	Small C/I Buildings	0.36	0.00	0.64	73
	Large C/I Buildings	0.50	0.00	0.50	5
	Government and Institutional	0.38	0.11	0.73	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All sample sizes are for the downstream NTG research using the common method. With the exception of Large C/I Buildings, all sample sizes provided at least 85/15 confidence/precision.
[c] ADM/Tetra Tech misprinted the program-level FR value in the PY7 annual report. The value reported in this table is the actual FR value.

A.3.5 Statewide Evaluator Final Recommendations

The SWE Team has the following recommendations for Penelec's EE&C programs going forward:

- The SWE Team recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for C/I lighting projects moving forward
- Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and customers more quickly if project documentation is incomplete.
- As the Home Performance – New Construction measure becomes more streamlined or as incentives change, attempt to attract builders who began with the program but dropped out.

A.4 PENN POWER

This section summarizes Penn Power's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by Penn Power's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by Penn Power's evaluation contractor to conduct M&V of Penn Power's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve Penn Power's programs in the future.

A.4.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.4.1.1 Phase II Savings by Program

Table A-68 lists the Penn Power EE&C programs that yielded reported savings in PY7. Table A-69 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Large C/I Equipment program was the largest contributor of both energy and demand savings.

Table A-68: Penn Power EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector
Appliance Turn-In	Residential
Efficient Products	Residential
Home Performance	Residential
Low Income	Low-Income
Small C/I Equipment	Non-Residential
Small C/I Buildings	Non-Residential
Large C/I Equipment	Non-Residential
Large C/I Buildings	Non-Residential
Gov./Institutional	GNI

Table A-69: Summary of Penn Power EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Appliance Turn-In	4,144	4%	0.55	4%
Efficient Products	21,719	20%	2.39	18%
Home Performance	24,468	22%	2.60	20%
Low Income	2,727	2%	0.22	2%
Small C/I Equipment	19,164	18%	2.98	23%
Small C/I Buildings	4,443	4%	0.70	5%
Large C/I Equipment	28,808	26%	3.41	26%
Large C/I Buildings	2,726	2%	0.34	3%
Gov./Institutional	1,167	1%	0.01	0%
Total Portfolio	***109,368***	***100%***	***13.21***	***100%***

A.4.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-70 below. In PY7, the net energy savings were approximately 70% of the gross energy savings.

Table A-70: Summary of Penn Power EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	12,953	11,133	51,422	36,021
C/I	7,045	3,870	41,079	26,255
GNI	7,283	4,184	16,866	10,499
Total Portfolio	***27,280***	***19,187***	***109,368***	***72,774***

A.4.2 Total Resource Cost Test

Table A-71 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for Penn Power's PY7 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report. Five programs were not cost effective in PY7. These programs may need to be redesigned in order to maintain viability in Phase III.

Table A-71: Summary of Penn Power's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$404,304	$190,756	$213,548	2.12
Efficient Products	$751,481	$1,513,372	($761,892)	0.50
Home Performance	$1,460,667	$1,533,645	($72,978)	0.95
Low Income	$221,601	$670,711	($449,110)	0.33
Small C/I Equipment	$3,577,507	$4,521,979	($944,472)	0.79
Small C/I Buildings	$1,039,908	$682,601	$357,307	1.52
Large C/I Equipment	$834,551	$804,579	$29,972	1.04
Large C/I Buildings	$1,610,817	$628,980	$981,837	2.56
Gov./Institutional	$488,685	$1,137,129	($648,444)	0.43
Total Portfolio	**$10,389,522**	**$11,683,752**	**($1,294,230)**	**0.89**

In summary, four of Penn Power's nine programs were found to be cost-effective and five were non-cost-effective. In total, the PY7 portfolio was not cost-effective, with both the residential and non-residential sector costs outweighing the lifetime benefits of the program offerings. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs

(TRC Ratio > 1.0)

- *Residential Appliance Turn-In*

- *Small C/I Energy Efficient Buildings*
- *Large C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Buildings*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *Energy Efficient Products*
- *Residential Home Performance*
- *Residential Low-Income*
- *Small C/I Energy Efficient Equipment*
- *Government and Institutional*

A.4.2.1 Assumptions and Inputs

One TRC model template was shared across all four FirstEnergy companies. Despite the similar model, the TRC model calculations were handled independently for each of the four EDCs. The Penn Power iteration of the FirstEnergy TRC model used a discount rate of 11.14% to compare the NPV of program benefits that will occur later in a measure's lifetime to the up-front costs of installation of implementation. This value matches the EDC's EE&C plan on file. Different values of LLF were used for different sectors, as shown in Table A-72.

Table A-72: Penn Power's PY7 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF	Demand LLF
Appliance Turn-In	Residential	11.14%	9.49%	9.49%
Efficient Products	Residential	11.14%	9.49%	9.49%
Home Performance	Residential	11.14%	9.49%	9.49%
Low Income	Residential	11.14%	9.49%	9.49%
Small C/I Equipment	Non-residential	11.14%	5.45%	5.45%
Small C/I Buildings	Non-residential	11.14%	5.45%	5.45%
Large C/I Equipment	Non-residential	11.14%	5.45%	5.45%
Large C/I Buildings	Non-residential	11.14%	5.45%	5.45%
Gov./Institutional	Non-residential	11.14%	5.45%	5.45%

In the residential sector, measure lives were reported on a measure-by-measure basis. The SWE Team spot-checked some of these measure lives and found them to be consistent with the 2015 TRM. [68] In the non-residential sector, the TRC model applied an EUL at the stratum level rather than at the measure level.

Similarly, the model assigned incremental costs at the measure level in the residential sector and at the stratum level in the non-residential sector in the model. The residential-sector incremental costs primarily were derived from the SWE incremental cost database, the Penn Power EE&C plan, and the

[68] The SWE notes a single exception; the First Energy TRC Model understates the EUL of the Room AC measure, using a 4-year measure life instead of the TRM value of 9 years.

project invoices. The sources for non-residential sector incremental costs included the SWE cost database, sampled project invoices, the Database for Energy Efficient Resources (DEER) 2008 incremental cost database, and the EDC EE&C plan.[69] The FirstEnergy TRC model relied on the evaluation samples as a basis for calculating incremental participant costs for non-residential programs. Those sampled values were weighted to apply to the remainder of the program. The SWE Team examined this approach and found it reasonable and appropriate.

The TRC model drew the energy and demand impacts from the tracking database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC model analysis was based on ex post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

The 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures beginning June 1, 2016, but does not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. In the Penn Power TRC model, a measure's lifetime was separated into two parts: the first year, and the remaining lifetime. The removed equipment was treated as the baseline for the first year, with the baseline shifting to the code-required baseline for the remainder of the measure's life. The model calculated the measure's lifetime savings as the sum of these two parts.

A.4.2.2 Avoided Cost of Capacity

Consistent with prior Phase II program years, the PY7 FirstEnergy TRC Models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.4.2.3 Conclusions and Recommendations

The FirstEnergy TRC model is performing all of the B/C calculations in accordance with the 2013 TRC Order. The SWE Team review of the Penn Power TRC model found no calculation errors and believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.4.3 Status of Evaluation Activities

This section discusses the status of Penn Power's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.4.3.1 Status of Evaluation, Measurement, and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation Framework that was applicable for PY6 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology

[69] The DEER 2008 incremental cost database is available for download at http://www.deeresources.com.

- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-73 displays key milestones completed by FirstEnergy and the SWE for FirstEnergy's Phase II EM&V Plan. FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs.

Table A-73: Key Milestones Reached for Penn Power's Phase II EM&V Plan

Date	Event
September 19, 2013	FirstEnergy EDCs submit first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on the FirstEnergy evaluation plan to FirstEnergy
November 13, 2013	SWE sends a list of "items that be must addressed" to FirstEnergy EDCs
February 19, 2014	FirstEnergy EDCs submit revised Phase II evaluation plan to the PUC and SWE
June 1, 2014	PY6 starts
December 17, 2014	FirstEnergy EDCs provide email with additional information on the approach used by ADM for the PY6 evaluation of Penn Power's Appliance Turn-In Program
January 5, 2015	FirstEnergy EDCs send email to SWE with clarification of sampling approach for the evaluations of the residential low-income program components (direct-install, giveaway, and low income low use kit components)

The initial EM&V Plan for all FirstEnergy companies, submitted on September 19, 2013, detailed proposed evaluation objectives and activities for nine programs across two sectors. Key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts were presented for each of the nine programs. After reviewing the plan, the SWE Team returned 34 comments on October 15, 2013. Many of the SWE Team's comments demonstrated the SWE Team's agreement with details of the FirstEnergy EDCs' plan. Most of the remaining comments concerned report formatting and minor clarifications that did not propose changes to the plan; substantive recommendations for revisions to the plan arose in only two areas:

- Frequency of EDC data gathering in partially deemed measures
- Definition of high-impact measures in C/I programs

FirstEnergy EDCs provided revisions to the plan on February 19, 2014, and the SWE Team approved the revised version as the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all PY6 and PY 7 EM&V activities.

A.4.3.2 Measurement and Verification Activities and Findings

Realization rates compare gross savings reported by the EDC with the verified gross savings determined by the EDC evaluation contractor through M&V. Table A-74 summarizes M&V findings based on activities conducted by the Penn Power evaluation contractor. The summary is based on details provided in Penn Power's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table A-74 presents realization rates and relative precision values for verified energy and demand savings for each of Penn Power's residential and non-residential energy efficiency programs in PY7.

Table A-74: Penn Power Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY7

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	92.0%	7.9%	92.6%	9.3%
Efficient Products	128.6%	5.6%	163.3%	14.2%
Home Performance	92.3%	5.5%	83.1%	6.6%
Low-Income	114.5%	9.9%	121.4%	9.9%
Small C/I Equipment	91.8%	13.3%	100.5%	14.4%
Small C/I Buildings	99.2%	11.2%	101.3%	9.4%
Large C/I Equipment	91.9%	11.9%	111.0%	12.4%
Large C/I Buildings	100.0%	2.2%	100.0%	0.0%
Government/Institutional	95.82%	13.7%	0.0%	0.0%

NOTE:
[a] Relative precision values are at the 85% confidence level.

A.4.3.2.1 Residential Programs

The energy realization rates for Penn Power's residential programs ranged from 92.0% to 128.6%. The demand realization rates ranged from 83.1% to 163.3%. Penn Power achieved the 15% relative precision requirement at the 85% confidence level for both energy and demand for all residential programs.

The Appliance Turn-In Program was evaluated through customer verification surveys to determine the fraction of refrigerators, freezers, and room air conditioners that were drawing power before retirement, as well as the other parameters necessary to determine the EUL from the TRM regression equation. The program realization rate is mostly a function of the difference between the ex ante and ex post EULs, the latter of which used actual PY7 collection data.

The evaluations of the upstream lighting and products portions of the Efficient Products Program involved reviews of sales invoices, a review of the tracking and reporting system, and a detailed review

of CSP energy and demand savings calculations. The appliance portion and the HVAC equipment/tune-up portion were evaluated through an invoice review, customer surveys, and a review of the energy and demand calculations with reference to the ENERGY STAR database.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The home energy audit kits were evaluated using the T&R system as well as online and phone surveys to determine the delivery and installation rates for each measure. The kit receipt rates and measure ISRs have been shown to fluctuate among EDCs, primarily due to statistical variations, and therefore average statewide ISRs are used for all four FirstEnergy companies. The new construction portion of the program was evaluated through an engineering review of a sample of projects in the portfolio. Energy and demand savings for this program were determined through REM/Rate software calculations, and the review focused on whether the modeling was performed correctly (including baseline assumptions) and if the results were reasonable. The prescriptive, low-cost direct-install portion was evaluated by reviewing the T&R system and sample invoices to check if the TRM calculations were performed correctly and if the invoices matched the information in the database. For comprehensive weatherization jobs, those that saved more than 2 MWh/yr were evaluated through billing analysis, and those saving under 2 MWh/yr received an invoice review. The HER portion was reviewed and duplicated by the evaluation contractor, producing results consistent with the implementation CSP's. The contractor then conducted its own full evaluation of the savings using a lagged seasonal regression model and adjusting for dual participation.

A.4.3.2.2 Low-Income Programs

The evaluation contractor reviewed the tracking data and on-site verification forms and results to determine ISRs for the WARM direct-install measures. For giveaway events, the evaluation contractor reviewed the tracking database and applied the ISR from the 2015 TRM. There were no LILU energy kits distributed in PY7.

A.4.3.2.3 Non-Residential Programs

Realization rates for Penn Power's non-residential programs' energy savings ranged from 91.8% to 100%. Realization rates for demand reductions from these programs ranged from 0.0% to 111.0%. The Government and Institutional Program was responsible for the low realization rate of 0% for demand, but all projects were street lighting, which has a 0 coincidence factor. Penn Power achieved the 15% precision requirement for kWh in all of its non-residential programs. It also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II of Act 129.

Figure A-12 shows the frequency of each M&V approach performed by ADM in PY7 for Penn Power's Small C/I Equipment Program evaluation sample and the verified energy savings associated with each M&V approach. ADM used both basic and enhanced levels of rigor to evaluate projects in the sample. Basic rigor includes surveys, desk reviews, and simple on-site verification (no logging). Enhanced rigor includes the following options, as recorded by ADM. The first consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. The second general approach is on-site verification with logging. This may be light logger deployment or more robust measurement of the retrofitted system's continuous energy usage. The third general approach involves modeling energy performance of a facility before and after the efficiency measure is installed with an energy simulation.

Figure A-12: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Equipment Program

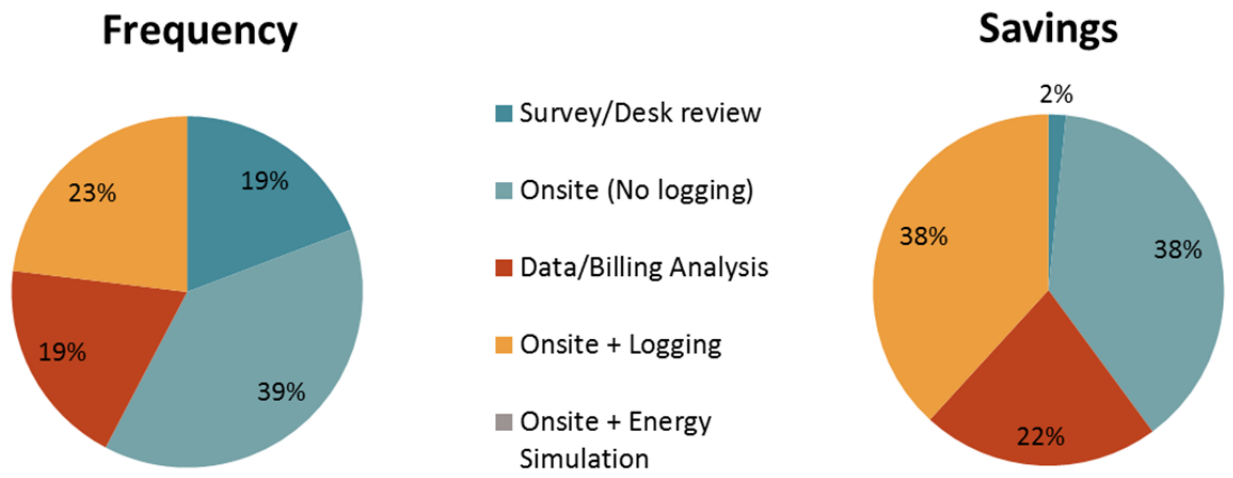


Figure A-12 indicates that 58% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 40% of the energy savings. This suggests that basic rigor was appropriately used, predominately for projects with smaller savings. Likewise, the more expensive enhanced rigor methods were reserved for a smaller number of projects, but these projects contributed a majority (60%) of the sample's energy savings. The SWE Team supports this "value of information" approach, whereby more expensive evaluation techniques are reserved for projects that account for the greatest share of program savings.

Figure A-13 shows the frequency of each M&V method used in the Small C/I Buildings Program and the energy savings associated with each method. Projects evaluated by enhanced rigor approaches accounted for 71% of evaluation sample savings.

Figure A-13: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Buildings Program

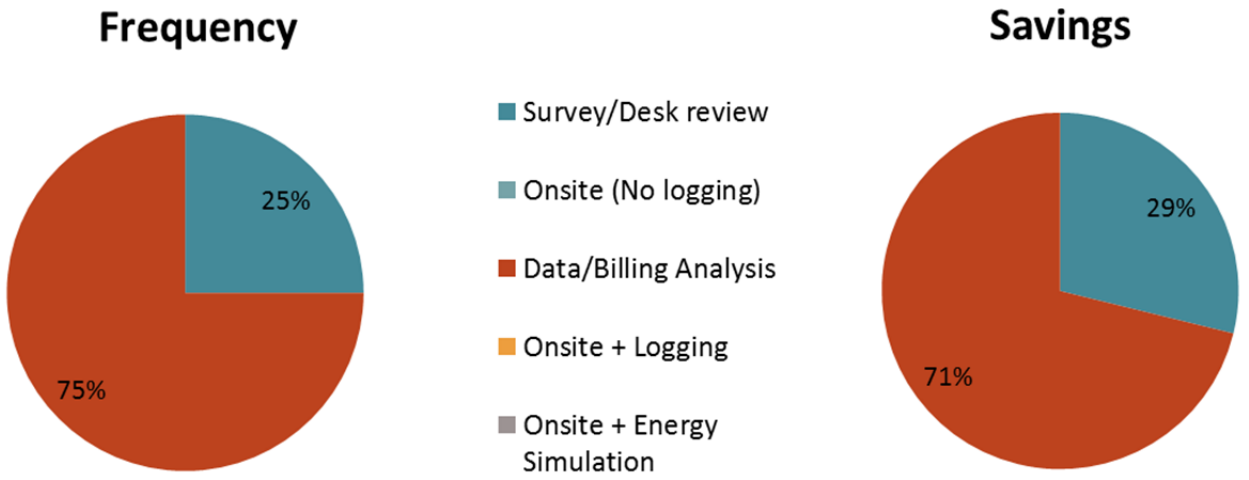
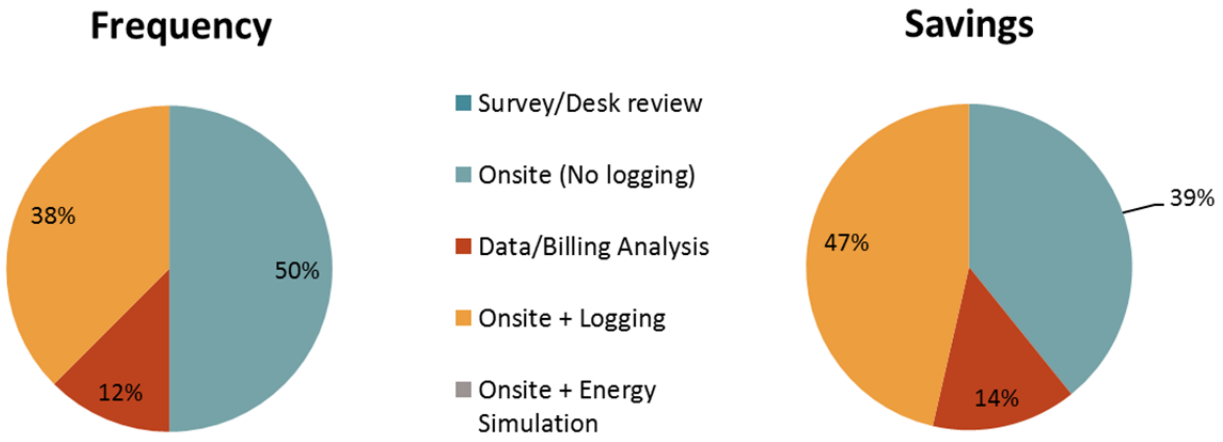


Figure A-14 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for 50% of the projects, and

these projects accounted for a majority of the savings. Basic rigor was appropriately limited to those projects with less savings.

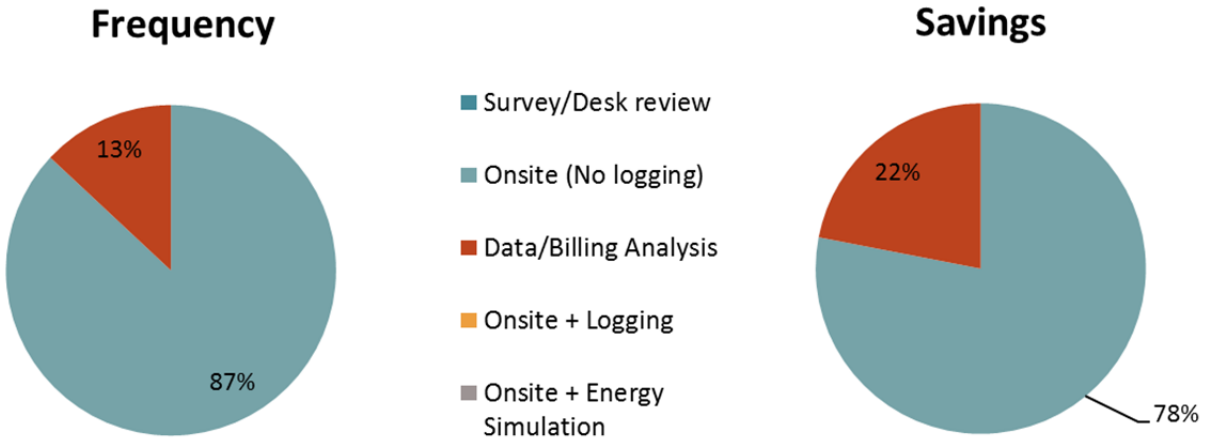
Figure A-14: Frequency of and Associated Energy Savings by M&V Approach – Large C/I Equipment Program



The Large Buildings Program had only one project completed in PY7, and it received an enhanced level of rigor in the form of an on-site inspection and building simulation.

Figure A-15 shows the frequency of each M&V method used in the Government and Institutional Program and the energy savings associated with each method. Basic rigor was used for 87% of the projects, and these projects accounted for 78% of the savings.

Figure A-15: Frequency of and Associated Energy Savings by M&V Approach – Government and Institutional Program



A.4.3.3 Process Evaluation Activities and Findings

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penn Power, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Refer to Section A.2.3.3 for an overview of ADM/Tetra Tech's process evaluation activities and findings.

A.4.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of Penn Power's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.4.4.1 Residential Program Audit Summary

A.4.4.1.1 Residential Lighting Program

For PY7, residential upstream lighting accounted for the largest individual stratum of the reported savings in Penn Power's Efficient Products Program. The SWE Team reviewed the database and tracking system submitted by Penn Power and its evaluation contractor to verify that the correct savings algorithms and deemed savings values were used in the program. The SWE Team also reviewed 10 invoices and product data sheets covering many different bulb types, from standard CFLs to decorative LEDs and floodlight bulbs. Due to the format of the tracking database, the SWE Team easily confirmed that the 2015 TRM was appropriately used for the calculations to quantify the program savings. The SWE Team also verified that Penn Power's evaluation contractor correctly noted any discrepancies in the census data and accounted for any adjustments in the verified savings data.

A.4.4.1.2 Appliance Turn-In Program

The SWE Team reviewed the spreadsheets and database used to calculate Penn Power's verified gross savings. Unlike in previous years where the evaluation contractor simply used the deemed UECs from the TRM, in PY7 the contractor calculated a utility-specific UEC from the PY7 appliance recycling customer database. The SWE Team confirmed that the UECs were calculated correctly using the 2015 TRM regression coefficients and PY7 Penn Power customer data and that they were used correctly in determining annual kWh and kW savings. Because of a difference in how gross savings are calculated in the 2015 TRM, it was not necessary to account for refrigerator replacement. This is taken into account only in the net savings calculations. The Excel worksheets documented calculations clearly and were easy to follow.

A.4.4.1.3 Efficient Products Program

The SWE Team thoroughly reviewed the data-tracking and reporting system containing the savings calculation and rebate invoice information for all of the Efficient Products Program strata. Additionally, it checked the proper use of the 2015 TRM in calculating the savings for each of the product types. The SWE found that the HPWH savings calculations strayed slightly from the TRM, but in an acceptably conservative fashion. According to the TRM, the HVAC interactive effect penalty only needs to be taken into account when the HPWH is installed in conditioned space and not when the default F_{derate} value is used. The evaluation contractor assumed both, which made the kWh estimates slightly conservative.

A.4.4.1.4 Home Performance Program

The SWE Team audited each operational component of the Home Performance Program: whole house direct-install, home energy audit conservation kits, new homes, and HERs (the school conservation kits component did not operate in PY7). The HERs accounted for a majority (83%) of the Home Performance Program savings in PY7. The SWE Team verified that the correct 2015 TRM savings were used for all measures in the home energy audit conservation kits and that the FirstEnergy statewide receipt rate and ISRs were correctly applied to the items.

For the whole house direct-install component, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The HER component received a full evaluation for the first time in Phase II in PY7. Due to the one-year measure life, it was unnecessary to evaluate this component in the other years. The SWE reviewed the independent analysis performed by the evaluation contractor and verified that it was done correctly. There was good consistency between the results of the three analyses performed (OPower's, ADM's replication of OPower, and ADM's), and the overall realization rate was 92%.

A.4.4.2 Low-Income Program and Audit Summary

The SWE Team reviewed the two distribution branches of the Low-Income Program operational in PY7 (direct install and giveaway) to ensure that the savings were correctly calculated using the 2015 TRM and that the realization rates were correctly determined and applied appropriately. Penn Power's evaluation contractor provided a complete database of direct-install measures, which included a pivot table that ranked measures by individual measure contribution to total program kWh savings. Using this, the SWE Team verified the calculations for five measures with the greatest overall impact and verified five randomly selected measures. The SWE Team also confirmed that kWh and kW calculations for the estimations of savings for the giveaway program were implemented per the 2015 TRM.

The SWE Team verified that Penn Power was in compliance with the requirement that the number of energy conservation measures offered to low-income households be proportionate to those households' share of the total energy usage in Penn Power's service territory. Penn Power offered six types of measures to the low-income sector in PY7, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 10.6%.

A.4.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were performed in accordance with the applicable TRM, or by another appropriate methodology. The SWE Team reviewed eight projects in Penn Power's PY7 non-residential programs across various measures, including process improvements, ductless heat pumps, industrial process improvement, and interior and exterior lighting. In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for lighting projects moving forward.

The SWE Team reviewed Penn Power's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-75, showing relative precision at the 85% confidence level.

Table A-75: Compliance across Sample Designs for Penn Power's PY7 Non-Residential Program Groups

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Small C/I Equipment	13.3%	14.4%	✓
Small C/I Buildings	11.2%	9.4%	✓

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Large C/I Equipment	11.9%	12.4%	✓
Large C/I Buildings	2.2%	0.0%	✓
Government/Institutional	13.7%	100.0%	✓

Penn Power met the goal of 15% precision at the 85% confidence level for energy for all non-residential program groups. Details concerning each program evaluation sample are provided below.

As part of the audit process, the SWE Team performed seven ride-along site inspections of non-residential projects to oversee Penn Power's on-site evaluation practices. The projects included lighting upgrades, VFDs on pumps, and EMS upgrades. The SWE Team approved all of the sampled project inspections. However, the SWE Team recommends that Penn Power only use the SWE-supplied Appendix C calculator for lighting projects moving forward. Details of all reviewed projects and associated findings are presented below.

The SWE Team performed a verified savings analysis on three submitted projects, checking the accuracy of the calculations and appropriateness of the evaluation method and level of rigor selections. The SWE Team found the level of rigor chosen by the evaluation contractor to be reasonable, based on project size and uncertainty. There was significant improvement in the presentation of M&V methodology and results in PY7 with the inclusion of a site-level report in each project file. Appendix B presents more detailed results of the verified savings analysis.

A.4.4.3.1 Project Files Review

The SWE Team reviewed eight projects in Penn Power's PY7 program across various measures, including process improvements, ductless heat pumps, industrial process improvement, and interior and exterior lighting. The submitted files included project-level savings calculation workbooks, application forms, measure installation confirmation, equipment specification sheets, invoices, post-installation inspection reports, and other supporting documents. In general, the submitted project files provided thorough documentation for SWE Team review.

Table A-76 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-76: Penn Power Project Files Review Summary

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-360037	Small C/I Equipment	Fuel canopy, wall pack, and parking lot exterior LED retrofit	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-392093	Large C/I Equipment	Lighting retrofit: metal halide to LED conversion in manufacturing facility	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-321782	Large C/I Equipment	Interior and exterior LED lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-264902	Large C/I Buildings	New Cheese manufacturing line with efficient refrigeration plant to replace old one	Yes	Yes	No	Yes	N/A	Yes, eQUEST Model
CR_PRJ-586751	Small C/I Buildings	Custom - Install anti-sweat heater controls to cycle heaters in response to store dew point temperature - Add plastic film wrappers to meat and produce departments - Reduced minimum head pressure set points - Optimized suction pressure set points Reduced liquid temperature leaving Rack A mechanical sub-cooler from 60°F to 50°F	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-651570	Small C/I Equipment	Lighting (exterior and interior)	Yes	Yes	No	Yes	Yes	N/A

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-419084	Large C/I Equipment	Custom (compressed air leak repair)	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-494738	Small C/I Buildings	Custom (new construction lighting, mini splits, envelope)	Yes	Yes	No	Yes	N/A	Yes

The SWE Team review of Penn Power's PY6 project files revealed cause for concern in regard to clarity of project files and appropriate use of the TRM. The SWE Team provided the following two recommendations:

1) SWE Team–provided calculators should be used properly; if they are unavailable for a given measure, custom calculators should be crafted carefully per the governing TRM equations and requirements.

2) More organized documentation should be kept on record to properly capture each project's full scope of work within its project file.

In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the supplied Appendix C calculator be used for lighting projects moving forward.

A.4.4.3.2 Sample Design Review

Penn Power's PY7 annual report provides detailed information about the sample design of the PY7 gross impact evaluation of non-residential programs. Penn Power's non-residential programs were the Small C/I Energy Efficient Equipment Program, Small C/I Energy Efficient Buildings Program, Large C/I Energy Efficient Equipment Program, Large C/I Energy Efficient Buildings Program, and Government and Institutional Program.

A.4.4.3.2.1 Small C/I Energy Efficient Equipment Program

In PY7, this program was divided into two components: equipment incentives and appliance recycling. Lighting measures contributed the majority of the gross energy savings for the program.

Stratified ratio estimation was used to estimate savings for the program, and stratified random sampling was used for sample design by the evaluation contractor. For large lighting projects in the evaluation sample, Penn Power's evaluation contractor designed an on-site sampling strategy that targeted ±20% precision at the 90% confidence level for the physical counting of fixtures. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then stratified based on energy savings at the measure level. The assumed Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-77. The data show that Penn Power met the SWE Team requirements of 85%/15% confidence/precision for both energy and peak demand.

Table A-77: Penn Power's PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	7	31.4%	3	3	31.4%	31.4%
Lighting – 3	18	27.4%	5	5	27.4%	27.4%
Lighting – 4	105	24.5%	8	8	24.5%	24.5%
Custom – certainty	1	0.0%	1	1	0.0%	0.0%
Custom – 2	3	29.4%	2	2	29.4%	29.4%
Custom – 3	14	30.4%	4	4	30.4%	30.4%
HVAC and DHW – 1	3	58.8%	1	1	58.8%	58.8%
HVAC and DHW – 2	11	68.6%	1	1	68.6%	68.6%
Appliance Turn-In – 1	9	67.9%	1	1	67.9%	67.9%
Kitchen/appliances – 1	2	N/A	0	0	0.0%	0.0%
Program Total	**173**	**13.6%**	**26**	**26**	**13.3%**	**14.4%**

A.4.4.3.2.2 Small C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-78. The precision levels for energy and for demand met the SWE Team requirements.

Table A-78: Penn Power's PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	53	30.6%	5	6	27.7%	27.7%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	1	0.0%	1	1	0.0%	0.0%
Custom – 2	2	0.0%	2	2	0.0%	0.0%
Custom – 3	9	26.8%	4	4	26.8%	26.8%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**65**	**11.5%**	**12**	**13**	**11.2%**	**9.4%**

A.4.4.3.2.3 Large C/I Energy Efficient Equipment Program

In PY7 this program consisted mostly of equipment upgrades and custom at industrial facilities. The evaluation contractor used stratified ratio estimation to estimate savings for the program and stratified random sampling for sample design. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then was stratified based on energy savings at the measure level. The Cv used in the sample design was 0.5 for all projects.

The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-79. The data show that Penn Power met the SWE Team requirements of 85%/15% confidence/precision for energy and peak demand for this program.

Table A-79: Penn Power's PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	1	0.0%	1	1	0.0%	0.0%
Lighting – 3	2	0.0%	2	2	0.0%	0.0%
Lighting – 4	8	44.1%	2	2	44.1%	44.1%
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	4	36.0%	2	3	20.8%	20.8%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**15**	**13.0%**	**7**	**8**	**11.9%**	**12.4%**

A.4.4.3.2.4 Large C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. However, no kits were distributed in PY7. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-80. The achieved precision for energy and demand satisfied the SWE Team requirements.

Table A-80: Penn Power PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	4	15.0%	1	1	2.2%*	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	4	15.0%	1	1	2.2%	0.0%

A.4.4.3.2.5 Government and Institutional Program

This program had three categorical components in PY7: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. Detailed information on the sample design and the achieved precision values for each stratum are shown in Table A-81. The GNI projects in PY7 were almost entirely street lighting projects, which have peak demand savings of 0, thus skewing the demand precision results.

Table A-81: Penn Power's PY7 Sampling Strategy and Achieved Precision – Government and Institutional Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	35	22.4%	8	8	22.4%	0.0%
Lighting – 4	112	17.3%	15	15	17.3%	0.0%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**147**	**13.7%**	**23**	**23**	**13.7%**	**100.0%**

A.4.4.3.3 Ride-Along Site Inspections

Table A-82 summarizes the SWE Team's PY7 ride-along site inspections of Penn Power's non-residential project installations. For PY7, all Penn Power PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or the evaluation contractor's savings calculations or reports.

Table A-82: Penn Power's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-712773	HVAC (pump VFDs)	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-711668	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-586424	EMS system	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-745376	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-747119	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-394776	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-394780	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.

A.4.4.3.4 Verified Savings Review

The SWE Team reviewed a subset of Penn Power's sampled sites and found appropriate rigor in the evaluation contractor's M&V methods as well as good organization and clear presentation. There was significant improvement in the presentation of M&V methodology and results in PY7 with the inclusion of a site-level report in each project file. Table A-83 shows the energy and demand savings for projects chosen for review by the SWE Team, as well as the M&V approach selected for site evaluation.

Table A-83: Verified Savings and M&V Methods for SWE Team–Sampled Penn Power Projects

Program	Project Number	Stratum	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	M&V Method
Small C/I Buildings	CR_PRJ-289552	Custom – certainty	415,913	131.68	Verify by interview, apply TRM
Small C/I Equipment	CR_PRJ-386168	Lighting – 3	122,454	28.47	On-site + logging
Small C/I Buildings	CR_PRJ-468193	Custom – 2	528,054	43.72	Billing analysis

Project CR_PRJ-289552 involved the new construction installation of high-efficiency rooftop units (RTUs) and mini-splits as well as LED and T5 fixtures at an indoor sports facility in Cranberry Township, PA. A total of 18 direct exchange (DX) HVAC units were installed with savings calculated through TRM algorithms using data inputs from cut sheets. Over 2,000 light fixtures were installed and analyzed with the Appendix E calculator using the space-by-space method. HOU were confirmed by the implementer and through posted operating hours for certain sections of the facility. The SWE agrees with the level of rigor and methods used for the analysis.

Project CR_PRJ-386168 involved the replacement of halogen fixtures with LED fixtures, conversion of T12s to T8s, and metal halide (MH) to pulse start in a retail store in Cranberry Township, PA. Two light loggers were deployed during a site visit, and all light fixtures were verified as installed. In addition to higher than ex ante HOU, the metering also resulted in higher CF. This resulted in the 135% realization rate for kWh and 137% for kW.

Project CR_PRJ-468193 involved the installation of anti-sweat heater controls and refrigeration system retro-commissioning at a grocery store in New Castle, PA. The savings were verified through a statistical billing analysis. The 173% realization rate is a result of the lack of long-term, pre-retrofit billing data available for the ex ante analysis. The SWE agrees with the level of rigor and method used for the analysis.

A.4.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penn Power, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described in Section A.2.4.4 pertains to all four FirstEnergy utilities, including Penn Power.

This remainder of this section summarizes the activities and key findings of the SWE Team's NTG audits of Penn Power's PY7 programs.

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation contractors, ADM/Tetra Tech, used the same evaluation methods for all four EDCs. See Section A.2.4.4 for a description of the SWE Team's review of the FirstEnergy EDC NTG evaluation, which applies to all four of FirstEnergy's Pennsylvania EDCs.

Table A-84 summarizes NTG findings from the Penn Power PY7 annual report.

Table A-84: Summary of NTG Estimates for Penn Power's Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Residential					
Estimated	Appliance Turn-In[c]	0.59	0.00	0.42	52
	Efficient Products	0.36	0.02	0.67	101
	Home Performance	0.40	0.10	0.70	N/A
Low-Income					
Estimated	Residential Low-Income Program	0.28	0.17	0.89	46
Non-Residential					
Estimated	Small C/I Equipment	0.68	0.13	0.44	N/A
	Large C/I Equipment	0.33	0.11	0.78	N/A
	Small C/I Buildings	0.55	0.00	0.45	16
	Large C/I Buildings	0.50	0.00	0.50	1
	Government and Institutional	0.38	0.11	0.73	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All sample sizes are for the downstream NTG research using the common method. With the exception of Small C/I Buildings and Large C/I Buildings, all sample sizes provided at least 85/15 confidence/precision.
[c] ADM/Tetra Tech misprinted the program-level FR value in the PY7 annual report. The value reported in this table is the actual FR value.

A.4.5 Statewide Evaluator Final Recommendations

The SWE Team has the following recommendations for Penn Power's EE&C programs going forward:

- The SWE Team recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for C/I lighting projects moving forward
- Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and customers more quickly if project documentation is incomplete.
- As the Home Performance – New Construction measure becomes more streamlined or as incentives change, attempt to attract builders who began with the program but dropped out.

A.5 WEST PENN POWER

This section summarizes West Penn's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by West Penn's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by West Penn's evaluation contractor to conduct M&V of West Penn's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve West Penn's programs in the future.

A.5.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.5.1.1 Phase II Savings by Program

Table A-85 lists the West Penn EE&C programs that yielded reported savings in PY7. Table A-86 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Large C/I Equipment program was the largest contributor of both energy and demand savings.

Table A-85: West Penn EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector
Appliance Turn-In	Residential
Efficient Products	Residential
Home Performance	Residential
Low Income	Low-Income
Small C/I Equipment	Non-Residential
Small C/I Buildings	Non-Residential
Large C/I Equipment	Non-Residential
Large C/I Buildings	Non-Residential
Gov./Institutional	GNI

Table A-86: Summary of West Penn EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Appliance Turn-In	16,445	5%	2.31	5%
Efficient Products	99,402	28%	11.55	26%
Home Performance	63,984	18%	6.64	15%
Low Income	4,725	1%	0.47	1%
Small C/I Equipment	54,098	15%	8.96	20%
Small C/I Buildings	8,161	2%	1.22	3%
Large C/I Equipment	103,535	29%	12.27	28%
Large C/I Buildings	5,396	2%	0.85	2%
Gov./Institutional	2,327	1%	0.11	0%
Total Portfolio	***358,073***	***100%***	***44.37***	***100%***

A.5.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-87 below. In PY7, the net energy savings were approximately 75% of the gross energy savings.

Table A-87: Summary of West Penn EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	83,684	68,347	176,463	125,922
C/I	61,391	42,411	147,885	105,815
GNI	13,685	9,577	33,726	22,525
Total Portfolio	***158,760***	***120,335***	***358,073***	***254,263***

A.5.2 Total Resource Cost Test

Table A-88 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for West Penn's PY7 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-88: Summary of West Penn's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$1,927,839	$812,695	$1,115,144	2.37
Efficient Products	$15,250,919	$8,604,628	$6,646,290	1.77
Home Performance	$6,218,817	$3,772,136	$2,446,680	1.65
Low Income	$640,722	$2,561,108	($1,920,386)	0.25

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Small C/I Equipment	$15,427,982	$3,153,707	$12,274,274	4.89
Small C/I Buildings	$1,419,428	$1,700,604	($281,176)	0.83
Large C/I Equipment	$25,929,747	$15,387,523	$10,542,224	1.69
Large C/I Buildings	$2,579,485	$1,650,412	$929,073	1.56
Gov./Institutional	$818,911	$1,299,894	($480,983)	0.63
Total Portfolio	**$70,213,849**	**$38,942,708**	**$31,271,141**	**1.80**

In summary, six of West Penn's nine programs offered were found to be cost-effective and three were non-cost-effective. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Residential Appliance Turn-In*
- *Energy Efficient Products*
- *Residential Home Performance*
- *Small C/I Energy Efficient Buildings*
- *Large C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Buildings*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *Residential Low-Income*
- *Small C/I Energy Efficient Buildings*
- *Government and Institutional*

In PY7, the Home Performance and Large C/I Buildings programs screened as cost-effective. Overall, programs with large amounts of energy and demand savings generally had high TRC ratios. This signifies that the programs garnering the most savings were also the most cost-effective programs in PY7.

A.5.2.1 Assumptions and Inputs

One TRC model template was shared across all four FirstEnergy companies. Despite the similar model, the TRC model calculations were handled independently for each of the four EDCs. The West Penn iteration of the FirstEnergy TRC model used a discount rate of 9.15% to compare the NPV of program benefits that will occur later in a measure's lifetime to the up-front costs of installation of implementation. This value matches the EDC's EE&C plan on file. Different values of LLF were used for different sectors, as shown in Table A-89.

Table A-89: West Penn's PY7 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF	Demand LLF
Appliance Turn-In	Residential	9.15%	9.10%	9.10%
Efficient Products	Residential	9.15%	9.10%	9.10%
Home Performance	Residential	9.15%	9.10%	9.10%
Low Income	Residential	9.15%	9.10%	9.10%
Small C/I Equipment	Non-Residential	9.15%	7.90%	7.90%
Small C/I Buildings	Non-Residential	9.15%	7.90%	7.90%
Large C/I Equipment	Non-Residential	9.15%	7.90%	7.90%
Large C/I Buildings	Non-Residential	9.15%	7.90%	7.90%
Gov./Institutional	Non-Residential	9.15%	7.90%	7.90%

In the residential sector, measure lives were reported on a measure-by-measure basis. The SWE Team spot-checked some of these measure lives and found them to be consistent with the 2015 TRM. In the non-residential sector, the TRC model applied an EUL at the stratum level rather than at the measure level.

Similarly, the model assigned incremental costs at the measure level in the residential sector and at the stratum level in the non-residential sector in the model. The residential-sector incremental costs primarily were derived from the SWE incremental cost database, the West Penn EE&C plan, and the project invoices. The sources for non-residential sector incremental costs included the SWE cost database, sampled project invoices, the Database for Energy Efficient Resources (DEER) 2008 incremental cost database, and the EDC EE&C plan. The FirstEnergy TRC model relied on the evaluation samples as a basis for calculating incremental participant costs for non-residential programs. Those sampled values were weighted to apply to the remainder of the program. The SWE Team examined this approach and found it reasonable and appropriate.

The TRC model drew the energy and demand impacts from the tracking database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC model analysis was based on ex post verified savings, so program impacts were adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

The 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures beginning June 1, 2016, but does not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. In the West Penn TRC model, a measure's lifetime was separated into two parts: the first year, and the remaining lifetime. The removed equipment was treated as the baseline for the first year, with the baseline shifting to the code-required baseline for the remainder of the measure's life. The model calculated the measure's lifetime savings as the sum of these two parts.

A.5.2.2 Avoided Cost of Capacity

Consistent with prior Phase II program years, the PY7 FirstEnergy TRC Models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.5.2.3 Conclusions and Recommendations

The FirstEnergy TRC model is performing all of the B/C calculations in accordance with the 2013 TRC Order. The SWE Team review of the West Penn TRC model found no calculation errors and believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.5.3 Status of Evaluation Activities

This section discusses the status of West Penn's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.5.3.1 Status of Evaluation, Measurement, and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation Framework that was applicable for PY6 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-90 displays key milestones completed by FirstEnergy and the SWE for FirstEnergy's Phase II EM&V Plan. FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs.

Table A-90: Key Milestones Reached for West Penn's Phase II EM&V Plan

Date	Event
September 19, 2013	FirstEnergy EDCs submit first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on the FirstEnergy evaluation plan to FirstEnergy
November 13, 2013	SWE sends a list of "items that be must addressed" to FirstEnergy EDCs
February 19, 2014	FirstEnergy EDCs submit revised Phase II evaluation plan to the PUC and SWE
June 1, 2014	PY6 starts
December 17, 2014	FirstEnergy EDCs provide email with additional information on the approach used by ADM for the PY6 evaluation of West Penn's Appliance Turn-In Program
January 5, 2015	FirstEnergy EDCs send email to SWE with clarification of sampling approach for the evaluations of the residential low-income program components (direct-install, giveaway, and low income low use kit components)

The initial EM&V Plan for all FirstEnergy companies, submitted on September 19, 2013, detailed proposed evaluation objectives and activities for nine programs across two sectors. Key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts were presented for each of the nine programs. After reviewing the plan, the SWE Team returned 34 comments on October 15, 2013. Many of the SWE Team's comments demonstrated the SWE Team's agreement with details of the FirstEnergy EDCs' plan. Most of the remaining comments concerned report formatting and minor clarifications that did not propose changes to the plan; substantive recommendations for revisions to the plan arose in only two areas:

- Frequency of EDC data gathering in partially deemed measures
- Definition of high-impact measures in C/I programs

FirstEnergy EDCs provided revisions to the plan on February 19, 2014, and the SWE Team approved the revised version as the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all PY6 EM&V activities.

A.5.3.2 Measurement and Verification Activities and Findings

Realization rates compare gross savings reported by the EDC with the verified gross savings determined by the EDC evaluation contractor through M&V. Table A-91 summarizes M&V findings based on activities conducted by the West Penn evaluation contractor. The summary is based on details provided in West Penn's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table A-91 presents realization rates and relative precision values for verified energy and demand savings for each of West Penn's residential and non-residential energy efficiency programs in PY7.

Table A-91: West Penn Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY7

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	92.0%	7.6%	92.7%	7.9%
Efficient Products	135.1%	1.7%	112.6%	5.2%
Home Performance	87.6%	5.2%	69.6%	5.1%
Low-Income	99.3%	9.9%	131.4%	9.9%
Small C/I Equipment	93.5%	13.1%	131.3%	15.4%
Small C/I Buildings	79.0%	13.4%	104.0%	9.4%
Large C/I Equipment	99.8%	8.1%	97.9%	9.5%
Large C/I Buildings	74.7%	12.5%	79.7%	12.2%
Government/Institutional	95.8%	14.4%	8.3%	19.6%

NOTE:
[a] Relative precision values are at the 85% confidence level.

A.5.3.2.1 Residential Programs

The energy realization rates for West Penn's residential programs ranged from 87.6% to 135.1%. The demand realization rates ranged from 69.6% to 131.4%. West Penn achieved the 15% relative precision requirement at the 85% confidence level for both energy and demand for all residential programs.

The Appliance Turn-In Program was evaluated through customer verification surveys to determine the fraction of refrigerators, freezers, and room air conditioners that were drawing power before retirement, as well as the other parameters necessary to determine the EUL from the TRM regression equation. The program realization rate is mostly a function of the difference between the ex ante and ex post EULs, the latter of which used actual PY7 collection data.

The evaluations of the upstream lighting and products portions of the Efficient Products Program involved reviews of sales invoices, a review of the tracking and reporting system, and a detailed review of CSP energy and demand savings calculations. The appliance portion and the HVAC equipment/tune-up portion were evaluated through an invoice review, customer surveys, and a review of the energy and demand calculations with reference to the ENERGY STAR database.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The home energy audit kits were evaluated using the T&R system as well as online and phone surveys to determine the delivery and installation rates for each measure. The kit receipt rates and measure ISRs have been shown to fluctuate among EDCs, primarily due to statistical variations, and therefore average statewide ISRs are used for all four FirstEnergy companies. The new construction portion of the program was evaluated through an engineering review of a sample of projects in the portfolio. Energy and demand savings for this program were determined through REM/Rate software calculations, and the review focused on whether the modeling was performed correctly (including baseline assumptions) and if the results were reasonable. The prescriptive, low-cost direct-install portion was evaluated by reviewing the T&R system and sample invoices to check if the TRM calculations were performed correctly and if the invoices matched the information in the database.

For comprehensive weatherization jobs, those that saved more than 2 MWh/yr were evaluated through billing analysis, and those saving under 2 MWh/yr received an invoice review. The HER portion was reviewed and duplicated by the evaluation contractor, producing results consistent with the implementation CSP's. The contractor then conducted its own full evaluation of the savings using a lagged seasonal regression model and adjusting for dual participation.

A.5.3.2.2 Low-Income Programs

The evaluation contractor reviewed the tracking data and on-site verification forms and results to determine ISRs for the WARM direct-install measures. For giveaway events, the evaluation contractor reviewed the tracking database and applied the ISR from the 2015 TRM. There were no LILU energy kits distributed in PY7.

A.5.3.2.3 Non-Residential Programs

Realization rates for West Penn's non-residential programs' energy savings ranged from 74.7% to 99.8%. Realization rates for demand reductions from these programs ranged from 8.3% to 131.4%. The Government and Institutional Program was responsible for the low realization rate of 8.3% for demand, but most projects were street lighting, which has a 0 coincidence factor. West Penn achieved the 15% precision requirement for kWh in all of its non-residential programs. It also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II of Act 129.

Figure A-16 Figure A-16 shows the frequency of each M&V approach performed by ADM in PY7 for West Penn's Small C/I Equipment Program evaluation sample and the verified energy savings associated with each M&V approach. ADM used both basic and enhanced levels of rigor to evaluate projects in the sample. Basic rigor includes surveys, desk reviews, and simple on-site verification (no logging). Enhanced rigor includes the following options, as recorded by ADM. The first consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. The second general approach is on-site verification with logging. This may be light logger deployment or more robust measurement of the retrofitted system's continuous energy usage. The third general approach involves modeling energy performance of a facility before and after the efficiency measure is installed with an energy simulation.

Figure A-16: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Equipment Program

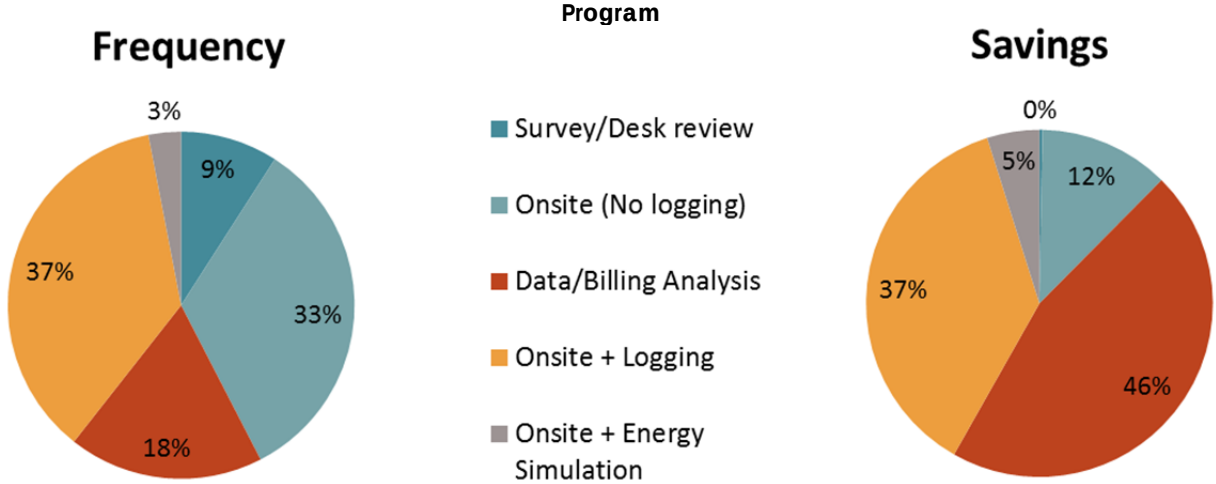


Figure A-16 indicates that 42% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for 12% of the energy savings. This suggests that basic rigor was used appropriately, predominately for projects with smaller savings. Likewise, the more expensive enhanced rigor methods were reserved for a smaller number of projects, but these projects contributed a majority (88%) of the sample's energy savings. The SWE Team supports this "value of information" approach, whereby more expensive evaluation techniques are reserved for projects that account for the greatest share of program savings.

Figure A-17 shows the frequency of each M&V method used in the Small C/I Buildings Program and the energy savings associated with each method. Basic rigor was used to evaluate 79% of projects, and these projects made up 52% of the savings.

Figure A-17: Frequency of and Associated Energy Savings by M&V Approach – Small C/I Buildings Program

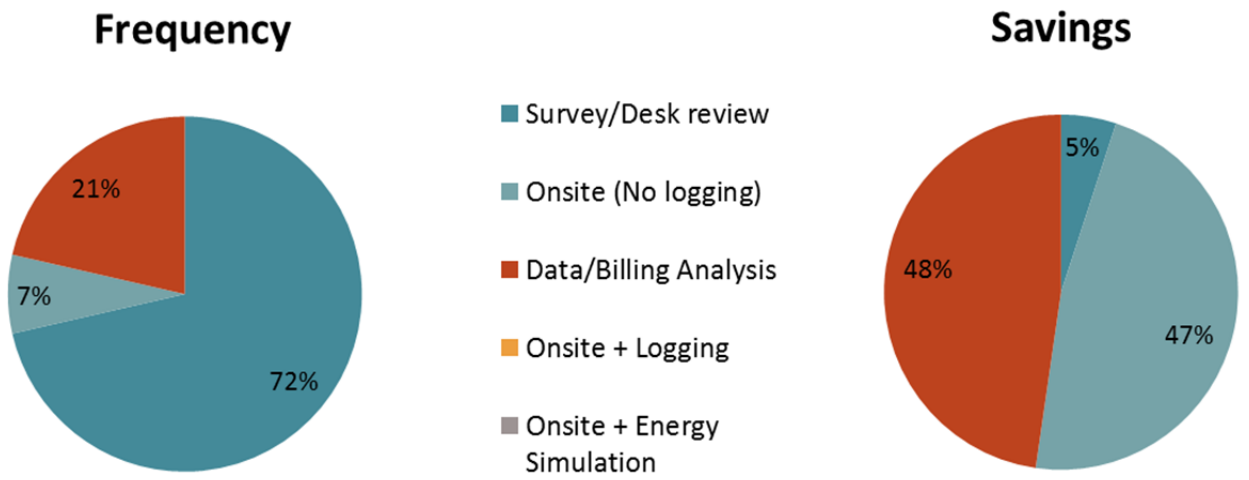


Figure A-18 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (85%), and these projects accounted for the vast majority of the savings. Basic rigor was appropriately limited to those projects with less savings.

Figure A-18: Frequency of and Associated Energy Savings by M&V Approach – Large C/I Equipment Program

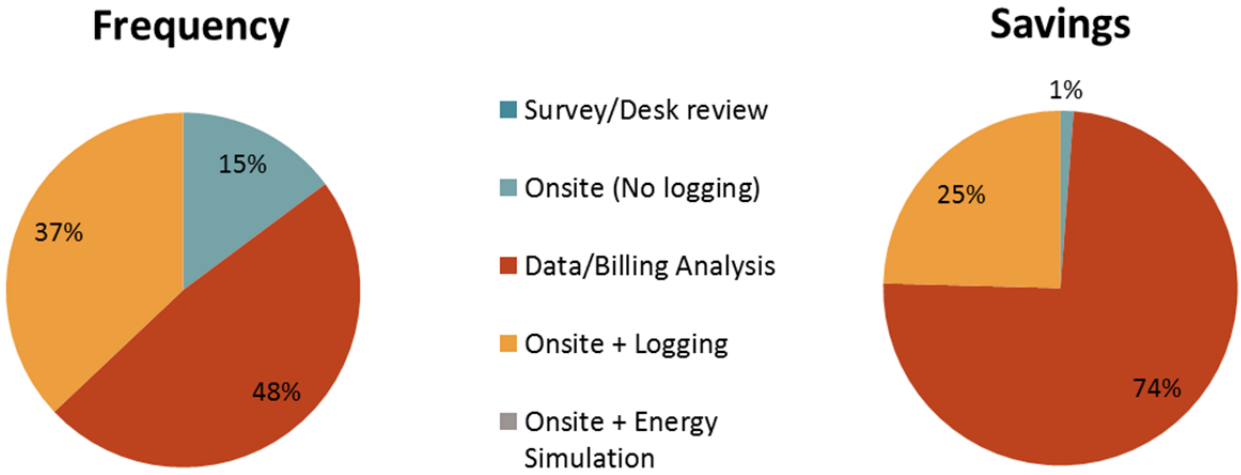


Figure A-19 shows the frequency of each M&V method used in the Large C/I Buildings Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (56%), and these projects accounted for most of the savings (83%).

Figure A-19: Frequency of and Associated Energy Savings by M&V Approach – Large C/I Buildings Program

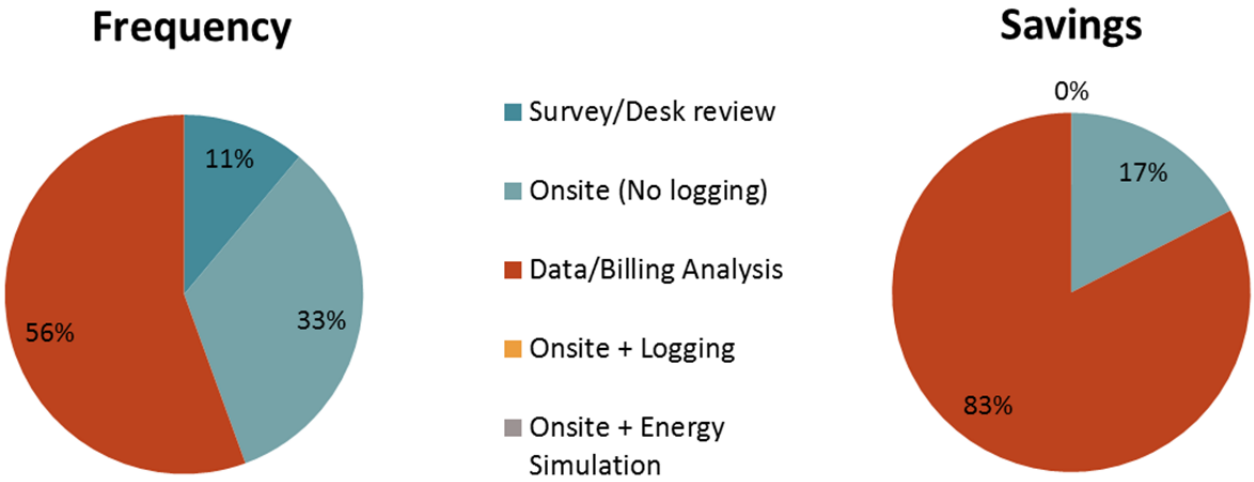
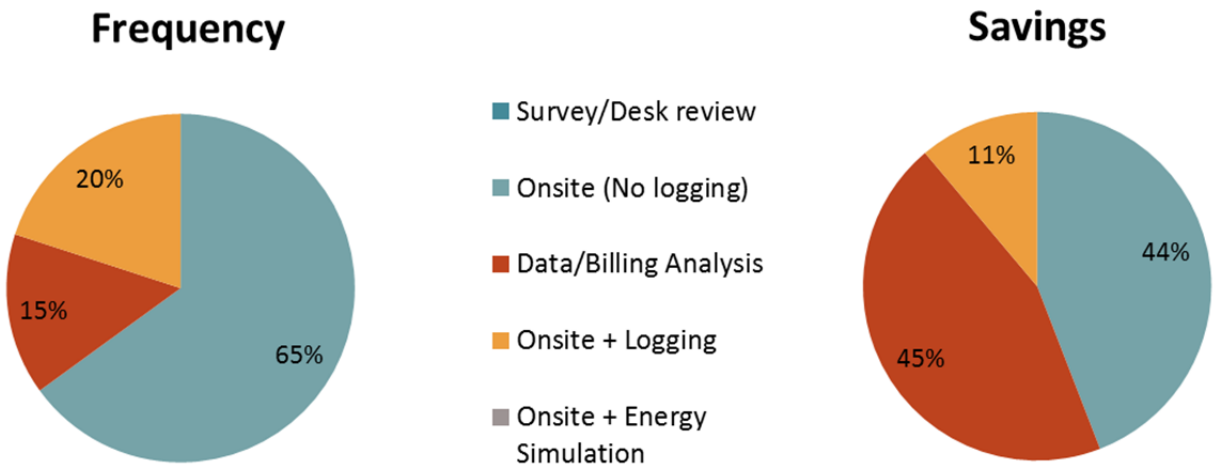


Figure A-20 shows the frequency of each M&V method used in the Government and Institutional Program and the energy savings associated with each method. Basic rigor was used for 65% of the projects, but these projects accounted for only 44% of the savings.

Figure A-20: Frequency of and Associated Energy Savings by M&V Approach – Government and Institutional Program



A.5.3.3 Process Evaluation Activities and Findings

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including West Penn, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Refer to Section A.2.3.3 for an overview of ADM/Tetra Tech's process evaluation activities and findings.

A.5.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of West Penn's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.5.4.1 Residential Program Audit Summary

A.5.4.1.1 Residential Lighting

For PY7, residential upstream lighting accounted for a majority of the reported savings in West Penn's Efficient Products Program. The SWE Team reviewed the database and tracking system submitted by West Penn and its evaluation contractor to verify that the correct savings algorithms and deemed savings values were used in the program. The SWE Team also reviewed 10 invoices and product data sheets covering many different bulb types, from standard CFLs to decorative LEDs and floodlight bulbs. Due to the format of the tracking database, the SWE Team easily confirmed that the 2015 TRM was appropriately used for the calculations to quantify the program savings. The SWE Team also verified that FirstEnergy's evaluation contractor correctly noted any discrepancies in the census data and accounted for any adjustments in the verified savings data.

A.5.4.1.2 Appliance Turn-In Program

The SWE Team reviewed the spreadsheets and database used to calculate West Penn's verified gross savings. Unlike in previous years where the evaluation contractor simply used the deemed UECs from the TRM, in PY7 the contractor calculated a utility-specific UEC from the PY7 appliance recycling customer database. The SWE Team confirmed that the UECs were calculated correctly using the 2015 TRM regression coefficients and PY7 West Penn customer data and that they were used correctly in determining annual kWh and kW savings. Because of a difference in how gross savings are calculated in the 2015 TRM, it was not necessary to account for refrigerator replacement. This is taken into account only in the net savings calculations. The Excel worksheets documented calculations clearly and were easy to follow.

A.5.4.1.3 Efficient Products Program

The SWE Team thoroughly reviewed the data-tracking and reporting system containing the savings calculation and rebate invoice information for all of the Efficient Products Program strata. Additionally, it checked the proper use of the 2015 TRM in calculating the savings for each of the product types. The SWE found that the HPWH savings calculations strayed slightly from the TRM, but in an acceptably conservative fashion. According to the TRM, the HVAC interactive effect penalty only needs to be taken into account when the HPWH is installed in conditioned space and not when the default F_{derate} value is used. The evaluation contractor assumed both, which made the kWh estimates slightly conservative.

A.5.4.1.4 Home Performance

The SWE Team audited each operational component of the Home Performance Program: whole house direct install, home energy audit conservation kits, new homes, and HERs (the school conservation kits component did not operate in PY7). The HERs accounted for a majority (86%) of the Home Performance Program savings in PY7. The SWE Team verified that the correct 2015 TRM savings were used for all measures in the home energy audit conservation kits and that the FirstEnergy statewide receipt rate and ISRs were correctly applied to the items.

For the whole house direct-install component, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The HER component received a full evaluation for the first time in Phase II in PY7. Due to the one-year measure life, it was unnecessary to evaluate this component in the other years. The SWE reviewed the independent analysis performed by the evaluation contractor and verified that it was done correctly. There was good consistency between the results of the three analyses performed (OPower's, ADM's replication of OPower, and ADM's), and the overall realization rate was 86%.

A.5.4.2 Low-Income Program and Audit Summary

The SWE Team reviewed the two distribution branches of the Low-Income Program operational in PY7 (direct install and giveaway) to ensure that the savings were correctly calculated using the 2015 TRM and that the realization rates were correctly determined and applied appropriately. West Penn's evaluation contractor provided a complete database of direct-install measures, which included a pivot table that ranked measures by individual measure contribution to total program kWh savings. Using this, the SWE Team verified the calculations for five measures with the greatest overall impact and verified five randomly selected measures. The SWE Team also confirmed that kWh and kW calculations for the estimations of savings for the giveaway program were implemented per the 2015 TRM.

The SWE Team verified that West Penn was in compliance with the requirement that the number of energy conservation measures offered to low-income households be proportionate to those households' share of the total energy usage in West Penn's service territory. West Penn offered six types of measures to the low-income sector in PY7, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 8.8%.

A.5.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were being performed in accordance with the applicable TRM, or by some other reasonable methodology. The SWE Team reviewed nine projects in West Penn's PY7 program across various measures, including EMSs, VSDs, interior and exterior lighting, and retro-commissioning. In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for lighting projects moving forward.

The SWE Team reviewed West Penn's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-92, showing relative precision at the 85% confidence level.

Table A-92: Compliance across Sample Designs for West Penn's PY7 Non-Residential Program Groups

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Small C/I Equipment	13.1%	15.4%	✓
Small C/I Buildings	13.4%	9.4%	✓
Large C/I Equipment	8.1%	9.5%	✓
Large C/I Buildings	12.5%	12.2%	✓
Government/Institutional	14.4%	19.6%	✓

West Penn met the goal of 15% precision at the 85% confidence level for energy for all non-residential program groups. Details concerning each program evaluation sample are provided below.

As part of the audit process, the SWE Team performed 10 ride-along site inspections of non-residential projects to oversee West Penn's on-site evaluation practices. All of these projects were lighting upgrades. The SWE Team approved all of the sampled project inspections. However, the SWE Team recommends that West Penn only use the SWE-supplied Appendix C calculator for lighting projects moving forward. Appendix B provides detailed information about all reviewed projects and their associated findings.

The SWE Team performed a verified savings analysis on five submitted projects, checking the accuracy of the calculations, appropriateness of the evaluation method, and level of rigor selections. The SWE Team found the level of rigor chosen by the evaluation contractor to be reasonable, based on project size and uncertainty. There was significant improvement in the presentation of M&V methodology and results in PY7 with the inclusion of a site-level report in each project file. Appendix B presents more detailed results of the verified savings analysis.

A.5.4.3.1 Project Files Review

The SWE Team reviewed nine projects in West Penn's PY7 program across various measures, including EMSs, VSDs, interior and exterior lighting, and retro-commissioning. The submitted files included project-level savings calculation workbooks, application forms, measure installation confirmation, equipment specification sheets, invoices, post-installation inspection reports, and other supporting documents. In general, the submitted project files provided thorough documentation for SWE Team review, and showed early involvement by the evaluation contractor.

Table A-93 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-93: West Penn Project File Summary

Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
CR_PRJ-349930	Small C/I Equipment	Interior and exterior lighting retrofit, linear fluorescent and CFL	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-307444	Small C/I Buildings	Building automation system upgrade/retro-commissioning	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-331196	Large C/I Equipment	Exterior lighting retrofit HPS to LED	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-349353	Large C/I Buildings	VSD compressor and recycling refrigerated dryer on compressed air system	Yes	Yes	No	Yes	N/A	Yes
CR_PRJ-444825	Small C/I Equipment	Lighting (controls)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-502567	Small C/I Equipment	Lighting (LED)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-628342	Small C/I Equipment	Lighting (refrigerated LED)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-478690	Large C/I Equipment	Lighting (interior and exterior LED)	Yes	Yes	No	Yes	Yes	N/A
CR_PRJ-723119	Small C/I Equipment	Lighting (interior and exterior LED)	Yes	Yes	No	Yes	Yes	N/A

In PY7, the SWE saw marked improvement in the consistency, orderliness, and organization of project files. This was aided by the consistent inclusion of site-specific cover pages, which helped the SWE follow the evaluation contractor's method and progression. At this time, the SWE Team only recommends that in the interest of transparency, only the supplied Appendix C calculator be used for lighting projects moving forward.

A.5.4.3.2 Sample Design Review

West Penn's PY7 final annual report provides detailed information about the sample design of the PY7 gross impact evaluation of non-residential programs. West Penn's non-residential programs were the Small C/I Energy Efficient Equipment Program, Small C/I Energy Efficient Buildings Program, Large C/I Energy Efficient Equipment Program, Large C/I Energy Efficient Buildings Program, and Government and Institutional Program.

A.5.4.3.2.1 Small C/I Energy Efficient Equipment Program

In PY7, this program was divided into two components: equipment incentives and appliance recycling. Lighting measures contributed the majority of the gross energy savings for the program.

Stratified ratio estimation was used to estimate savings for the program, and stratified random sampling was used for sample design by the evaluation contractor. For large lighting projects in the evaluation sample, West Penn's evaluation contractor designed an on-site sampling strategy that targeted ±20% precision at the 90% confidence level for the physical counting of fixtures. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then stratified based on energy savings at the measure level. The assumed Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-94. The data show that West Penn met the SWE Team requirements of 85%/15% confidence/precision for both energy and peak demand.

Table A-94: West Penn's PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	32	26.5%	6	6	26.5%	26.5%
Lighting – 3	82	28.3%	6	6	28.3%	28.3%
Lighting – 4	371	22.5%	10	10	22.5%	22.5%
Custom – certainty	2	0.0%	2	2	0.0%	0.0%
Custom – 2	2	50.9%	1	1	50.9%	50.9%
Custom – 3	54	30.7%	5	5	30.7%	30.7%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	32	70.9%	1	1	70.9%	70.9%
Appliance Turn-In – 1	106	71.7%	1	1	71.7%	71.7%
Kitchen/appliances – 1	16	69.7%	1	1	69.7%	69.7%
Program Total	**697**	**13.0%**	**33**	**33**	**13.1%**	**15.4%**

A.5.4.3.2.2 Small C/I Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-95. The precision levels for energy and for demand met the SWE Team requirements.

Table A-95: West Penn's PY7 Sampling Strategy and Relative Precision – Small C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	3,179	11.3%	40	64	8.9%	8.9%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	12	0.0%	12	11	6.3%	6.3%
Custom – 2	1	0.0%	1	1	0.0%	0.0%
Custom – 3	25	48.8%	2	2	48.8%	48.8%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**3,217**	**14.4%**	**55**	**78**	**13.4%**	**9.4%**

A.5.4.3.2.3 Large C/I Energy Efficient Equipment Program

In PY7 this program consisted mostly of equipment upgrades and custom at industrial facilities. The evaluation contractor used stratified ratio estimation to estimate savings for the program and stratified random sampling for sample design. All lighting projects that were expected to have more than 800 MWh/yr in savings and other projects that were expected to have more than 400 MWh/yr in savings were automatically selected for the evaluation. At the end of Q2 and Q4, the evaluation contractor reviewed the tracking data to draw a sample population for that quarter. The sample population was separated by company and programs first, and then was stratified based on energy savings at the measure level. The Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY7 and the achieved precision values for each stratum are presented in Table A-96. The data show that West Penn met the SWE Team requirements of 85%/15% confidence/precision for energy and peak demand for this program.

Table A-96: West Penn's PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Equipment Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	100.0%	100.0%
Lighting – certainty	5	0.0%	5	5	0.0%	0.0%
Lighting – 2	6	65.7%	1	2	41.6%	41.6%
Lighting – 3	8	67.3%	1	1	67.3%	67.3%
Lighting – 4	50	30.5%	5	5	30.5%	30.5%
Custom – certainty	9	0.0%	9	9	0.0%	0.0%
Custom – 2	1	0.0%	1	1	0.0%	0.0%
Custom – 3	16	31.2%	4	4	31.2%	31.2%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**95**	**10.1%**	**26**	**27**	**8.1%**	**9.5%**

A.5.4.3.2.4 C/I Large Energy Efficient Buildings Program

This was a new program in Phase II. The program includes two components: energy conservation kits delivered by mail to non-residential customers and whole-building projects such as new construction, retro-commissioning, and building envelope improvements. Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described for the Small C/I Energy Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-97. The precision levels for energy and for demand met the SWE Team requirements.

Table A-97: West Penn PY7 Sampling Strategy and Relative Precision – Large C/I Energy Efficient Buildings Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	1	N/A	0	0	100.0%	100.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	0	N/A	0	0	0.0%	0.0%
Lighting – 3	0	N/A	0	0	0.0%	0.0%
Lighting – 4	0	N/A	0	0	0.0%	0.0%
Custom – certainty	2	0.0%	2	2	0.0%	0.0%
Custom – 2	2	0.0%	2	2	0.0%	0.0%
Custom – 3	11	28.7%	4	4	28.7%	28.7%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**16**	**12.6%**	**8**	**8**	**12.5%**	**12.2%**

A.5.4.3.2.5 Government and Institutional Program

This program had three components in PY7: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. Information about the sample design and achieved precision values for each stratum is provided in Table A-98. The achieved precision value for energy met the SWE Team requirements of 85%/15% confidence/precision, but for demand it was slightly higher, at 19.6%.

Table A-98: West Penn's PY7 Sampling Strategy and Achieved Precision – Government and Institutional Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Relative Precision at 85% C.L. for Energy	Relative Precision at 85% C.L. for Demand
CFL kits – 1	0	N/A	0	0	0.0%	0.0%
Lighting – certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	4	0.0%	4	3	20.8%	0.0%
Lighting – 3	22	28.3%	5	4	32.6%	32.6%
Lighting – 4	112	18.8%	13	13	18.8%	18.8%
Custom – certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW – 2	0	N/A	0	0	0.0%	0.0%
Appliance Turn-In – 1	0	N/A	0	0	0.0%	0.0%
Kitchen/appliances – 1	0	N/A	0	0	0.0%	0.0%
Program Total	**138**	**11.8%**	**22**	**20**	**14.4%**	**19.6%**

A.5.4.3.3 Ride-Along Site Inspections

Table A-99 summarizes the SWE Team's PY7 ride-along site inspections of West Penn's non-residential project installations. For PY7, all West Penn PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or the evaluation contractor's savings calculations or reports.

Table A-99 : West Penn PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-427502	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-424573	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-412295	Lighting	Minor discrepancies in the fixture count were noted.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-331545	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-383035	Lighting	Minor discrepancies in the fixture count and wattages were noted.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-384530	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-378994	Lighting	Minor discrepancies in the fixture count were noted.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-388066	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-387812	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.
PRJ-387842	Lighting	Although the final verified savings is correct, the Appendix C calculator was not used in its original form.	Eval	In the interest of transparency, the SWE Team recommends that the evaluation contractor use only the Appendix C calculator for lighting projects moving forward.

A.5.4.3.4 Verified Savings Review

The SWE Team reviewed a subset of West Penn's sampled sites and found appropriate use of rigor in the evaluation contractor's M&V methods. There was significant improvement in the presentation of

M&V methodology and results in PY7 with the inclusion of a site-level report in each project file. Table A-100 shows the energy and demand savings for projects the SWE Team chose to review, as well as the M&V approach selected for site evaluation.

Table A-100: Verified Savings and M&V Methods for SWE Team–Sampled West Penn Projects

Program	Project Number	Stratum	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	M&V Method
Large C/I Equipment	CR_PRJ-632496	Lighting – certainty	2,248,623	376.95	On-site + logging
Large C/I Equipment	CR_PRJ-641534	Custom – certainty	616,850	70.42	Option B regression
Government	CR_PRJ-754676	Lighting – 3	22,323	0	On-site verification (exterior lighting)
Large C/I Equipment	CR_PRJ-465810	Custom – certainty	10,144,860	1,211.4	Billing analysis; EMS data analysis
Large C/I Equipment	CR_PRJ-565154	Lighting – 2	1,063,151	94.55	On-site + logging; EMS data analysis

Project CR_PRJ-632496 involved replacing fluorescent and incandescent fixtures with LED fixtures in an industrial manufacturing facility in Waynesboro, PA. Twelve light loggers were deployed during a site visit, and all light fixtures were verified as installed. Metering revealed a lower HOU and higher CF than those used in the ex ante analysis. This resulted in the 96% realization rate for kWh and 156% for kW.

Project CR_PRJ-641534 involved installing a master flow controller and a 2,000-gallon storage tank to improve the efficiency of the compressed air system at a manufacturing facility in Houston, PA. Pre- and post-trend data, including kW and CFM, were supplied and were correlated with daily production. These were then used to calculate energy and demand savings. The energy realization rate of 127% is due to a difference in analyzing daily production.

Project CR_PRJ-754676 involved streetlight retrofits of high pressure sodium (HPS) bulbs to LED fixtures in Greensburg, PA. The evaluation contractor performed a site visit and verified the installation of all fixtures. The installed fixtures, however, were determined to be 257W instead of the 260W used in the ex ante analysis. This resulted in the energy realization rate of 101%. The demand realization rate of 0% is due to the dawn-to-dusk operating hours.

Project CR_PRJ-465810 was a new construction project of an efficient-process hot rolling steel mill outside Pittsburgh, PA. There are no TRM baselines, measures, or building codes governing steel mills, so the approach taken was to determine an “industry standard” efficiency for hot rolling mills and compare that with the “as-built” condition. The industry standard energy use was determined from a report titled “The Energy Use in the Steel Industry,” which provided an average kWh/metric ton figure. This was then used in conjunction with meter data from the new mill as well as production data to determine annual energy savings over an industry standard mill. The SWE agrees with the approach and the rigor used.

Project CR_PRJ-565154 involved lighting retrofit at an industrial manufacturing facility in Youngwood, PA. Over 300 T8 and MH fixtures were retrofitted with LEDs. All fixtures were verified during a site

inspection, and the HOU, CF, and controls factor were determined from EMS data. The difference in these metered values accounts for the 99% kWh and 89% kW realization rates.

A.5.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including West Penn, and so the annual evaluation reports of the four EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described in Section A.2.4.4 pertains to all four FirstEnergy utilities, including West Penn.

This remainder of this section summarizes the activities and key findings of the SWE Team's NTG audits of West Penn's PY7 programs.

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation contractors, ADM/Tetra Tech, used the same evaluation methods for all four EDCs. See Section A.2.4.4 for a description of the SWE Team's review of the FirstEnergy EDC NTG evaluation, which applies to all four of FirstEnergy's Pennsylvania EDCs.

Table A-101 summarizes NTG findings from the West Penn PY7 annual report.

Table A-101: Summary of NTG Estimates for West Penn's Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Residential					
Estimated	Appliance Turn-In[c]	0.69	0.00	0.31	66
	Efficient Products	0.38	0.01	0.63	131
	Home Performance	0.24	0.06	0.82	N/A
Low-Income					
Estimated	Residential Low-Income Program	0.27	0.17	0.90	46
Non-Residential					
Estimated	Small C/I Equipment	0.39	0.10	0.72	N/A
	Large C/I Equipment	0.35	0.08	0.73	N/A
	Small C/I Buildings	0.40	0.00	0.60	83
	Large C/I Buildings	0.52	0.00	0.48	9
	Government and Institutional	0.38	0.11	0.73	N/A

NOTES
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All sample sizes are for the downstream NTG research using the common method. All sample sizes provided at least 85/15 confidence/precision.
[c] ADM/Tetra Tech misprinted the program-level FR value in the PY7 annual report. The value reported in this table is the actual FR value.

A.5.5 Statewide Evaluator Final Recommendations

The SWE Team has the following recommendations for West Penn's EE&C programs going forward:

- The SWE Team recommends that in the interest of transparency, only the SWE-supplied Appendix C calculator be used for C/I lighting projects moving forward
- Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and customers more quickly if project documentation is incomplete.
- As the Home Performance – New Construction measure becomes more streamlined or as incentives change, attempt to attract builders who began with the program but dropped out.

A.6 PECO

This section summarizes PECO's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by PECO's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by PECO's evaluation contractor to conduct M&V of PECO's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve PECO's programs in the future.

A.6.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.6.1.1 Phase II Savings by Program

Table A-102 lists the PECO EE&C programs that yielded reported savings in PY7. Table A-103 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Smart Home Rebates program was the largest contributor of both energy and demand savings.

Table A-102: PECO EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector
Smart Appliance Recycling	Residential
Smart Builder Rebates	Residential
Smart Energy Saver	Residential
Smart Home Rebates	Residential
Smart House Call	Residential
Smart Multi-Family Solutions - Residential	Residential
Smart Usage Profile	Residential
Low-Income Energy Efficiency Program	Low-Income
Residential Smart AC Saver Program	Residential
Smart Business Solutions	Non-Residential
Smart Construction Incentives	Non-Residential
Smart Equipment Incentives - Commercial and Industrial	Non-Residential

Programs Reporting PY7 Gross Savings	Sector
Smart Equipment Incentives - Government, Nonprofit and Institutional	GNI
Smart On-Site	Non-Residential
Commercial Smart AC Saver	Non-Residential

Table A-103: Summary of PECO EE&C Program Impacts on Verified Gross Portfolio Savings

Program[a]	Phase II VG Savings (MWh)	Percent of Portfolio Phase II VG MWh Savings	Phase II VG Savings (MW)[b]	Percent of Portfolio Phase II VG MW Savings
Smart Appliance Recycling - Residential	24,212	2%	3.4	2%
Smart Builder Rebates	592	0%	0.2	0%
Smart Energy Saver	7,219	1%	0.8	0%
Smart Home Rebates - Residential	403,631	37%	63.5	28%
Smart House Call	10,566	1%	1.5	1%
Smart Multi-Family Solutions - Residential	16,835	2%	1.8	1%
Smart Usage Profile	39,041	4%	0	0%
Low-Income Energy Efficiency Program	54,607	5%	6.2	3%
Residential Smart AC Saver Program	0	0%	55.5	25%
Smart Business Solutions	29,004	3%	7.6	3%
Smart Construction Incentives	43,348	4%	6.6	3%
Smart Equipment Incentives - Commercial and Industrial	238,518	22%	39.1	17%
Smart Equipment Incentives - Government, Nonprofit and Institutional	132,883	12%	25.5	11%
Smart On-Site	90,049	8%	11.6	5%
Commercial Smart AC Saver	0	0%	1.5	1%
Total Portfolio	**1,090,505**	**100%**	**224.8**	**100%**

NOTES

[a] This table lists multiple line-item breakouts for programs that are offered across multiple sectors. Therefore, the table has more rows than unique programs.

[b] All demand values include an LLF.

A.6.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-104. In PY7, the net energy savings were approximately 60% of the gross energy savings.

Table A-104: Summary of PECO EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	250,696	161,106	485,743	298,899
C/I	152,203	99,321	376,776	301,597
GNI	125,402	64,145	227,985	143,250
Total Portfolio	***528,301***	***324,572***	***1,090,505***	***743,746***

A.6.2 Total Resource Cost Test

Table A-105 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and the TRC ratio for PECO's PY7 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-105: Summary of PECO's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Smart AC Saver (Residential)	$15,430,738	$6,753,738	$8,677,000	2.28
Smart Appliance Recycling	$6,605,619	$1,380,653	$5,224,966	4.78
Smart Builder Rebates	$432,956	$840,198	($407,242)	0.52
Smart Energy Saver	$1,775,349	$450,255	$1,325,094	3.94
Smart Home Rebates	$187,504,780	$74,069,365	$113,435,414	2.53
Smart House Call	$7,033,639	$7,503,388	($469,749)	0.94
Smart Multi-Family Solutions (Residential)	$1,317,267	$787,186	$530,082	1.67
Smart Usage Profile	$4,143,465	$540,399	$3,603,067	7.67
Low-Income Energy Efficiency Program	$12,434,554	$8,088,046	$4,346,508	1.54
Smart AC Saver (Commercial)	$210,266	$312,936	($102,699)	0.67
Smart Business Solutions	$3,409,739	$1,779,019	$1,630,720	1.92
Smart Equipment Incentives (C/I)	$94,325,461	$34,165,074	$60,160,387	2.76
Smart Construction Incentives	$18,311,993	$13,316,100	$4,995,893	1.38
Smart Multi-Family Solutions (Nonresidential)	$1,381,862	$794,257	$587,604	1.74
Smart On-Site	$22,861,343	$30,570,834	($7,709,491)	0.75
Smart Equipment Incentives (GNI)	$69,659,041	$26,963,995	$42,695,045	2.58
Common Costs	-	*$11,027,484*	-	-
Total Portfolio	**$466,838,072**	**$219,342,927**	**$227,495,145**	**2.04**

In summary, 12 of the 16 programs offered were found to be cost-effective and 4 were found to be non-cost-effective in PY7. IN PY7, all programs that were cost-effective in PY6 remained cost-effective. Similarly, all programs that were not cost-effective or had no participation in PY6 were not cost-effective in PY7. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Smart AC Saver (Residential)*
- *Low-Income Energy Efficiency Program*
- *Smart Appliance Recycling*
- *Smart Home Rebates*
- *Smart Energy Saver*
- *Smart Multi-Family Solutions (Residential)*
- *Smart Usage Profile*
- *Smart Business Solutions*
- *Smart Equipment Incentives (C/I)*
- *Smart Construction Incentives*
- *Smart Multi-Family Solutions (Non-Residential)*
- *Smart Equipment Incentives (GNI)*

Non-Cost-Effective Programs
(TRC Ratio < 1.0)

- *Smart Builder Rebates*
- *Smart House Call*
- *Smart AC Saver (Commercial)*
- *Smart On-Site*

A.6.2.1 Assumptions and Inputs

PECO used the same discount rate (7.6%) in its PY7 TRC model to discount program benefits and costs for all programs, as was done in the prior Phase II years. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the up-front installation and implementation costs. The value used in the TRC model does not agree with the EDC's EE&C plan submitted in January 2013, which specifies a discount rate of 7.4%. Consistent with our recommendation in the prior Phase II years, the SWE requests that PECO's subsequent Phase II reports rely on the discount rate that was approved in its latest EE&C plan.[70]

PECO used different LLFs for calculating the programs' energy and demand savings. For all programs, a universal energy LLF of 7.1% was used. Demand LLF values from 10.0% to 16.1 % were used for different sectors. Table A-106 shows details about the discount rates and the energy and demand LLF values PECO used for each program.

[70] As an alternative, the SWE previously recommended that PECO file a request to the Commission to revise its Phase II EE&C plan to reflect its more recent discount rate calculation. PECO has informed the SWE Team that the company believes that the 7.6% discount rate is a more accurate reflection of their current weighted average cost of capital. To our knowledge, this request was never submitted.

Table A-106: PECO's Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
Smart AC Saver (Residential)	Residential	7.6%	7.1%	16.1%
Smart Appliance Recycling	Residential	7.6%	7.1%	16.1%
Smart Builder Rebates	Residential	7.6%	7.1%	16.1%
Smart Energy Saver	Residential	7.6%	7.1%	16.1%
Smart Home Rebates	Residential	7.6%	7.1%	16.1%
Smart House Call	Residential	7.6%	7.1%	16.1%
Smart Multi-Family Solutions (Residential)	Residential	7.6%	7.1%	16.1%
Smart Usage Profile	Residential	7.6%	7.1%	16.1%
Low-Income Energy Efficiency Program	Residential	7.6%	7.1%	16.1%
Smart AC Saver (Commercial)	C/I	7.6%	7.1%	10.0%
Smart Business Solutions	C/I	7.6%	7.1%	10.0%
Smart Equipment Incentives (C/I)	C/I	7.6%	7.1%	10.0%
Smart Construction Incentives	C/I	7.6%	7.1%	10.0%
Smart Multi-Family Solutions (Nonresidential)	C/I	7.6%	7.1%	10.0%
Smart On-Site	C/I	7.6%	7.1%	10.0%
Smart Equipment Incentives (GNI)	GNI	7.6%	7.1%	10.5%

NOTES
[a] PECO's PY6 annual report shows line losses as a multiplier. SWE has converted to an LLF for consistency in reporting across EDCs.

PECO's TRC model assigned an EUL to each measure listed in the TRC model. The PA TRM is provided as the direct source for a large majority of the measures. For the remaining measures, measure lives were typically cited from the PECO EE&C plan. The SWE Team spot-checked the measure lives in the PECO TRC model. While no new inconsistencies were found, the SWE notes that a previous deviation from the TRM identified in the SWE PY6 annual report remains in the PECO PY7 TRC model. "Refrigeration – Floating Head Pressure Controls" is included in Section 3.5.5 of the 2015 TRM with a deemed EUL of 15 years. The PECO TRC model applies a 10-year EUL for the same measure. The SWE recommends that PECO continue to update the TRC model annually to accurately align with the appropriate TRM and prior year SWE recommendations, where applicable.

The model applied incremental costs at the measure level, listing sources clearly in the model. The majority of the values came from the PECO EE&C plan, with supplemental data sourced from the SWE measure cost database and PECO's tracking data. Appendix B of the PECO PY7 annual report provided

detailed cost and source information for instances where the measure costs were not derived from the SWE incremental cost database or the PECO EE&C plan.

The PECO TRC model drew the energy and demand impacts from PECO's tracking database, which used TRM-specified values and equations to assign ex ante annual savings values to completed measures. The TRC model analysis was based on ex post verified savings, and program impacts were adjusted by an applicable realization rate. Navigant determined realization rates at the program level, with separate realization rates applied to energy and demand impacts. The TRC model extends the ex post verified savings over the effective measure life and summed, by year, for each program.

The SWE found small differences in verified energy and demand savings in the PECO TRC model and the verified energy and demand savings by program in program tracking databases and the PY7 annual report. There were small differences between verified energy savings in the PECO TRC and the verified energy savings from program tracking databases in two programs: Smart Home Rebates and Smart Appliance Recycling. Overall, the modeled portfolio energy savings in the TRC model were approximately 200 MWh/yr less than the PY7 verified energy savings from the annual report. For demand savings, there was a 0.6 MW difference between the demand savings for Smart Multi-Family Solutions in the PECO PY7 Annual Report compared to the PECO TRC model. These differences are less than 1% of the total portfolio verified energy savings and have an insignificant impact on the portfolio benefits and TRC ratios.

In PY7, the 2015 TRM instructs EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures but did not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. The PECO TRC model uses an adjusted EUL to account for the dual baseline measures and is consistent with the 2015 PA TRM guidance on the issue of dual baselines.

A.6.2.2 Avoided Cost of Capacity

Consistent with prior Phase II program years, the PY7 PECO TRC models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.6.2.3 Conclusions and Recommendations

The PECO TRC model was transparent, and the SWE observed no significant changes in the TRC model during Phase II. The SWE Team determined that the PECO TRC model provided the requested details regarding the determination of financial benefits from energy and demand impacts. The SWE review determined that there were minor differences (less than 1%) between the modeled energy and demand savings and the verified energy and demand savings in the PY7 annual report.

The SWE Team also requests that PECO use the discount rate approved in its Phase II EE&C plan unless an updated factor was approved through an amended plan filing. Although the difference in TRC ratio at the portfolio level is slight, using a 7.6% discount rate rather than the 7.4% discount rate approved in the PECO EE&C plan lowers the TRC benefits associated with PY7 offerings by approximately $5 million.

A.6.3 Status of Evaluation Activities

This section discusses the status of PECO's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.6.3.1 Status of Evaluation, Measurement, and Verification Plans

This section discusses the status of PECO's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The SWE Evaluation Framework that was applicable for PY6 evaluation plans was the framework finalized and published on June 28, 2013. This framework required each EDC to complete an initial evaluation plan for each program in its portfolio, addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-107 displays key milestones completed by PECO and the SWE for the company's Phase II EM&V Plan.

Table A-107: Key Milestones Reached for PECO's Phase II EM&V Plan

Date	Event
August 30, 2013	PECO submits first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on PECO evaluation plan to PECO
November 7, 2013	PECO submits revised EM&V Plan to the PUC and SWE
November 7, 2013	SWE approves the revised PECO EM&V Plan
June 1, 2014	PY6 starts
January 7, 2015	PECO submits revisions to PECO PY6 EM&V Plans

PECO's initial EM&V Plan, submitted August 30, 2013, detailed proposed evaluation objectives and activities for 15 programs across two sectors. Key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts were presented for each of the 15 programs. After

reviewing the plan, the SWE Team returned 89 comments to PECO. The SWE's substantive recommended revisions to the plan are described in Section 5.3.1 of the SWE's PY5 annual report to the PUC.

The SWE Team reviewed the revisions provided by PECO on November 7, 2013 and approved the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all EM&V activities occurring in PY5.

PECO submitted 11 changes to the evaluation plan for PY6:

1) For the Smart Appliance Recycling program, telephone surveys of secondary market actors were performed as part of the secondary market research.

2) For the Smart AC Saver program, participant surveys and a gross impact load study were moved from PY6 to PY7. Additionally, a new task of exploring NTG was added to the PY7 activities.

3) Four program evaluation tasks for lighting measures and one task for non-lighting measures were added to the evaluation plan for the Smart Home Rebates Program. Project data for this program were not examined from a randomly selected set of records to confirm installations of tracking systems in PY6, but were to be examined in PY7. Two additional evaluation activities were conducted for this program in PY6: a web-based survey instrument and price elasticity modeling on sales data.

4) Three program evaluation tasks were added to the Smart House Call (SHC) Program. The PECO evaluation plan submitted to the SWE before the PY6 program evaluation began provided that "In PY6 and PY7, the evaluation team will analyze the frequency in which participants have subsequently participated in additional Smart Ideas programs." Sampling for SHC was changed from an 85/15 to a 90/10 confidence/precision interval for NTG estimation.

5) The evaluation team eliminated on-site verification as an evaluation activity for the Low-Income Energy Efficiency Program.

6) The evaluation team will no longer assess student awareness of energy efficiency for the Smart Energy Saver Program. The PECO evaluation plan submitted to the SWE before the PY6 program evaluation began provided that "Teachers will now be interviewed by phone in PY6 for this program."

7) Three program evaluation activities were added to the Smart Equipment Incentives Program (C/I and GNI): PECO account representative interviews, distributor/supplier in-depth interviews, and industry-specific representative organization interviews.

8) In the Smart Business Solutions (SBS) Program, PECO's EE&C plan was revised in March 2014 to change program expenditures to $4.4 million from $8.4 million through Phase II. As a result, the total projected energy savings decreased from 43,867 MWh/yr to 37,483 MWh/yr through the end of Phase II.

9) A survey of a sample of program participants was completed in PY5 as planned, and survey results were presented in PECO's PY5 annual report to the PUC. PECO's original evaluation plan called for a survey of non-participants. In PY6 PECO fielded an online survey for partial participants (partial participants received an audit but didn't install measures) and non-participants (refused the audit) to understand their barriers. However, due to changes in program implementation that provided services only to customers requesting to participate, there was no participation in those surveys.

10) Two of the program evaluation tasks for SBS were changed in PY6 from PY5.

11) New tasks were added to PECO's PY6 evaluation plan. Telephone verifications were added as a data-collection method for SBS. A meta-review of similar projects across the country was added as a program evaluation task for PY6 to the Smart Multi-Family (SMF) Solutions Program. The categories for SMF Solutions changed from SMF, SMF – GNI, and SMF – C/I to residential and non-residential. The sample sizes changed along with these changes to the categories. Market research for PY6 was added as a program evaluation task for the Smart On-Site Program.

A.6.3.2 Measurement and Verification Activities and Findings

Table A-108 provides a summary of M&V findings based on activities conducted by Navigant. The summary is based on details provided in PECO's PY7 annual report and on information obtained from the SWE Team's data requests and audits. Table A-108 presents realization rates and relative precision values for verified energy and demand savings for each of PECO's residential and non-residential energy efficiency programs for PY7.

Table A-108: Realization Rates and Relative Precisions for PECO's Programs in PY7

Program	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)
Low-Income Energy Efficiency Program	92%	0%	92%	0%
Smart Appliance Recycling	95%	0%	95%	0%
Smart Builder Rebates	99%	2%	76%	22%
Smart Energy Saver	87%	1%	90%	1%
Smart Home Rebates	122%	4%	136%	4%
Smart House Call	98%	1%	99%	1%
Smart Multi-Family Solutions	90%	3%	180%	3%
Smart Usage Profile	106%	0%	N/A	N/A
Smart Business Solutions	97%	11%	97%	8%
Smart Equipment Incentives - Commercial and Industrial	100%	11%	107%	17%
Smart Construction Incentives	87%	29%	72%	22%
Smart On-Site	87%	0%	86%	0%
Smart Equipment Incentives - Government, Nonprofit and Institutional	99%	7%	104%	6%
Residential Smart AC Saver	0%	N/A	82%	0%
Commercial Smart AC Saver	0%	N/A	18%	0%
NOTES:				

Program [a] At the 85% precision level	Energy Realization Rate	Relative Precision (Energy)	Demand Realization Rate	Relative Precision (Demand)

A.6.3.2.1 Residential Energy Efficiency Programs

Realization rates for PECO's residential programs' energy savings ranged from 87% to 122%. Realization rates for demand reductions from these programs ranged from 76% to 180%. All residential programs met the relative precision requirement established in the Evaluation Framework.

The Smart AC Saver program uses Digital Control Units (DCU's) to control a participant's air conditioning compressor for a pre-determined amount of time during June to September, while allowing the air handler blower to continue to function normally. While Act 129 had no demand target requirements in PY7, PECO maintained the program and achieved a MW reduction of 40.5 MW. Navigant used a per-switch savings calculated from a load study conducted by Comverge in PY5, weather adjusting the results for the PY7 test event days.

For the Smart Appliance Recycling program, Navigant first completed a census review of the residential units in the program tracking database to verify that the reported savings used the correct 2015 TRM deemed savings for recycled refrigerators and freezers. For verified savings, Navigant applied the PY7 appliance characteristics of age, cubic feet, etc. to the TRM UEC equation to get a more accurate UEC estimation for PY7.

Navigant's evaluation of the Smart Builder Rebate program involved desk reviews and whole-building modeling. Desk reviews consisted of a review of REM/Rate models and prescriptive measures for compliance with the 2015 TRM. Through the whole-building modeling, Navigant independently calculated energy and demand savings for project homes.

The Smart Home Rebates program consists of both efficient products and upstream lighting. Navigant completed a census review of the program tracking system by comparing the data to savings calculation algorithms in the TRM. For lighting measures, Navigant performed 530 intercept surveys in PY7 to develop estimates of cross-sector sales. The overall realization rates for the program (across all sectors) were 122% for energy savings and 136% for demand savings.

For the evaluation of the Smart House Call program, Navigant used a census review of implementer invoices and the program tracking system to reconstruct energy and demand savings calculations consistent with the 2015 TRM, conducted phone surveys to verify measure installations, and conducted desk audits of a census of participants to verify the accuracy of the program tracking system. The impact evaluation found and corrected small calculation errors in the tracking system associated with air sealing and LED nightlight measures. The adjusted savings, coupled with installation verification telephone surveys, yielded overall program realization rates of 98% for energy and 99% for demand.

The Smart Energy Saver program, which provides take-home kits to students, was evaluated via student installation surveys. Using this information, Navigant quantified installation rates for each measure and calculated savings for each measure based on the algorithms in the 2015 TRM. Navigant only updated TRM-defined variables based on installation survey data where permitted by the 2015 TRM.

Navigant assessed projects from PECO's Smart Multi-Family Solutions (Residential) Program using a combination of simple file reviews and telephone surveys for a sample of program participants. The evaluation team then conducted on-site visits for a subset of the telephoned sample for enhanced verification. Last, the evaluation team performed a record-by-record review of projects by recalculating the savings estimates using the 2015 TRM guidance.

Finally, the Smart Usage Profile (SUP) program savings were evaluated via billing regression analysis. The program used a randomized control trial (RCT) experimental design, and Navigant estimated program savings through the use of a linear fixed-effect regression analysis. Navigant also investigated the effect of the SUP Program on increasing participation in the other residential energy efficiency programs and netted these savings out of the SUP Program to account for the possibility of double-counting savings.

A.6.3.2.2 Low-Income Energy Efficiency Programs

For LEEP, Navigant conducted a TRM-based engineering review of the program tracking database, coupled with information gathered from telephone survey verifications on a sample of participants, to calculate verified gross savings values. Navigant conducted the simple engineering review using the entire population of projects in the tracking database. Navigant also conducted on-site inspections for 19 projects. They accompanied the CSP on 5 Component 1 comprehensive home ride-along audits and 14 Component 1 follow-up site visits to verify measure installation. In nearly all cases, the onsite activities verified that equipment was installed and in operation.

A.6.3.2.3 Non-Residential Energy Efficiency Programs

Realization rates for PECO's non-residential programs' energy savings ranged from 87% to 100%. Realization rates for demand reductions from these programs ranged from 18% to 107%. The low realization rate of 18% was for the Commercial Smart AC Saver Program. PECO achieved better than the 15% precision requirement for kWh and kW in all of its non-residential programs except for the Smart Construction Incentives (SCI) Program, which had 29% and 22% relative precisions for energy and demand, respectively. This was a result of the evaluation contractor's decision to restratify the population after 10 incomplete projects were discovered in Q4. The SWE agrees that this was the best course of action given the circumstances and notes that, despite this missed target, PECO did achieve Phase II total precisions of 6% and 8% for energy and demand for the SCI Program.

Figure A-21 shows the frequency of each M&V approach performed by Navigant in PY7 for PECO's Smart Equipment Incentives (SEI) Program evaluation sample and the verified energy savings associated with each M&V approach. Navigant used both basic and enhanced levels of rigor to evaluate projects in the sample. Basic rigor includes surveys, desk reviews, and simple on-site verification (no logging). In the 2014 Pennsylvania Evaluation Framework, Basic Rigor Option 1 consists of verification of the number of installations and the selection of the proper deemed savings value from the TRM. Basic Rigor Option 2 consists of verification of appropriate application of the TRM savings algorithms for TRM partially deemed measures using gathered site data that typically are limited to performance specification data and do not need to be measured on-site. Enhanced rigor includes IPMVP Options A, B, C, and D. Option A combines the measurement of key parameters of retrofitted equipment with the use of stipulated values for other measurement parameters. Option B involves more robust measurement of the retrofitted system's continuous energy usage, typically through short-term power metering. Option C consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. Option D involves modeling energy performance of a facility before and after the efficiency measure is installed. The frequencies and savings presented in Figure A-21 include C/I and GNI measures within the SEI Program.

Figure A-21: Frequency of and Associated Energy Savings by M&V Approach – SEI Program

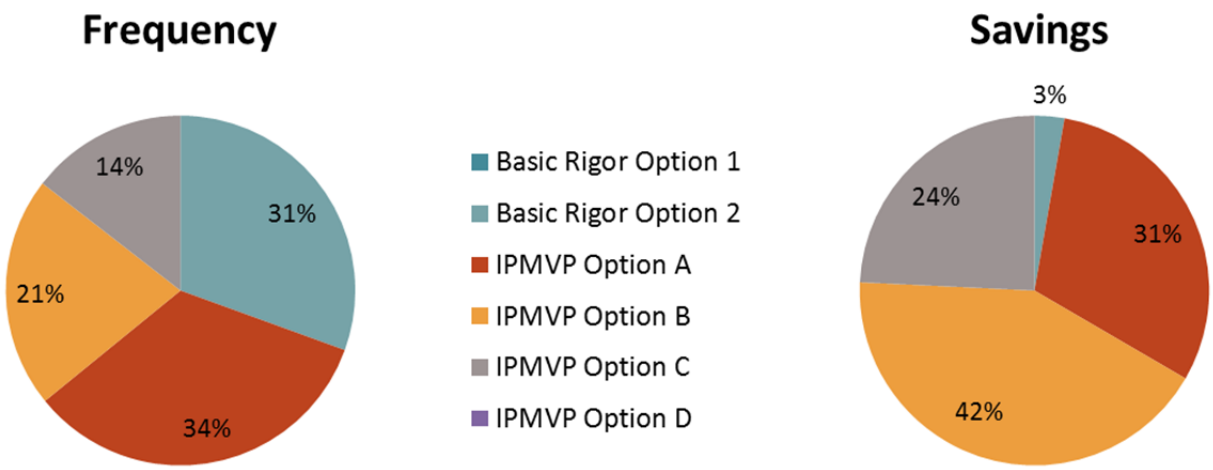
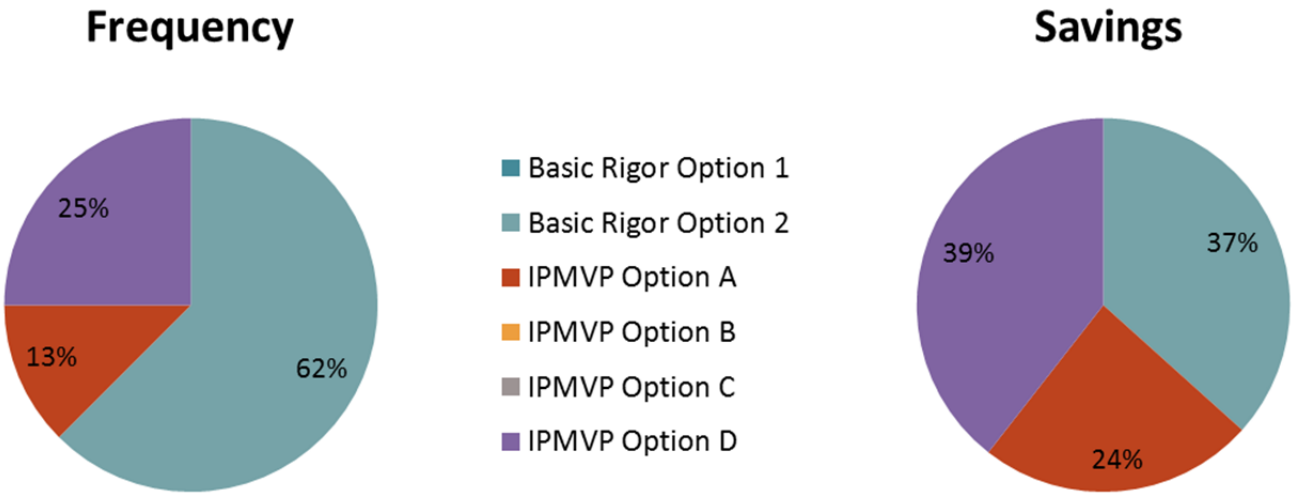


Figure A-21 indicates that 31% of the sampled measures for the SEI Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 3% of the energy savings. This suggests that basic rigor was appropriately used, predominately for measures with smaller savings. Likewise, the more expensive methods were reserved for a smaller number of projects, but these projects contributed a large majority (97%) of the program's energy savings. The SWE Team supports this "value of information" approach, whereby more expensive evaluation techniques are reserved for projects that account for the greatest share of program savings.

Figure A-22 shows the frequency of each M&V method used in the SCI Program and the energy savings associated with each method. Basic rigor was used for a majority of the projects (62%), but these projects accounted for only 37% of the savings. Enhanced rigor was appropriately used for fewer projects, but these accounted for 63% of the savings. Additionally, PECO's annual report noted that Navigant paid close attention to baseline choices, which are not always obvious for new construction measures.

Figure A-22: Frequency of and Associated Energy Savings by M&V Approach – SCI Program



Navigant performed verification on a stratified sample of 13 projects from PECO's Smart Business Solutions (SBS) Program in PY7. Enhanced rigor Option A was used for all projects.
The Smart On-Site (SOS) Program had six projects completed in PY7. All projects were evaluated with enhanced rigor Option B.

Navigant assessed projects from PECO's Smart Multi-Family Solutions Non-Residential Program using file reviews and telephone surveys as the evaluation activity for all projects sampled. Additionally, the evaluation contractor conducted on-site visits for a subset of telephone survey participants for enhanced verification.

A.6.3.3 Process Evaluation Activities and Findings

The process evaluation that Navigant conducted for PECO included a review of key program documents and databases; surveys of participants and nonparticipants; and interviews with utility program staff, implementation staff, and market actors affiliated with the program—although not every program's process evaluation included all of these elements. Table A-109 summarizes the data sources Navigant used and its key findings for each program.

Table A-109: Summary of Key Findings and Data Sources – PECO

Program	Key Findings	Data Sources
Residential Sector		
Smart Home Rebates (SHR)	– Discrepancies existed between reported and verified air conditioner savings due to gaps in program data. – 71% of surveyed customers reported being aware of PECO's LED store discounts in PY7. – 12% of those who bought PECO discounted bulbs were low income; savings from these participants were not claimed as low-income savings. – Increasing LED shelf space corresponded with decreasing CFL shelf space. – Satisfaction with PECO has remained high since PY5. – 71% of HVAC participant respondents learned of the program from contractors, installers, or builders. – Seasonal shifts and scaling back of the program affected smaller HVAC contractor firms more than larger firms.	– Program tracking data – In-store intercept survey (n=530) – Shelf surveys of 17 stores – 11 HVAC installer interviews – HVAC rebate participants (n=100) – Appliance rebate participants (n=100) – Interview with program manager and implementer
Smart House Call (SHC)	– Participant satisfaction was high in PY7. – Participants did not commonly cite being referred to other PECO programs for which they may be eligible. – Participants generally scheduled an audit once they learned of the program. – Participants heard of the program via bill inserts, mailers, and word of mouth. – Limited-time discount offers by PECO were successful in increasing customer participation.	– Program tracking data – Participant survey (n=130) – Interview with program manager and implementer
Smart Appliance Recycling (SAR)	– JACO's bankruptcy was likely responsible for SAR failing to reach its PY7 and Phase II energy savings goals. – JACO's closure interfered with the delivery of rebates. – Program satisfaction among customers who were affected by the JACO closure dropped, but this had a minor impact on overall program satisfaction.	– PY7 Q1–Q4 tracking data – Participant survey (n=130) – Interview with program manager

Program	Key Findings	Data Sources
Smart Usage Profile (SUP)	– Program savings will likely increase in Phase III since more households will receive HERs in Phase III. – SUP participants were successfully channeled into the SHC program. – Relatively few household characteristics specific to each customer were used to tailor program messaging or reports. – A low percentage of customers received electronic HERs; those who did had a lower rate of customer complaints and a higher rate of customer engagement.	– Program tracking data – Interview with program manager and implementer
Smart Energy Saver (SES)	– TRM assumed that kit nightlights were replacing existing nightlights; in two-thirds of cases the kit nightlights did not replace existing nightlights. – SES implementation deviated from the plan; more than half of student installation surveys were filled out in the classroom rather than at home, and not all unused kits made it back to the program.	– Program tracking data – Returned student installation surveys
Smart Builder Rebates (SBR)	– All interviewed builders were satisfied with the rater and program implementation staff; builders reported lower satisfaction with marketing and training assistance. – It took an average of 131 days for builders to receive incentive; prompt payment of the incentive was a high priority for builders. – Additional cost and lack of educated HVAC contractors were the key challenges for builders when building ENERGY STAR (ES) homes. – 84% of the homes built by interviewed builders received a rebate via the program; thus there was little room for increasing ES home market penetration among existing participating builders. – PY7 ES home market penetration ranged from 1% to 14% across counties in PECO territory. – Implementer outreach efforts suggest that incentives for ES homes are not sufficient to overcome cost barriers to participation.	– Program tracking data – Interview with program manager and implementer – 7 interviews with participating builders
Smart AC Saver (SACS) – Residential	– Evaluation contractor received Insufficient AMI data for the level of impact analysis needed in PY8 and beyond. – Over 90% of surveyed participants were satisfied with the program. – Participants generally are not aware of events. – One-third of surveyed participants noted they would not participate if the incentives were cut by half. Note that prior participants also reported unwillingness to accept a lower incentive; yet when the incentive was cut from $120 to $80 per summer, very few participants dropped out of the program.	– Program tracking data – Participant survey (n=70) – Interview with program manager
Smart Multi-Family Solutions (SMF) – Residential	– Free-ridership in PY7 increased over PY6 (from 0.25 to 0.43 in the residential sector). – Most participants (71%) were contacted about the program by the implementer. – The majority of landlords were not aware of or able to	– Program tracking data – Participant survey (n=48) – Interview with program manager and implementer

Program	Key Findings	Data Sources
	recall offerings through the program's prescriptive channel. – 50% of participating landlords recalled receiving an audit report, and of those, 25% reported that the program representative did not review the report with them. – Participants were satisfied with the program.	
Low-Income Sector		
Low-Income Energy Efficiency (LEEP)	– The majority of participants (89%) were satisfied with the program. – CFL socket saturation increased in the low-income community. – The educational materials provided to participants did not have a clear call to action. Additionally, more than half of Component 3 survey respondents reported not receiving or not remembering receiving the materials. – Defining customers through the CAP rate tariff (applies to Components 1 and 2) has the potential to miss eligible participants. – The majority of LEEP customers (55%) were served through Component 3 (free CFL giveaways).	– Program tracking data – Participant survey (n=90) – 19 site visits – Interview with program manager and implementer
Non-Residential Sector		
Smart AC Saver (SACS) – Commercial	– Same findings as reported for SACS - Residential above	– Program tracking data – Participant survey (n=70) – Interview with program manager
Smart Equipment Incentives (SEI)	– Trade allies reported that the trade ally incentive (introduced in PY6) encouraged them to deliver more projects through the program. – Program succeeded at reducing the percentage of lighting projects from PY5 to PY7. – Interviews and survey responses indicated that in some cases PY7 incentives barely covered the cost of the engineering requirements in the rebate application. – The "limited time offer" marketing campaign brought in more projects in February and March than in May and June.	– Program tracking data – Participant online survey (n=86: 51 C/I, 35 GNI) – Interview with program manager and implementer – 7 trade ally interviews
Smart Construction Incentives (SCI)	– There were several incomplete projects due to: (1) the overzealous pursuit of projects by the implementer, despite tight deadlines; (2) empathy for customers rushing to be included in Phase II; (3) implementer confusion about TRM rules for completion and occupancy; and (4) ambiguous language in the program application about certificates of occupancy. – Energy savings realization rates dropped from over 112% (had the buildings been fully complete and occupied) to 87%. – The post-installation inspection reports (which would have alerted staff of a project's completion status) were often not reviewed in detail by program and implementation staff. – The program improved in PY7 due to the program's PY6 efforts to identify and requalify committed trade allies. – The new construction projects in the program have long lead times.	– Program tracking data – On-site visits (n=43) – Interview with program manager and implementer

Program	Key Findings	Data Sources
	– Over 75% of portfolio savings are coming from either lighting or custom projects. The majority of savings from custom projects come from lighting measures.	
Smart Multifamily Solutions (SMF) – Commercial	– Same findings as reported for SMF – Residential above	– Program tracking data – Participant survey (n=24) – Interview with program manager and implementer
Smart On-Site (SOS)	– 17% of the Phase II MWh savings goal was completed in the last two days of the phase, and projects making up 7% of the Phase II MWh goal did not get completed during the phase. – Projects that did not finish took between 15 and 28 months from the time of application to completion, making it difficult for PECO to react to any need to adjust its plan to meet the portfolio savings goals. – Developers unanimously oppose restrictions on participation based on system size and Phase deadline. – One developer suggested that the move toward containerized systems for systems as large as 1.5 MW can shorten the development cycle. Further analysis of program data revealed that containerized systems did not complete faster than two traditional projects completed in PY5. – All developers pointed to obtaining an operating permit from the Pennsylvania Dept. of Environmental Protection as the source of considerable delay and uncertainty. – Three developers said they had issues with the interconnection agreement. – Some participants noted issues with customer service, including responsiveness and consistency of messages.	– Program tracking data – Interview with program manager and implementer – Interviews with all participants and project developers (n=6)
Smart Business Solutions (SBS)	– Program fell short of the Phase II objectives by about 15% and overspent the budget by about $1 million. – The program was able to ramp up and down easily. – Linear fluorescent upgrades of T12s to T8 and T5s accounted for 76% of program savings. The TRM in Phase III will shift the baseline for linear fluorescent upgrades from T12s to T8s, drastically reducing the amount of savings PECO can claim for T12 upgrades. – There may be a missed opportunity for PECO to offer customers a more comprehensive approach to energy savings. On-site visits offer the sales auditor an opportunity to review and propose more efficiency options than those incentivized through SBS.	– Program tracking data – Interview with program manager and implementer

A.6.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of PECO's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.6.4.1 Residential Program Audit Summary

A.6.4.1.1 Smart saver AC – Residential

For this audit effort, the SWE Team verified the analysis used to determine the combined demand savings and its alignment with PECO's evaluation plan. The SWE Team verified that the deemed savings approach was reasonable and applied correctly to the number of DCU's receiving signals. Further, the SWE Team reviewed the applicability of the CSP research and found that Navigant's adjustments to the total MW reported for PY7 is an accurate representation of verified savings for the program.

A.6.4.1.2 Smart Appliance Recycling

The SWE Team performed a review of reported and verified gross energy and demand savings for recycled refrigerators and freezers. The SWE confirmed the appropriate use of 2015 TRM deemed savings estimates for the reported savings as well accurate use of the regression coefficients and the UEC factors calculated in the derivation of verified gross savings.

A.6.4.1.3 Smart Builder Rebates

The SWE Team reviewed Navigant's use of the 2015 TRM algorithms for calculating energy and demand savings for lighting. The SWE Team noted that the evaluator-verified savings for all Q1 and Q2 new homes appeared to use an ISR, interactive effect, and CF that are inconsistent with those in the 2015 TRM. The program evaluator confirmed that all Q1 and Q2 new homes were permitted during PY5 and therefore should comply with the 2013 TRM. The SWE confirmed that all Q1 and Q2 lighting algorithms are consistent with the 2013 TRM but recommends that the evaluator include the permitted date in future Smart Builder program data responses to the SWE. There were no Q3 new homes, and all calculated savings in PY6 correctly align with the 2014 TRM.

Savings for non-lighting measures were estimated using hourly energy simulation models. The SWE Team verified that the non-lighting component of the Smart Builder Rebates Program was evaluated according to PECO's evaluation plan and that the realization rates determined by the evaluation contractor from the independent modeling had been correctly applied to the ex ante savings. The SWE used the REM/Rate files from the evaluation sample and confirmed that the reported and verified savings were reasonable by creating independent building energy simulation models using the BeOpt software.

The SWE believes Navigant's approach to estimating verified energy and demand savings to be reasonable and accurate.

A.6.4.1.4 Smart Energy Saver

This program provides school-based energy efficiency education and take-home energy efficiency kits that include low-cost items to install at home. For the initial verification effort, the SWE Team verified that the program evaluation activities were consistent with PECO's evaluation plan. Navigant used a combination of database review and installation surveys to calculate verified gross savings.

The SWE Team verified that, for each measure type, savings were properly calculated and aligned with TRM savings and algorithms. The SWE Team also reviewed the survey data files and confirmed the calculation of ISRs for the various technologies, where appropriate.

The SWE believes Navigant's approach to estimating verified energy and demand savings to be reasonable.

A.6.4.1.5 Smart Home Rebates

PECO's Smart Home Rebates (SHR) Program includes both an upstream lighting component and rebates for energy efficient HVAC equipment and other household appliances.

For the upstream lighting component of the program, the SWE Team reviewed the database and tracking system to verify that PECO was using the appropriate savings values and algorithms from the 2015 TRM. As Navigant had performed a census audit of the lighting database, following almost the exact routine that the SWE Team follows for the annual-based audit, the SWE Team selected a small subsample of the tracking system records to confirm proper assignment of baseline wattage and efficient wattage. The SWE found no discrepancies and believes Navigant and PECO correctly compared baseline and efficient wattages based on the bulb lumens and the 2015 TRM guidance tables. The SWE also confirmed the appropriate use of 2014 TRM algorithms for both residential and cross-sector sales bulbs. The TRM allows EDCs to gather EDC-specific data with regard to bulb and HVAC interactive effects, and Navigant applied interactive effects factors specific to PECO's service territory based on interactive effects modeling that the Navigant team conducted as part of the PY4 Smart Lighting Discounts evaluation.

For the rebated equipment subsection of the SHR Program, the SWE Team reviewed the data tracking system as well as the desk reviews completed by Navigant. The SWE Team confirmed that PECO's tracking system was using the correct 2014 TRM deemed savings values or savings algorithm calculations, where appropriate, to calculate the verified energy and demand saving, with one exception. In the PY5 SWE annual report, the SWE Team noted that "For fuel-switching measures, the 2013 TRM algorithm requires the electric savings to be calculated using the heating capacity of the electric system being replaced. Instead, it appears PECO has used the capacity of the gas unit being installed, which is often two times (2x) greater than the electric system." The savings attributed to fuel switching in PY6 appears to continue to be calculated based on the heating capacity of the gas unit being installed rather than the heating capacity of the removed electric system. Similar to in PY5, the SWE again noted that although the overall impact of this modification is significant at the individual project level, fuel-switching savings continues to be small relative to the program and portfolio as a whole.

Overall, the SWE believes Navigant's approach to estimating verified energy and demand savings to be reasonable, with the small exception of the fuel-switching measures.

Last, the SWE Team continues to recommend that PECO use its evaluated cross-sector sales adjustment in the future calculation of reported savings in order to allow for more accuracy in reported savings, and to reduce variation between reported and verified savings. Although not a specific requirement for reported savings, EDCs should use the best available data on cross-sector sales at the time of their quarterly and annual reports. PECO had previously conducted cross-sector sales research in PY5 but did not incorporate these findings in its calculation of reported gross savings.

A.6.4.1.6 Smart House Call

PECO's SHC Program focuses on the direct installation of energy efficiency measures in participants' homes as well as further rebate opportunities for additional HVAC and building shell measures. For PY7, the SWE Team confirmed that each unique measure in the program tracking database used the correct

2015 TRM algorithm or approved IMP. The SWE Team agrees with the calculation of gross verified savings for this program.

During the review, the SWE noted that the tracking system database had, for the air source heat pump (ASHP) maintenance measure, populated SEER_e and HSPF_e data fields. While these fields are not applicable to the ASHP maintenance measure, the SWE posits that the collected data may represent the existing efficiency of the HVAC equipment and was populated as an incorrect data field. Given PECO's preference to use EDC-specific values for other TRM variables in the SHC Program, the SWE recommends that the existing equipment efficiency for the ASHP maintenance measure be collected and tracked accordingly in the database. In the interim the SWE agrees with the use of the deemed value from the 2015 TRM as reasonable.

The SWE Team reviewed the results of Navigant's records review and phone survey on a sample of participants, and found an incorrect calculation of the realization for the records review and phone survey. The SWE Team coordinated with the evaluator to recalculate the verified energy and demand totals. The corrected verified energy and demand savings are 2,852 MWh/yr and 0.412 MW, respectively. These corrections change the PY6 portfolio verified gross energy savings by less than 1%.

A.6.4.1.7 Smart Multi-Family Solutions (Residential)

For the residential component of the Smart Multi-Family Solution program, the SWE reviewed the quarterly database of customers, projects, and measures and confirmed the accurate use of the 2015 TRM for lighting and low-flow devices. Next the SWE reviewed the calculation of ISRs from the telephone survey and on-site verification efforts from eight projects and affirmed the correct application of the sample realization rate to the program's population. The SWE notes that the on-site verification data logs are detailed, clean, and easy to follow.

The SWE agrees with the calculation of gross verified savings for this program.

A.6.4.1.8 Smart Usage Profile

The SWE Team confirmed that the billing analysis followed PECO's program evaluation plan and the Pennsylvania Mass Market protocol. The SWE Team also reviewed the billing analysis output, equations, and statistics and confirmed that the approach is sound and the conclusions reasonable. Program savings were estimated using a linear fixed-effects regression (LFER) analysis. To evaluate the robustness of the savings estimates, PECO also estimated SUP program savings using a post-only model, referred to by Navigant in PECO's PY7 annual report as a post-program regression model. This approach is one used by Allcott and Rogers. The SWE reviewed the alternative models and concluded that the secondary analysis produced savings estimates that are statistically equivalent with the LFER approach.

PECO performed a difference-in-difference (DID) analysis to estimate the potential for double-counting of SUP effects versus effects from other residential programs. Estimated savings that could be attributed to SUP and another PECO program were subtracted from the reported savings for the SUP program. The SWE reviewed the DID approach and results and concluded that the approach is reasonable and that PECO appropriately nets out savings that can be attributed to other programs.

The SWE Team agrees with PECO's verified gross savings findings for SUP.

A.6.4.2 Low-Income Program and Audit Summary

The SWE Team confirmed that all four components of PECO's LEEP were evaluated consistently with the approaches in PECO's Phase II evaluation plan. The SWE Team reviewed the calculated savings for each measure type in the LEEP to ensure accuracy and consistency with the 2015 TRM. The SWE Team found that the tracking database had accurate data fields and that the algorithms were in general agreement with the TRM.

Navigant provided the SWE Team with a sample of project supporting data. The SWE Team reviewed these files and found no inconsistencies with their application in the determination of gross savings.

Last, the SWE Team verified that PECO was in compliance with the Act 129 requirement for the number of energy conservation measures offered to low-income households. PECO offered 19 measures to the low-income sector in PY7, which was 17% of the total number of measures offered across all sectors, compared with its Act 129 compliance target of 8.8%.

The SWE believes Navigant's approach to estimating verified energy and demand savings for LEEP to be reasonable.

A.6.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were being performed in accordance with the applicable TRM, or by some other reasonable methodology. During PY7, the SWE Team reviewed project documentation from PECO's Smart Equipment Incentives, Smart Construction Rebates, Smart Business Solutions, and Smart Multifamily programs. Several projects were selected from each quarter within each program, for a total of 21 projects. For the most part, PECO's project documentation was complete, well organized, and clearly labeled. Only one small inconsistency in kWh (<0.5%) was found between a single project file and the tracking database. The details of the review can be found below.

The SWE Team reviewed PECO's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-110, showing relative precision at the 85% confidence level.

Table A-110: Compliance across Sample Designs for PECO's PY7 Non-Residential Program Groups

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Smart Equipment Incentives (C/I)	11%	17%	✓
Smart Construction Incentives	29%	22%	✗
Small Business Solutions	11%	8%	✓
Smart Multi-Family Solutions – Non-residential	4%	4%	✓
Smart Equipment Incentives (GNI)	7%	6%	✓

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Smart On-Site (SOS)	0%	0%	✓

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups except SCI in PY7. Navigant was forced to modify its initial sampling approach for SCI due to issues with several Q4 projects. Details about each program evaluation sample are provided below.

As part of the audit process, the SWE Team performed 10 ride-along site inspections of non-residential projects to observe PECO's on-site evaluation practices. The projects selected for ride-along inspection encompassed lighting, chiller, and motor upgrades and HVAC occupancy sensors. The SWE Team approved all 10 sampled projects and had no further recommendations. Details of all 10 projects and their associated findings are presented below.

The SWE Team performed a verified savings analysis on six submitted projects, checking the accuracy of the calculations and the appropriateness of the evaluation method and level of rigor. The SWE Team was generally pleased with the orderliness of the project files and reports and the level of rigor used in the evaluations. However, there was one discrepancy between the verified savings reported in the site-level report for one project and the verified savings reported in the tracking system. The detailed results of the verified savings analysis are provided below.

A.6.4.3.1 Project Files Review

During PY7, the SWE Team reviewed project documentation from PECO's Smart Equipment Incentives (SEI), Smart Construction Incentives (SCI), Smart Business Solutions (SBS), and Smart Multifamily (SMF) programs. Several projects were selected from each quarter within each program, for a total of 21 projects. For the most part, PECO's project documentation was complete, well organized, and clearly labeled.

Table A-111 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-111: PECO PY7 Project Files Review

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q1	PECO-15-07164	SEI GNI	T12 to T8 retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PECO-15-07757	SEI GNI	LED streetlight retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PECO-15-08680	SEI GNI	Lighting retrofit (CFL and inc. to LED)	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PECO-16-09043	SEI GNI	PC Power management (x 161 computers)	Yes	Yes	No	Yes	Yes	N/A
PY7Q4	PECO-15-08917	SEI GNI	Lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PECO-15-07395	SEI C/I	EMS system installation (automated logic)	Yes	Yes	No	Yes	N/A	Yes
PY7Q1	PECO-15-07810	SEI C/I	Corridor and exterior 8760 light LED retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PECO-14-06855	SEI C/I	Lighting retrofit (T8 to HPT8)	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PECO-15-08636	SEI C/I	Lighting retrofit (T8 to LED and MH to LED)	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PECO-14-06367	SCI	New construction lighting	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PECO-14-06932	SCI	New construction lighting LED, and HVAC RTU	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PECO-14-06473	SCI	New construction lighting	Yes	Yes	No	Yes	Yes	N/A

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q2	PECO-15-07122	SCI	New construction lighting, ASHP, and AC	Yes	Yes	No	Yes	Yes	N/A
PY7Q4	PECO-14-06279	SCI	Custom HVAC (row-based data center cooling)	Yes	Yes	No	Yes	N/A	Yes
PY7Q4	PECO-15-08974	SCI	HVAC (efficient RTUs)	Yes	Yes	No	Yes	Yes	N/A
PY7Q4	PECO-16-09572	SCI	Custom (LEED new construction)	Yes	Yes	No	Yes	N/A	Yes
PY7Q1	2484	SBS	Lighting retrofit	Yes	No: 14,865 kWh in calculator and 14,925 kWh in tracker	No	Yes	Yes	N/A
PY7Q1	2868	SBS	Lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PECO-14-06473	SCI	New construction lighting	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PECO-15-07122	SCI	New construction lighting, ASHP, and AC	Yes	Yes	No	Yes	Yes	N/A
PY7Q4	PECO-13-05362	SOS	CHP	Yes	Yes	No	Yes	N/A	Yes

The only issue encountered in the SWE's PY7 project file reviews was an inconsistency between the kWh savings in the Appendix C calculator and the tracking database for project number 2484 in the SBS Program. The calculator records that 14,865 kWh were saved, but the database records 14,925 kWh. After discussion with Navigant, they found this same discrepancy in their evaluation of the program and confirmed the savings recorded in the database is the correct value. They stated that this is likely due to the file containing a preliminary calculation of savings versus the database recording the final ex ante savings per the TRM.

A.6.4.3.2 Sample Design Review

PECO's PY7 annual report provided detailed information about the sample design for the PY7 gross impact evaluation of non-residential programs: SEI (C/I), SEI (GNI), SCI, SBS, SMFS – Non-Residential, and SOS. The following sections summarize the sampling approaches used by Navigant to develop verified savings estimates, as well as the SWE Team's audit of the approach.

A.6.4.3.2.1 Smart Equipment Incentives Program – C/I

This program was launched in Phase I and has been continued in Phase II. The sample designed by Navigant was aimed at exceeding the required 85%/15% confidence/precision at the program level and used a similar method as in PY5 and PY6. However, based on PY6 and PY5 evaluations where a Cv of 0.5 was assumed for all strata, Navigant assumed a Cv of 0.4 for the large stratum, 0.5 for the medium stratum, and 0.7 for the small stratum. Additionally, Navigant followed the SWE Team's request to design the sample to exceed 90/10 and included extra sites in the analysis. This was requested to ensure a program total of 85/15, which was not achieved in PY5. As it did in PY5 and PY6, Navigant used stratified ratio estimation to produce verified savings for the SEI Program. Based on participation data, the strata boundaries were defined as follows:

- Stratum 1 - large stratum: top 33% of reported kWh savings
- Stratum 2 - medium stratum: middle 33% of reported kWh savings
- Stratum 3 - small stratum: lower 33% of reported kWh savings

Navigant drew samples in three stages: after Q2, after Q3, and after Q4. Both Q1 and Q2 data were used at the first stage of sampling. Finally, Navigant used the pool of all projects as the population, and sampled only from the projects that represented the top 98% of aggregate program savings. Navigant stated that the projects representing the bottom 2% of aggregate program savings did not represent the entire population, so it did not sample from them. The sampling strategy for the SEI C/I Program is shown in Table A-112.

Table A-112: PECO's PY7 Sample Design Strategy – SEI C/I Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large	16	85%/15%	11	11
Medium	84	85%/15%	24	31
Small	1,229	85%/15%	32	32
Program Total	**1,329**	**85%/15%**	**67**	**74**

The achieved precision values at the 85% confidence level for both energy and peak demand are shown in Table A-113.

Table A-113: Observed Coefficients of Variation and Relative Precisions – PECO's SEI C/I Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Large	0.90	24%	1.18	31%
Medium	1.40	30%	1.56	33%
Small	0.34	9%	1.02	26%
Program Total		**11%**		**17%**

In PY5 audit activities, the SWE Team found that PECO failed to meet the requirements of +/–15% precision at the 85% confidence level for both peak demand and energy savings. The achieved precision for savings and demand were about 15.7% and 15.1%, respectively, at the 85% confidence level. In PY6, however, PECO made vast improvement in precision for energy and appropriate improvement for peak demand. This continued in PY7, with an achievement of 11% for energy and 17% for demand. Only targets for energy need to be met in Phase II.

A.6.4.3.2.2 Smart Equipment Incentives Program – GNI

Similar to the SEI C/I Program, this program was launched in Phase I and has been continued in Phase II. Navigant used stratified ratio estimation to develop verified savings for the program. The projects were stratified into four groups: large, medium, small, and municipal lighting. Based on PY6 and PY5 evaluations where a Cv of 0.5 was assumed for all strata, Navigant assumed a Cv of 0.4 for the large stratum, 0.5 for the medium stratum, 0.7 for the small stratum, and 0.3 for municipal lighting projects. The sampling strategy for the PY7 SEI GNI Program is presented in Table A-114. In each of the three stages—after Q2, Q3, and Q4—samples were pulled and the sample design was reviewed and adjusted to make sure it would achieve the targeted confidence/precision levels. Finally, samples were selected only from projects that represented the top 98% of overall program savings.

Table A-114: PECO's PY7 Sampling Strategy – SEI GNI Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large	7	85%/15%	7	7
Medium	65	85%/15%	14	32
Small	371	85%/15%	14	14
Municipal lighting	27	85%/15%	4	5
Program Total	**470**	**85%/15%**	**39**	**58**

The achieved precision values for both energy and demand are listed in Table A-115. The results show that the samples represented the population in this program effectively and that the precision target was met.

Table A-115: Observed Coefficients of Variation and Relative Precisions – PECO's SEI GNI Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Large	0.10	0%	0.19	0%
Medium	0.20	4%	0.71	13%
Small	0.84	34%	0.50	21%
Municipal lighting	0.00	0%	N/A	0%
Program Total		**7%**		**6%**

A.6.4.3.2.3 Smart Construction Incentives Program

The sample design for this program used a stratified random sampling approach at the project level. Samples were pulled from the population of program participants in the program-tracking database. Navigant was forced to modify its initial sampling approach due to issues with several Q4 projects. According to PECO's PY7 annual report, "While conducting site visits on several Q4 projects, Navigant found that five of 10 visited sites were either not fully complete or not fully occupied, despite having passed the TRM-mandated deadline for completion and occupancy to be counted towards Phase II… Navigant determined that the best course of action for extrapolating the realization rates related to this finding to the entire PY7 population would be to create separate strata for Q4 and dead-zone (DZ) projects, as project incompletion was not an issue in any of the visited Q1, Q2, or Q3 sites. DZ projects are those that were completed in Q4, but too late to be included in the standard final program quarterly data extract for sampling." The modified sampling strategy used in PY7 for this program is shown in Table A-116.

Table A-116: PECO's PY7 Sampling Strategy – SCI Program

Stratum	Population	Target Levels of Confidence & Precision (before breaking out DZ)	Target Sample Size (before breaking out DZ)	Achieved Sample Size
Large Q1–Q3	13	85%/15%	11	7
Large Q4–DZ	13			3
Small Q1–Q3	80	85%/15%	13	8
Small Q4–DZ	62			5
Large whole-building Q1–Q3	7	85%/15%	4	5
Large whole-building Q4–DZ	4			2
Small whole-building Q1–Q3	3	85%/15%	2	2
Program Total	**182**	**85%/15%**	**30**	**32**

The achieved precision values for energy and demand are presented in Table A-117.

Table A-117: Observed Coefficients of Variation and Relative Precisions – PECO's SCI Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Large Q1–Q3	0.55	23%	0.46	19%
Large Q4–DZ	1.03	118%	0.72	83%
Small Q1–Q3	0.32	17%	0.29	16%
Small Q4–DZ	0.36	28%	0.46	35%
Large whole-building Q1–Q3	0.36	15%	0.45	19%
Large whole-building Q4–DZ	0.76	159%	0.61	127%
Small whole-building Q1–Q3	0.00	0%	0.46	78%
Program Total		**29%**		**22%**

The adjustments made to the sampling strategy were not sufficient to exceed the SWE Team requirements of confidence/precision levels as specified in the Evaluation Framework. The SWE inquired with PECO as to what the results would be if the evaluator had adhered to the original sampling strategy and was provided the alternative coefficients of variation and relative precision seen in Table A-118. The SWE approves the modified sampling approach used by PECO.

Table A-118: Observed Coefficients of Variation and Relative Precisions – PECO's SCI Program (Original Sampling Approach, Results Not Used)

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Large	1.07	42%	0.91	36%
Small	0.36	15%	0.48	19%
Large Whole Building	0.51	19%	0.56	21%
Small Whole Building	0.00	0%	0.46	78%
Program Total		**20%**		**19%**

A.6.4.3.2.4 Smart Business Solutions Program

The SBS Program was launched in PY5. The participant sample design is at the project level. The method used was stratified random sampling, with samples being pulled from the population of participants in

the PY6 tracking database. There were fewer projects in PY7 due to cost overruns in PY6, and about 3% were GNI projects. The lower project count allowed for stratification of only two groups instead of the four used in prior years. The details of the sampling strategy for this program are shown in Table A-119.

Table A-119: PECO's PY7 Sampling Strategy – SBS Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large	42	85%/60%	11	7
Small	147	85%/60%	5	6
Program Total	**189**	**85%/15%**	**16**	**13**

The achieved precision values for energy and demand are presented in Table A-120.

Table A-120: Observed Coefficients of Variation and Relative Precisions – PECO SBS Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Large	0.23	13%	0.16	9%
Small	0.29	20%	0.19	13%
Program Total		**11%**		**8%**

The program total achieved precision was 11% for energy and 8% for demand, both of which exceed the SWE Team requirements for confidence/precision as specified in the Evaluation Framework.

A.6.4.3.2.5 Smart Multi-Family Solutions Program – Non-Residential

This program was new for Phase II. Stratified ratio estimation was used to estimate savings for the program, and the sample was designed accordingly. The projects were stratified into two groups: medium/large and small. The stratification was based on the ex ante kWh savings recorded in the program-tracking database. Table A-121 lists the details of the sampling strategy for this program in PY7.

Table A-121: PECO's PY7 Sampling Strategy - SMF Non-Residential Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Non-residential Participants	122	85%/15%	24	24

The achieved precision levels for both energy and peak demand are shown in Table A-122. The results show that the samples represented the population in this program effectively and that the precision target was met.

Table A-122: Observed Coefficients of Variation and Relative Precisions – PECO's SMF Non-Residential Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Small	0.23	7%	0.23	7%
Medium/large	0.10	5%	0.10	5%
Participant Total	**0.16**	**4%**	**0.16**	**4%**

A.6.4.3.2.6 Smart On-Site Program

All six projects completed in PY7 were sampled for evaluation, resulting in relative precisions of 0% for both energy and demand. Table A-123 lists the details of the sampling strategy for this program in PY7.

Table A-123: PECO's PY7 Sampling Strategy – Smart On-Site Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
All	6	85%/15%	6	6

The achieved precision levels for both energy and peak demand are shown in Table A-124. The results show that the samples represented the population in this program effectively and that the precision target was met.

Table A-124: Observed Coefficients of Variation and Relative Precisions – PECO's SOS Program

Stratum	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (Cv) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
All	0.23	0%	0.26	0%
Program Total	**0.23**	**0%**	**0.26**	**0%**

A.6.4.3.3 Ride-Along Site Inspections

Table A-125 summarizes the SWE Team's PY7 ride-along site inspections of PECO non-residential project installations. For PY7, all PECO PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluation contractor savings calculations or reports.

Table A-125: PECO's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PECO-14-06375	HVAC	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-14-06458	HVAC	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-14-06778	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-14-06963	HVAC	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-15-08208	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-15-07120	Lighting	Minor variations in the fixture counts were discovered on-site.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
PECO-13-05437	HVAC (chillers)	Equipment discovered on-site did not match the application; additional lighting project was discovered.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
PECO-15-07594	HVAC, lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PECO-14-06805	Recommissioning HVAC	The operating hours and VFD settings were found to be different on-site.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
PECO-15-08497	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.

A.6.4.3.4 Verified Savings Review

The SWE Team requested a subset of Navigant's sample for review. Table A-126 shows the energy and demand savings for the projects chosen for SWE Team review, as well as the M&V method selected for each project evaluation. The SWE Team was generally pleased with the orderliness of the project files and reports and the level of rigor used in the evaluations. However, there was one discrepancy between the verified savings reported in the site-level report for project number PECO-15-08298 and the verified savings reported in the tracking system.

Table A-126: Verified Savings and M&V Methods for SWE Team–Sampled PECO Projects

Program	Stratum	Project Number	Verified Energy Savings (kWh)	Verified Demand Savings (kW)	M&V Method
SEI	C/I – large	PECO-15-08298	208,641	18.00	Enhanced rigor option 3: billing regression analysis
SEI	C/I – medium	PECO-14-06363	676,160	56.10	Enhanced rigor option 2: retrofit isolation engineering models
SEI	C/I – medium	PECO-15-07770	439,199	34.10	Enhanced rigor option 1: simple engineering model with measurement
SCI	Large – Q1–Q3	PECO-15-07437	1,571,972	191.86	IPMVP Option A
SCI	Large whole-building – Q1–Q3	PECO-14-06642	337,690	41.55	IPMVP Option D
SOS	All	3	941,823	122.26	IPMVP Option B

Project number PECO 15-08298 involved replacing 152 packaged terminal heat pumps (PTHPs) and installing guest occupancy sensors at a hotel in Philadelphia, PA. Navigant performed a site visit to confirm installation and acquired pre- and post-installation billing data from PECO and used a regression to determine verified savings. The resulting realization rate was 63%. The verified savings listed in the site report are 158,247 kWh and 0 kW, but the tracking system records the verified savings as 208,641 kWh and 18 kW.

Project number PECO-14-06363 involved installing a direct digital HVAC control system and installing VFDs on air handler unit (AHU) supply fan motors in a government building in Norristown, PA. Navigant acquired pre- and post-installation billing data from PECO and used a regression to determine verified savings. The realization rates were 100%.

Project number PECO-15-07770 involved an interior and exterior LED lighting retrofit at a water treatment plant in Levittown, PA. Several fixtures were discovered to still be in storage and not yet installed, which reduced the ex post savings slightly and resulted in realization rates of 95% and 98%, respectively, for energy and demand.

Project number PECO-15-07437 involved a new construction interior and exterior lighting, efficient RTU, anti-sweat heater control, and freezer/cooler electronically commutated motor (ECM) project at a retail store in Warrington, PA. Navigant performed a site inspection and metering to reveal 24/7 operation of interior fixtures and dusk-to-dawn operation of exterior fixtures. The original lighting HOU were based on the much lower grocery default, so the realization rates for energy and demand were 167% and 122%, respectively.

Project number PECO-14-06642 involved a new construction lighting and HVAC project at a government building in Philadelphia, PA. An on-site verification was performed to verify installation of equipment, and trend data were collected from the EMS system. These data were used to update the IPMVP Option D energy simulation model. Savings realization rates were less than 100% for both energy and demand due to the inclusion of exterior lighting savings and an electric heating penalty in ex post savings.

Project 3 involved installing a CHP system at a nursing home in Philadelphia, PA. Navigant performed an on-site inspection to verify installation of equipment and to review the gas train supplying the engine, electric meters, and thermal monitoring equipment to confirm that IPMVP Option B was the appropriate M&V method. Reviewing trend data revealed that the engine had significant downtime due to oversizing of the system. Therefore, ex post energy and demand savings were significantly below the ex ante estimates due to the inclusion of engine downtime hours in the ex post analysis. Realization rates for energy and demand were 48% and 52%, respectively. The SWE agrees with the rigor and approach used in the analysis.

A.6.4.4 Net-to-Gross and Process Evaluation Audit Summary

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in Navigant's PECO PY7 annual report to determine whether they were consistent with the reporting template provided by the SWE. The SWE Team's audit of the process reports also included a review of process-related methods and research activities to determine whether they were consistent with the approved evaluation plan, and a review of the linkage between findings, conclusions, and recommendations.

Overall, the process evaluations were consistent with the PY7 evaluation plan.

The sampling approaches for the process evaluation activities were appropriate. The participant and customer surveys either attempted a census or used a simple or stratified random sampling approach. All samples had enough cases to achieve at least 85/15 confidence/precision per program. Some samples achieved 90/10 confidence/precision per program. For other non-survey research activities—the in-depth interviews with program staff, implementers, or other program actors—the sampling was purposive.

The report provided a comprehensive overview of the process evaluation key findings and recommendations. Two areas could be improved:

- Comparisons between PY7 and PY5 or PY6 data lacked references to the statistical test(s) or variability statistics to determine the significance of the reported differences. The SWE Team recommends reporting this additional level of detail to clarify for the reader that the reported differences were statistically significant.

- The report drew residential program recommendations from key findings rather than from conclusions. The SWE Team recommends connecting findings to conclusions and then to recommendations, to help readers better judge the quality of the recommendations.

The report documents included a summary of methods and findings, a table of recommendations, and a description of whether or not the EDC was implementing or considering the recommendations.

The report generally included sufficient detail for the SWE Team and others to assess the methods, findings, conclusions, and recommendations.

Detailed summaries of the SWE Team's review of the process evaluation by program are in Appendix B.

The remainder of this section summarizes the activities and key findings of the SWE Team's NTG audits of PECO's programs.

Table A-127 summarizes the results of the SWE Team's audit of Navigant's NTG assessment of the PECO programs.

Table A-127: Summary of SWE Team Review of PECO NTG Evaluations

Elements Reviewed in PECO Annual Report	SWE Findings
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Yes, with exceptions noted
NTG method used – the common method or another	Common method
NTG common method applied correctly	Yes

The following subsections present detailed discussions of the SWE Team's NTG audits of PECO's programs in PY7, including a summary of the program-level NTG values that PECO's evaluation contractor reported. The results are provided for residential, low-income, and non-residential programs.

A.6.4.4.1 Residential Programs

Navigant estimated NTGR for Smart Home Rebates (SHR), Smart House Call (SHC), Smart Builder Rebates (SBR), Smart Appliance Recycling (SAR), and Smart Multifamily (SMF) Solutions programs. Navigant did not estimate NTGR for the Smart Usage Profile (SUP) Program, since free-ridership and participant spillover are already incorporated in the impact analysis. Navigant assumed NTGR to be 1.0 for the residential Smart A/C Saver (SACS) Program. For Smart Energy Saver (SES), Navigant did not estimate NTG impacts in PY7 because the program will not continue in Phase III.

Navigant cited using the SWE Team's common approach for estimating NTGR and provided detailed descriptions of the common method, but it did not explain how it combined strata NTG values into program-level estimates. Assessment of Navigant's NTG Excel files confirmed that Navigant used the SWE Team's common approach for NTGR estimation.

Navigant provided the SWE Team with all of its NTG and net savings calculations, together with the raw survey data, in Excel workbooks. In reviewing these Excel workbooks, the SWE Team found that all NTG and net savings Excel calculations were correct. However, the workbooks provided did not include the calculations that combined strata estimates into program-level estimates.

Table A-128 summarizes the SWE Team's review of the NTG activities by program.

Table A-128: Summary of NTG Audit of PECO's Residential Programs

Program	NTG Method	Review Comments
Smart Home Rebates (SHR)	The common method was used.	Navigant used the common approach for NTG but did not explain how it combined strata NTG values into program-level values.
Smart Appliance Recycling (SAR)	The common method was used.	Net savings for various appliance recycling counterfactual scenarios were estimated. Navigant did not explain how it combined strata NTG values into program-level NTGR.
Smart House Call (SHC)	The common method was used.	Navigant used the common approach for NTG but did not explain how it combined strata NTG values into program-level values.
Smart Usage Profile (SUP)	Not estimated; impact analysis accounts for FR and SO.	Navigant did not estimate NTGR, as the randomized control trial (RCT) approach to impact analysis results in net savings.
Smart Energy Saver (SES)	No NTGR estimation in PY7.	Navigant did not estimate NTG in PY7 since this program is being terminated at the end of PY7.
Smart Builder Rebates (SBR)	The common method was used.	Navigant used the common approach for NTG, relying on interviews with participating builders.
Smart A/C Saver (SACS) – Residential	NTGR assumed to be 1.0.	Navigant did not conduct NTG research to determine FR. Navigant assumed that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives the conservation service provider paid them for their load curtailment. This reasonable assumption also was stated in the evaluation plan.
Smart Multi-Family (SMF) Solutions Program	The common method was used.	Navigant used the common approach for NTG but did not explain how it combined strata NTG values into program-level values.

Table A-129 summarizes NTG values from the PECO PY7 annual report.

Table A-129: Summary of NTG Estimates for PECO's Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Smart Home Rebates (SHR)	0.49	0.03	0.54	542
	Smart House Call (SHC)	0.13	0.07	0.94	130
	Smart Builder Rebates (SBR)	0.50	0.00	0.50	7
	Smart Appliance Recycling (SAR)	0.50	0.00	0.50	140
	Smart Multi-Family (SMF) Solutions	0.43	0.01	0.59	48

	Program				
Not calculated	Smart A/C Saver (SACS) – Residential	N/A	N/A	1.0	N/A
	Smart Usage Profile (SUP)	N/A	N/A	N/A	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All samples provided at least 85/15 precision/confidence.

A.6.4.4.2 Low-Income Residential Programs

For the first time in its evaluation history, Navigant estimated NTG for PECO's Low-Income Energy Efficiency Program (LEEP). Navigant reported using the common method to estimate NTG, but did not explain if it used any weighting schemes to calculate NTG at the program level. However, the Excel workbook provided revealed that program NTG was calculated using measure savings weights.

Table A-130 summarizes the SWE Team's review of the low-income NTG activities. The SWE Team found Navigant's description of the NTG methods to be relatively clear and the application of the SWE common methods to be error-free.

Table A-130: Summary of NTG Audit of PECO's Low-Income Program

Program	NTG Method	Review Comments
Low-Income Energy Efficiency Program (LEEP)	The common method was used.	Navigant used the common approach for LEEP NTG but the report did not explain how it combined strata NTG values into program-level values.

Table A-131 shows the NTGR as reported in the PECO PY7 annual report.

Table A-131: Summary of NTG Estimates for PECO's Low-Income Program

Approach	Program	Free-ridership	Spillover	NTGR	Sample Size
Estimated	Low-Income Energy Efficiency Program (LEEP)	0.19	0.00	0.81	90

A.6.4.4.3 Non-Residential Programs

Navigant estimated an NTGR for Smart Equipment Incentives (SEI), Smart On-Site (SOS), and the commercial component of the SMF Solutions Program and assumed NTGR to be 1.0 for the commercial SACS. For the remaining programs Smart Business Solutions (SBS) and Smart Construction Incentives (SCI), Navigant did not estimate NTG impacts in PY7, and instead applied the respective values from either PY5 or PY6.

The SWE Team found Navigant's description of the NTG methods to be detailed and clear, except for how it combined strata NTG results into program-level estimates. Assessment of Navigant's NTG Excel files confirmed that Navigant used the SWE Team's common approach for the SMF Solutions NTGR estimation.

Navigant provided the SWE Team with all of its NTG calculations, together with the raw survey data, in Excel workbooks and additional information on spillover calculations, when requested. In reviewing

these Excel workbooks and additional information, the SWE Team found that all NTG Excel calculations were correct and followed the SWE Team's common method. However, the workbooks provided did not include the calculations that combined strata estimates into program-level estimates.

Table A-132 summarizes the SWE Team's review of the NTG methodology by program. The SWE Team found the application of the SWE common methods to be generally error-free.

Table A-132: Summary of NTG Audit of PECO's Non-Residential Programs

Program	NTG Method	Review Comments
Smart Equipment Incentives (SEI) – C/I and GNI	The common method was used.	Navigant used the common approach. The workbook contained FR and SO values and calculations. Calculations followed the SWE common method.
Smart Construction Incentives (SCI)	Not calculated; Navigant used PY6 values.	Because there were no significant changes to program delivery or the target market, Navigant used the PY6 NTGR for the PY7 NTGR.
Smart On-Site (SOS)	The common method was used.	Navigant used the common approach.
Smart A/C Saver (SACS) – Commercial	NTGR assumed to be 1.0	Navigant did not conduct NTG research to determine FR. Navigant assumed that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives the conservation service provider paid them for their load curtailment. This reasonable assumption also was stated in the evaluation plan.
Smart Multi-Family (SMF) Solutions Program	The common method was used.	Navigant used the common approach for NTG but did not explain how it combined strata NTG values into program-level values.
Smart Business Solutions (SBS)	No NTGR estimation in PY7; NTGR estimated in PY5.	The common method was used to estimate the NTGR in PY5. There was no NTG estimation in PY7. Navigant did not report the PY5 NTG values in the PY7 annual report.
Smart On-Site (SOS)	The common method was used.	Navigant used the common approach for NTG but did not explain how it combined strata NTG values into program-level values.

Table A-133 shows the NTG values reported in the PY7 annual report.

Table A-133: Summary of NTG Estimates for PECO's Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Smart Equipment Incentives (SEI) – C/I	0.37	0.01	0.64	51
	Smart Equipment Incentives (SEI) – GNI	0.58	0.01	0.43	35
	Smart Multi-Family (SMF) Solutions Program	0.38	0.00	0.62	22
	Smart On-Site (SOS)	0.11	0.00	0.89	6

Not calculated	Smart A/C Saver – Commercial	N/A	N/A	1.0	N/A
Referenced from PY6	Smart Construction Incentives (SCI)	0.48	0.00	0.52	N/A
Referenced from PY5	Smart Business Solutions (SBS)	0.10	0.00	0.90	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] All samples provided at least 85/15 precision/confidence.

A.6.5 Statewide Evaluator Final Recommendations

The SWE Team has the following four recommendations for PECO's consideration.

- Focus education and marketing efforts on HVAC installers for the non-lighting aspect of Smart Home Rebates program in Phase III as the program ramps back up and invites new installation companies to join.
- Develop targeted Low-Income Energy Efficiency (LEEP) program materials that prioritize next steps and guide customers to the most appropriate program component, and ensure that schedule expectations are clear and applied consistently across customers.
- PECO: Use the limited time offer as a lever in future years if participation is low in the Smart Equipment Incentives (SEI) program.
- PECO: Set final Phase III Smart On-Site (SOS) project enrollment deadlines of January 1, 2019 for projects over 1 MW and January 1, 2020 for projects less than 1 MW, to mitigate completion risks that lead to portfolio-level uncertainty.

A.7 PPL

This section summarizes PPL's program performance through PY7. It includes an overview of the cumulative energy savings and demand reductions achieved by PPL's Act 129 EE&C programs in Phase II; an overview of the TRC test results for each program and for the portfolio of programs; a discussion of the activities completed by PPL's evaluation contractor to conduct M&V of PPL's EE&C programs and to calculate the cost-effectiveness of the portfolio of programs; a description of the work and findings of the SWE Team audits; and the SWE Team's recommendations of actions to help improve PPL's programs in the future.

A.7.1 Summary of Energy and Demand Reductions

This section lists the programs that provided energy savings in PY7 and includes the energy and demand savings contributed by each program offered during Phase II. The sector-level verified gross and net energy savings achieved in PY7 are also provided.

A.7.1.1 Phase II Savings by Program

Table A-134 lists the PPL EE&C programs that yielded reported savings in PY7.
Table A-135 shows the verified gross energy and demand savings of each program at the conclusion of Phase II. The Prescriptive Equipment program was the largest contributor of both energy and demand savings.

Table A-134: PPL EE&C Programs with Reported Gross Savings in PY7

Programs Reporting PY7 Gross Savings	Sector(s)
Appliance Recycling	Residential
Continuous Energy Improvement	GNI
Custom Incentive	Non-Residential / GNI
E-Power Wise	Low-Income
Low-Income Energy-Efficiency Behavior and Education	Low-Income
Low-Income WRAP	Low-Income
Master Metered Multifamily Housing	GNI
Prescriptive Equipment	Non-Residential / GNI / Residential
Residential Energy-Efficiency Behavior and Education	Residential
Residential Home Comfort	Residential / Small Commercial / GNI
Residential Retail	Residential
Student & Parent Education	Residential
Programs implemented with no reported PY7 savings	**Sector(s)**
School Benchmarking	GNI

Table A-135: Summary of PPL EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	Percent of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Appliance Recycling	25,012	4%	4.45	4%
Continuous Energy Improvement	4,697	1%	0.77	1%
Custom Incentive	56,852	8%	7.39	7%
E-Power Wise	5,933	1%	0.74	1%
Low-Income Energy-Efficiency Behavior and Education	10,622	2%	2.07	2%
Low-Income WRAP	11,832	2%	1.44	1%
Master Metered Multifamily Housing	6,488	1%	0.77	1%
Prescriptive Equipment	303,542	43%	47.33	45%
Residential Energy-Efficiency Behavior and Education	39,078	6%	7.30	7%

Program	Phase II VG Savings (MWh/yr)	Percent of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	Percent of Portfolio Phase II VG MW Savings
Residential Home Comfort	18,649	3%	6.15	6%
Residential Retail	206,018	29%	26.55	25%
School Benchmarking	0	0%	0.00	0%
Student & Parent Education	13,397	2%	1.30	1%
Total Portfolio[a]	**698,736**	**100%**	**106.27**	**100%**

NOTES:
[a] Adjusted for double-counting

A.7.1.2 PY7 Gross and Net Savings by Sector

The sector-level verified gross and net energy savings achieved in PY7 are provided in Table A-136 below. In PY7, the net energy savings were approximately 75% of the gross energy savings.

Table A-136: Summary of PPL EE&C Verified Net Savings – by Sector

Sector	PY7 VG Savings (MWh/yr)	PY7 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	128,417	99,073	270,117	213,224
C/I	141,900	102,732	335,372	253,580
GNI	47,044	36,207	93,248	75,008
Total Portfolio	***317,361***	***238,012***	***698,736***	***541,813***

A.7.2 Total Resource Cost Test

Table A-137 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for PPL's PY7 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY7 annual report.

Table A-137: Summary of PPL's PY7 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Recycling	$5,782,135	$1,240,144	$4,541,991	4.66
Residential EE Behavior and Education	$3,893,563	$503,938	$3,389,625	7.73
Residential Home Comfort	$12,472,643	$18,976,932	($6,504,288)	0.66
Residential Retail	$61,324,528	$16,347,202	$44,977,326	3.75

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Student and Parent Education	$3,465,013	$2,216,353	$1,248,660	1.56
E-Power Wise	$1,614,329	$503,003	$1,111,326	3.21
Wise Home Pilot (Part of E-Power Wis)	$114,793	$97,952	$16,841	1.17
Low-Income EE Behavior and Education	$1,062,297	$385,025	$677,272	2.76
Low-Income WRAP	$4,836,389	$6,444,747	($1,608,359)	0.75
Defacto Heating Pilot (Part of WRAP)	$46,443	$225,981	($179,537)	0.21
Continuous Energy Improvement	$1,035,251	$361,247	$674,004	2.87
Custom Incentive	$20,301,843	$16,178,329	$4,123,514	1.25
Master Metered Multifamily Housing	$1,580,508	$950,573	$629,935	1.66
Prescriptive Equipment	$120,754,941	$101,548,395	$19,206,546	1.19
School Benchmarking[a]	0	$92,253	($92,253)	0.00
Common Costs	-	$7,005,580	-	-
Total Portfolio	**$238,284,677**	**$173,077,654**	**$65,207,024**	**1.38**

NOTES:
[a] PPL is not tracking energy savings from the School Benchmarking program. This practice is explained in its approved implementation plan. Counting savings from this program could potentially double-count or reflect savings from participation in other overlapping programs.

In addition to the programs offered in PY6, PPL introduced two pilots within existing low-income programs in PY7: The Wise Home Pilot (a component of E-Power Wise) and the Defacto Heating Pilot (a component of WRAP). In summary, 10 of PPL's 13 programs were found to be cost-effective, 2 were found to be non-cost-effective (as expected in the EE&C Plan), and 1 claimed no savings and therefore has a TRC ratio of 0. In general, cost-effective programs in PY6 remained cost-effective in PY7. One program, the Continuous Energy Improvement program, transitioned to become cost-effective in PY7. The breakout of cost-effective, non-cost-effective, and no-participant programs is shown below.

Cost-Effective Programs
(TRC Ratio > 1.0)

- *Appliance Recycling*
- *Residential EE Behavior and Education*
- *Low Income Behavior and Education*
- *Residential Retail*
- *Student and Parent Education*
- *E-Power Wise*
  - *Wise Home Pilot (a component of E-Power Wise)*
- *Continuous Energy Improvement*
- *Custom Incentive*
- *Master Metered Multifamily Housing*
- *Prescriptive Equipment*

Non-Cost-Effective Programs

(TRC Ratio < 1.0)

- *Residential Home Comfort*
- *Low-Income Wrap*
  - *Defacto Heating Pilot (a component of WRAP)*

No Savings claimed

(TRC Ratio = 0)

- *School Benchmarking*

A.7.2.1 Assumptions and Inputs

As stipulated in the approved EE&C Plan, PPL used a discount rate of 8.14% in its TRC model to discount program benefits and costs. The rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. Different values of LLFs were used for different sectors, as shown in Table A-138. Inconsistencies were found in the energy LLF values applied in the TRC model workbook and those specified in the PPL PY7 annual report, specifically in the Student and Parent Education Program. The SWE believes the values specified in the PY7 annual report to be incorrect, and has noted the energy LLF used by program in the PPL TRC model in Table A-138. These inconsistencies do not materially impact the TRC calculations.

Table A-138: PPL's PY7 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
Appliance Recycling	Residential[b]	8.14%	7.69%[b]	7.69%[b]
Residential EE Behavior and Education	Residential	8.14%	7.69%	7.69%
Residential Home Comfort	Residential[b]	8.14%	7.69%[b]	7.69%[b]
Residential Retail	Residential[b]	8.14%	7.69%[b]	7.69%[b]
Student and Parent Education	Residential[c]	8.14%	7.69%[c]	7.69%[c]
E-Power Wise	Residential	8.14%	7.69%	7.69%
Wise Home Pilot	Residential	8.14%	7.69%	7.69%
Low-Income EE Behavior and Education	Residential	8.14%	7.69%	7.69%
Low-Income WRAP	Residential	8.14%	7.69%	7.69%
Defacto Heating Pilot	Residential	8.14%	7.69%	7.69%
Continuous Energy Improvement	GNI	8.14%	5.86%	5.86%
Custom Incentive	C/I[b]	8.14%	3.96%[b]	3.96%[b]
Master Metered Multifamily Housing	GNI	8.14%	5.86%	5.86%
Prescriptive Equipment	C/I[b]	8.14%	7.69%[b]	7.69%[b]

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
School Benchmarking	GNI	8.14%	5.86%	5.86%

NOTES:
[a] PPL's PY7 annual report shows line losses that are treated as a multiplier (i.e. 1.0833) in their TRC model. SWE has converted the multiplier to a LLF for consistency in reporting across EDCs
[b] Program includes savings across multiple sectors. Additional sector LLFs may include commercial (7.69%), industrial (3.96%), and GNI (5.86%).
[c] The value presented in the table is the value that ultimately was used in the calculations. This value, however, does not agree with LLF definitions in the PPL PY6 annual report.

Cadmus assigned an EUL to each measure in PPL's EE&C portfolio in order to determine the number of years of saving to attribute to that measure. The SWE Team checked the measure lives in the PPL TRC model against the measure lives in the 2013 TRM and found negligible variances.[71] The measure lives applied to custom measures not explicitly stated in the TRM were found to be reasonable.

Incremental costs for all rebated measures were typically sourced from the SWE incremental cost database, with other measure cost data sourced in Appendix B of PPL's PY7 annual report. For these measures, several different methods were used to assign incremental costs in the PPL TRC model. For Prescriptive Equipment programs, incremental costs for New Construction lighting measures (excluding exterior lighting) were based on Energy Trust of Oregon's average cost per square foot for 20% lighting power density (LPD) reduction adjusted linearly for project-specific LPD reductions. Incremental costs for retrofit lighting fixtures, controls, residential retail lighting, and custom projects were determined through an analysis of the project files and invoices.

The PPL TRC analysis was based on ex post verified savings, as required by the TRC Order. Cadmus adjusted measure impacts by an applicable realization rate. Cadmus calculated realization rates by program, sector, and stratum. Realization rates for demand impacts were calculated separately and were used to adjust the reported demand impacts prior to entering them into the TRC calculations. The energy and demand impacts in the tracking databases were calculated at the meter level, and a LLF was appropriately applied prior to the calculation of avoided cost benefits.

The SWE Team found the energy and demand impacts used in the PPL TRC model to be generally consistent with those provided in the program tracking databases, with one minor exception. The PPL PY7 annual report adjusted portfolio savings by 3,385 MWh/yr to reflect potential double-counting from the Residential Energy-Efficiency Behavior & Education program, but no similar adjustment was observed in the TRC model review. This variance is expected to impact the TRC benefits and TRC ratios for PY7 by less than 1%, and would not materially impact the overall TRC ratio.

As in prior Phase II years, the 2015 TRM specifically instructed EDCs to account for dual baselines with regard to T12 linear fluorescent replacements. The dual baseline adjustment impacts the lifetime energy and demand savings of measures but does not impact first-year savings for PY7. EDCs may choose to reflect the dual baselines either by applying savings adjustment factors or by reducing the EUL to adjust lifetime savings. The PPL TRC model uses a savings adjustment to account for the dual baseline measures, consistent with the guidance provided in the 2015 TRM.

[71] As in PY6, the SWE observed only one variance from the 2015 TRM in the PY7 PPL TRC Model. Water heater temperature setback EUL was found to be one year in the TRC model versus a TRM-specified EUL of four years. The overall impact of this adjustment is negligible to the program- and portfolio-level TRC.

A.7.2.2 Avoided Cost of Energy and Capacity

Consistent with prior Phase II program years, the PY7 PPL TRC models use the Phase II approved avoided costs of energy and capacity. The PY7 models were updated to select the appropriate PY7 stream of avoided costs.

A.7.2.3 Conclusions and Recommendations

The PPL TRC model was transparent, and the SWE observed no significant changes in the TRC model during Phase II. The SWE Team determined that the PPL TRC model provided the requested details regarding the determination of financial benefits from energy and demand impacts. The SWE review determined that there were minor differences (less than 1%) between the modeled energy and demand savings and the verified energy and demand savings in the PY7 report. The SWE believes the PY7 TRC benefits, costs, and ratios to be reasonable and accurate.

A.7.3 Status of Evaluation Activities

This section discusses the status of PPL's EM&V plans, M&V activities and findings, and process evaluation activities and findings.

A.7.3.1 Status of Evaluation, Measurement, and Verification Plans

The standardization of evaluation protocols across EDCs was outlined in the Phase II Evaluation Framework in order to create consistency in evaluation practices across EDCs. The initial Phase II SWE Evaluation Framework was finalized and published on June 28, 2013. The Phase II SWE published an updated Evaluation Framework on July 14, 2015. Both Phase II Evaluation Framework documents required each EDC to complete an initial evaluation plan for each program in its portfolio[72], addressing the following objectives:

- Outline gross impact evaluation methodology
- Outline NTG analysis methodology
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a time line of evaluation activities
- Establish key program contacts

Through an ongoing process, the SWE Team worked with the EDCs and EDC evaluation contractors to review EM&V plans to realize the common goal of accurately tracking and reporting realized energy and demand savings. The initial EM&V plan for Phase II was to be submitted by each EDC to the SWE Team by August 31, 2013. The SWE Team was granted a review period to approve the plan or suggest modifications to it. If revisions were required, the EDC and SWE Team were allotted alternating two-

[72] For example, the initial SWE Phase II Evaluation Framework published on June 28, 2013 stated on page 28 that "EDCs must complete an evaluation plan for each evaluation and submit it to the SWE SharePoint site for review within 90 days from the beginning of the program year (by August 31). The evaluation plan should be a single electronic document with a chapter for each program in the portfolio, or a separate document for each program".

week revision periods until both parties were satisfied with the document. The review process provided either party the opportunity to request additional time if unforeseen circumstances arose.

Table A-139 displays key milestones completed by PPL and the SWE for the company's Phase II EM&V Plan. The SWE is presenting information on all revisions to this EM&V Plan that have occurred during Phase II in order to provide a complete picture of the evolution of this plan during Phase II to date.

Table A-139: Key Milestones Reached for PPL's Phase II EM&V Plan

Date	Event
June 1, 2013	PY5 starts
August 30, 2013	PPL submits first draft of Phase II evaluation plan to the PUC and SWE
October 15, 2013	SWE returns comments on the PPL evaluation plan to PPL
January 31, 2014	PPL submits revised Phase II EM&V Plan to the PUC and SWE
January 31, 2014	SWE approves the revised PPL EM&V Plan
June 1, 2014	PY6 starts
June 1, 2015	PY7 starts
May 27, 2015	PPL submits revisions to PPL PY7 EM&V Plan
September 8, 2015	PPL submits additional revisions to its PY7 EM&V Plan

PPL's initial EM&V Plan, submitted on August 30, 2013, detailed proposed evaluation objectives and activities for 13 programs across two sectors. The plan presented key evaluation issues, impact evaluation details, process evaluation details, sampling plans, and key contacts for each of the 13 programs. The SWE Team reviewed the plan and returned 105 comments. The SWE Team noted major deficiencies in the following areas (all of these issues were addressed by PPL):

- Confirmation that PPL's billing analysis for the residential low-income program will focus on Act 129, Phase II participants only, and not include any Low-Income Usage Reduction Program (LIURP) participants
- More explanation of the verification steps planned for the Residential Efficient Equipment Program
- Phone and web survey definitions and objectives across most applicable programs
- Research design and sample sizes across most programs
- Benchmarking across most applicable programs
- OPower analyses of behavior modification programs
- Act 129 Winter Relief Assistance Program (WRAP) impact evaluation methodology
- Residential Lighting Program impact evaluation methodology
- Residential Appliance Recycling Program savings calculation methodology
- Level of rigor across all non-residential programs
- Concern for mutual exclusivity of samples and/or savings calculations from overlapping programs

As noted above, the SWE is presenting information on all revisions to this EM&V Plan that have occurred during Phase II (includes PY5, PY6 and PY7) in order to provide a complete picture of the evolution of this plan during Phase II to date.

PPL submitted EM&V Plan revisions on January 31, 2014, and these were incorporated into the draft plan, which was approved as the final Phase II EM&V Plan. The SWE Team's review of the evaluation activities revealed that the plan was followed appropriately for all EM&V activities occurring in PY6.

PPL submitted subsequent revisions to its PY6 EM&V Plan. The revisions incorporated program changes, reflected changes to the evaluation plan, and addressed the SWE Team's comments in its PY5 annual report. The list of changes to the evaluation activities for PY6 included the following:

1) Beginning in PY6, Cadmus's Act 129 WRAP evaluation activities included telephone surveys with a sample of baseload job recipients. An additional two measure groups of WRAP activities were added in addition to baseload jobs and heat pump water heaters: low-cost jobs and full-cost jobs. The sample size for Cadmus's random sample for WRAP data collection was changed from 50 to 140 sites.

2) The PPL evaluation plan submitted to the SWE before the PPL PY6 program evaluation began provided that in PY6 the Appliance Recycling Program process evaluation would describe and assess the program's success meeting key performance indicators (KPIs). The KPIs are "days to pick up" and "days to issue check." The total number of nonparticipant surveys and trade ally interviews was changed in both PY5 and PY6 for the Appliance Recycling Program.

3) Participant phone surveys were no longer included as an evaluation activity for the E-Power Wise program in PY6 and PY7.

4) Secondary research and calculation of demand savings (MW) impacts were no longer included as evaluation activities for the Low-Income Behavior and Education Program.

5) Opt-out surveys, secondary research, and calculation of demand savings (MW) impacts were no longer included as evaluation activities for the Residential Energy-Efficiency Behavior and Education Program. This change also applied to the PPL PY7 EM&V Plan.

6) The Residential Home Comfort Program no longer included the trade ally training component, and instead included a manufactured homes component. Process evaluation sample sizes for the Home Comfort Program changed going forward for new homes, audit and weatherization, efficient equipment fuel switching, and manufactured home purchasers. Sample sizes for trade ally interviews were changed for PY6 and PY7. The efficient equipment rebate recipients sample was added. Impact evaluation survey sample sizes were changed for most activities.

7) Follow-up participant surveys were no longer offered as an evaluation activity for the Student and Parent Energy-Efficiency Education Program in PY6 and PY7.

8) Trade ally interviews were no longer an evaluation activity for the Custom Incentive Program.

PPL submitted revisions to its PY7 EM&V Plan on September 8, 2015. Most changes reflect PPL's revised Phase II EE&C Plan approved in June 2015, related decisions for the impact evaluations, and decisions about process evaluations.

A.7.3.2 Measurement and Verification Activities and Findings

PPL achieved 145% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2016 from Phase II in addition to Phase I carryover. Realization rates compare gross savings with the verified gross savings determined by the EDC evaluation contractor through M&V activities.

Table A-140 provides a summary of M&V findings based on activities conducted by Cadmus. The summary is based on details provided in PPL's PY7 annual report and on information obtained from the SWE Team's data requests and audits. Table A-140 presents realization rates and relative precision values for verified energy and demand savings for each of PPL's residential and non-residential energy efficiency programs for PY7.

Table A-140: Realization Rates and Relative Precisions for PPL's Programs in PY7

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Recycling	100%	N/A	100%	N/A
Continuous Energy Improvement	98.2%	3.8%	131.4%	46.6%
Custom Incentive	100.1%	4.3%	107%	N/A
E-Power Wise	62.4%	3.3%	39.8%	4.1%
Low-Income WRAP	100.1%	2.3%	101.7%	N/A%
Master Metered Multifamily Housing	109%	9.9%	110%	7.6%
Prescriptive Equipment	98.1%	1.8%	95.8%	2.8%
Residential Energy-Efficiency Behavior and Education	98.2%	10.7%	17.2%	29.1%
Residential Home Comfort	99.5%	2.5%	96.1%	1.6%
Residential Retail	100%	11.5%	100%	11.7%
Low-Income Energy-Efficiency Behavior and Education	98%	20.8%	12.9%	46.2%
Student & Parent Education	79.3%	.9%	59.3%	1.0%
School Benchmarking	0%	0%	0%	0%

NOTES:
[a] Relative precision values shown are at the 85% confidence level.

A.7.3.2.1 Residential and Low-Income Energy Efficiency Programs

Realization rates for PPL's residential programs' energy savings ranged from 62.4% to 100%. Realization rates for demand reductions from these programs ranged 12.9% to 100%.

During PY7, Cadmus performed M&V activities in accordance with PPL's EM&V Plan to verify PPL's reported savings. The EM&V Plan describes verification activities for deemed and partially deemed measures using the 2015 TRM as the basis for verifying annual electric energy and demand savings when applicable. For deemed measures, the impact evaluation activities included a basic level of rigor through desk audits (tracking system and file reviews) and phone surveys, including verification of measure

installation, measure quantities, and supporting project documentation. Evaluations of programs that did not use deemed measures instead used billing analyses to evaluate measure energy savings.

For PPL's Appliance Recycling program, Cadmus reviewed all project records and inspected a census of PY7 participant records from the EEMIS database to verify reported savings. Cadmus was not able to reconcile EEMIS records with the JACO's ICSP's database because JACO did not provide PY7 data prior to ceasing operations. Since discrepancies were rare in prior evaluations and the ICSP tracking data was unavailable, Cadmus verified all records in EEMIS. Reported savings for room air conditioners assumed average of the locations specified in the 2015 TRM rather than mapping savings to the exact locations. Adjustments were made to the PY7 program data by mapping each ZIP code to the specified climate zone city specified in the 2015 TRM. Overall the program realization rates for energy and demand were 100% and 100%, respectively.

To evaluate the energy savings associated with the Residential EE Behavior and Education program, Cadmus analyzed monthly electric bills for a census of program treatment and control group homes. During PY7, there were three treatment groups, each receiving monthly reports for a different length of time. The evaluation methodology is based on IPMVP Option C and employs a regression of customer average daily electricity consumption using a statistical approach detailed by Allcott and Rogers.[73] PPL reports PY7 program net savings of 39,786 MWh/yr attributed to 148,305 participating homes, or an overall average savings of 268 kWh per home. Overall the verified savings equaled the reported energy savings, resulting in a realization rate of 100%. The evaluator also examined the impacts of behavioral programs on participation in other energy efficiency programs, and this is reflected in an adjustment to the final verified gross portfolio savings total.

To evaluate the energy savings associated with the Low Income EE Behavior and Education program, Cadmus analyzed monthly electric bills for a census of program treatment and control group homes. During PY7, there were two treatment groups, each receiving monthly reports for a different length of time. The evaluation methodology is based on IPMVP Option C and employs a regression of customer average daily electricity consumption using a statistical approach detailed by Allcott and Rogers.[74] PPL reports PY7 program net savings of 10,833 MWh/yr attributed to 87,376 participating homes, or an overall average savings of 124 kWh per home. Overall the verified savings were slightly lower than the reported energy savings, resulting in a realization rate of 98%. The evaluator also examined the impacts of behavioral programs on participation in other energy efficiency programs, and this is reflected in an adjustment to the final verified gross portfolio savings total.

Cadmus's M&V efforts for the Residential Home Comfort program included quarterly records verification (desk audit). The records review verified the quantities reported in EEMIS and the input parameters necessary to calculate savings using the 2015 TRM. The program realization rate was calculated using findings from the projects chosen from the results of the records review. For verification activity sampling, records were assigned to one of eleven strata. The EM&V sample plan was designed to meet levels of at least 85% confidence and 15% precision at the program level. The energy realization rates in the eleven strata ranged from 88% to 227%, with the overall program realization rate

[73] Hunt Allcott and Todd Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." American Economic Review 104 (10): 3003–3037.
[74] Ibid.

for energy being 99%. The demand realization rates ranged from 88% to 100% across the strata, resulting in an overall program realization rate for demand of 96%.

PPL's Residential Retail program offers upstream incentives for energy efficient lighting and rebates for energy efficient equipment sold through retailers. In PY7, PPL introduced a tiered rebate approach for heat pump water heaters that provides for an increased incentive for units with an energy factor above the minimum threshold for the rebate. For rebated energy efficient equipment, Cadmus looked up specific model numbers for rebated equipment and verified that the appropriate TRM deemed values or algorithms had been used in order to develop ex ante savings adjustments. Cadmus then conducted desk reviews of a simple random sample of rebate forms to verify installation and confirm the quantities reported in the tracking system.

For the evaluation of the upstream lighting component of the Residential Retail Program, Cadmus verified the database against the implementer-based invoicing system and conducted a complete baseline wattage review and TRM algorithm verification. A cross-sector sales adjustment was made to account for bulbs that were installed in commercial facilities. As in PY6, Cadmus and PPL opted to continue to use the previous cross-sector sales estimate (12%) in PY7. As any baseline or deemed variable adjustments were made to the Ex Ante savings prior to verification, overall the energy realization rate and demand realization rate for the upstream lighting component and the Residential Retail program as a whole was 100%.

The Student and Parent program provides school-based energy efficiency education to students, parents, and teachers and take-home kits of low-cost energy efficiency items to be installed in homes. Cadmus conducted a complete database review, a record review for a sample of participants, a review of student and parent returned home energy worksheets, ICSP-administered classroom teacher evaluations, teacher workshop, and parent workshop evaluation surveys to verify installation rates and TRM open variables. Cadmus conducted multiple reviews of the EEMIS and ICSP's databases as well as reviewing the sources for the records in the databases. It inspected the databases for accuracy and consistency of EEMIS records against the ICSP records and found minimal discrepancies. Reported savings first were adjusted to align program planning assumptions with 2015 TRM values, and survey data were used to adjust equipment ISRs and installation quantities in order to calculate verified energy and demand savings.

A.7.3.2.2 Non-Residential Energy Efficiency Programs

Realization rates for PPL's C/I program energy savings ranged from 98.1% to 109.1%. Realization rates for demand reductions from these programs ranged from 95.8% to 131.4%. Relative precisions for these programs ranged from 1.77% to 9.85% for energy savings and from 2.8% to 46.57% for demand reduction at the 85% confidence level. All of PPL's programs achieved the 15% precision requirement for kWh. Outside of the CEI program, PPL also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II.

Figure A-23 displays the frequency of each M&V approach performed by Cadmus in PY7 for PPL's Custom Program group evaluation sample and the verified energy savings associated with each M&V approach. The enhanced rigor used in the evaluations included IPMVP Options A, B, C, and D. Option A combines the measurement of key parameters of retrofitted equipment with the use of stipulated values for other measurement parameters. Option B involves more robust measurement of the retrofitted system's continuous energy usage, typically through short-term power metering. Option C

consists of utility billing analysis to determine energy savings. Typically, 12 months of pre- and post-installation billing data are required for this approach. Option D involves modeling energy performance of a facility before and after the efficiency measure is installed.

Figure A-23: Frequency of and Associated Energy Savings by M&V Approach – Custom Program

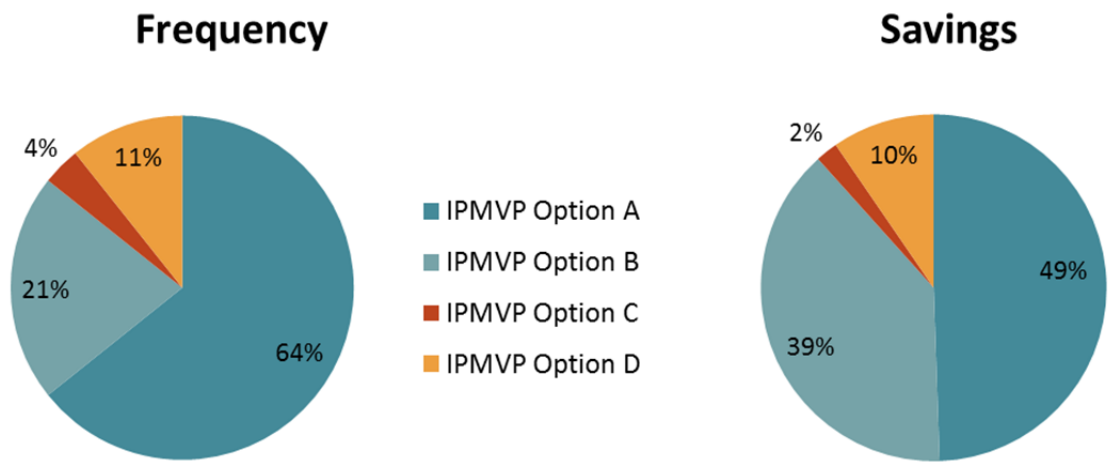


Figure A-23 indicates that Cadmus used Option A for 64% of the projects selected for sampling. However, these projects accounted for 49% of the sample's energy savings. Option B was used for only 21% of projects, but they accounted for 39% of the savings. Options C and D were only used on 4% and 11% of projects, respectively, and these projects accounted for similar proportions of the program's savings.

During PY7, PPL applied various evaluation approaches to verify its reported savings. The level of rigor used to evaluate projects sampled followed each program's corresponding QA/QC and EM&V plans. The MMMF program used site visit and records review for the entire sample. The Prescriptive Equipment Non-Lighting Program was evaluated with basic rigor using desk reviews and phone verifications. The Prescriptive Equipment Lighting Program used site visits and file reviews for the entire sample. The CEI Program used Option C for its entire evaluation sample.

A.7.3.3 Process Evaluation Activities and Findings

The process evaluation conducted by Cadmus involved review of key program documentation; interviews with program staff, implementers, program-affiliated contractors, and community-based organizations; and surveys with program participants, partial participants, and nonparticipants, although not every evaluation included all of these activities. Table A-141 summarizes the data sources Cadmus used and its key findings for each program.

Table A-141: Summary of Key Findings and Data Sources – PPL

Program	Key Findings	Data Sources
Residential Sector		
Residential Energy-Efficiency Behavior and Education Program	– The program did not meet its participation plans in PY7 due to attrition during PY6, but did exceed its plans for energy savings. – Due to higher than expected savings, the program ceased delivery of HERs at the end of Q2 in PY7.	– Program staff and implementer interviews (n=2) – Program database and HERs recipient records

Program	Key Findings	Data Sources
	– The program manager and implementer did not report any implementation challenges in PY7. – The shortened report delivery period during PY7 resulted in fewer customer calls to the call center. – The HERs provided an aggregate uplift in participation in (12%) and savings (5%) from other PPL energy efficiency programs.	– EEMIS database
Residential Home Comfort Program	– Overall, the program met its energy savings and participation plans for PY7 and Phase II. – Over one-third (38%) of audit participants installed measures, but high up-front costs of an audit continued to be a barrier to participation in PY7. – Ductless heat pumps achieved the most savings in PY7. The new products added in PY7, particularly the central air conditioners, were successful at increasing energy savings. – The new homes prescriptive path (n=2) and manufactured home offerings (n=1) continued to not perform as well as planned. – The rigidity of the prescriptive paths, in which contractors had to install specific products, led to lower participation. The HERS new home approach performed better than planned because contractors had some flexibility in choosing qualified measures. – The program met its customer satisfaction goal of 80% (98% reported being very or somewhat satisfied) but did not meet its customer complaint goal of zero complaints.	– Program staff and implementer interviews (n=2) – Cross-program participant surveys (n=286) – EEMIS database
Residential Retail Program (Equipment)	– The program exceeded its planned energy savings for PY7 and Phase II. – The program was delivered efficiency and effectively. Rebate processing times averaged 3 weeks, lower than in PY6. – Some participants expressed disappointment with refrigerator rebates that were lowered due to changes in ENERGY STAR qualification criteria for various models. – More surveyed participants reported satisfaction with the program (79%) compared with PY6 (69%). Recipients of rebates for HPWHs were more satisfied than recipients of refrigerator rebates.	– Program staff and implementer interviews (n=2) – Refrigerator participant surveys (n=62) – HPWH participant surveys (n=70)
Residential Retail Program (Lighting)	– The program exceeded its planned energy savings for PY7 and Phase II. – The program was delivered efficiently and effectively, and the quality of the data from the various program sources was very good. – Most surveyed PPL customers (79%) reported awareness of LEDs, and 78% had seen them for sale at retailers in PY7, compared to 71% in PY6. However, most surveyed customers (85%) were unaware that PPL discounted LED bulbs.	– Program staff and implementer interviews (n=2) – Residential customer surveys (n=337) – Low-Income Energy-Efficiency Behavior & Education Program treatment and control surveys (n=301)

Program	Key Findings	Data Sources
	– 44% of respondents reported currently using LEDs, up from 30% in PY6; non-users cited high cost as a barrier. – Most respondents with LEDs were overall very satisfied with their LEDs. – Reported willingness to pay $5 or more for LEDs dropped in PY7 compared with PY6, but 90% of respondents reported being willing to pay $3 per LED. However, respondents who purchased LEDs from participating retailers reported an average price of $7.51 per bulb; respondents who purchased LEDs from any retailer reported an average price of $8.10 per bulb. – Most respondents who disposed of CFLs in PY7 (60%) reported throwing the bulbs in the trash. Only 7% of surveyed respondents reported awareness of PPL's CFL recycle bins.	– Program database and manufacturing invoices
Student and Parent Energy Efficiency-Education Program	– The program met its PY7 participation plans but did not meet planned energy savings; the program also did not meet its participation or savings plans for Phase II. – Interviewed staff reported a smooth delivery of the program in PY6 and PY7. – All four key performance indicator goals were met or exceeded in PY7. Program enrollment was successful; new school enrollment reached 30% of all participants, 150 teachers enrolled to participate, and the number of returned HEWs exceeded 72%. – The implementation CSP's targeted marketing and personalized outreach efforts increased program awareness and helped increase participation, particularly for new schools. – Classroom teachers (81%) and workshop teachers (84%) were overall highly satisfied with the program and its components. Teacher and parent recommendations for improvement included providing more student interaction opportunities, reducing the paperwork of the HEWs, and improving the presentations.	– Program staff and implementer interviews (n=2) – Student home energy worksheets (HEWs) (n=19,249) – Parent HEWs (n=1,015) – Parent surveys (n=2,229) – Teacher and parent workshop evaluation surveys (n=1,918) Program database and participant records
Low-Income Sector		
E-Power Wise	– The program met or exceeded its planned energy savings and plans for participation – The program was very well managed. – The number of agencies that distributed kits for the program increased by three in PY7, in line with planned goals. – Interviewed agencies are very satisfied with the program overall. One agency was not too satisfied with the training, and agencies recommended removing the furnace whistle from the kit. – Interviewed agencies reported they most commonly distributed kits in one-on-one meetings with clients	– Program staff and implementer interviews (n=2) – Community-based organization interviews (n=5) – Customer surveys returned from kits (n=776) – Program database

Program	Key Findings	Data Sources
	because they were getting little participation via workshops. – Three of the five interviewed agencies reported that program saturation was still a concern because they frequently see the same clients.	
Wise Home Pilot (component of the E-Power Wise Program)	– The program met its key performance indicator goal of 80% participant satisfaction (96% reported being very or somewhat satisfied). – Most participants (75%) reported being very or somewhat satisfied with their home's comfort and temperature control after participating, up from 44% before participating; most participants reported being very or somewhat satisfied with other program elements and rated them as very or somewhat important. – Most surveyed participants (84%) reported that their monthly energy bills did not change or decreased since participating. – There are far fewer manufactured homes in the study region that have electric heating and more homes with non-electric heating than initially anticipated, which led to major changes in the program and study design, substantial delays in implementation, and customer attrition. – Customer distrust played a large role in low recruitment, particularly because the program was free. – Delays in implementation pushed the installations and weatherizations into winter instead of being performed as planned during the summer. This caused some unanticipated delays due to weather, holidays, and shorter days.	– Program staff and implementer interviews (n=3) – Participating technician interview – Customer enrollment surveys (n=243) – Leave-behind participant postcards (n=40) – Participant satisfaction surveys (n=44) – Program database
Low-Income Energy-Efficiency Behavior and Education Program	– The program exceeded its PY7 and Phase II planned MWh/yr savings and nearly met its planned participation. – The interviewed staff reported that the program worked well and that customers received HERs as planned. – The program did not meet its key performance indicator goal of increasing participation to 90,000 customers due to attrition in PY6, but it did meet its call center goal for reducing calls compared with PY6. – Most of surveyed customers (89%) reported reading, partially reading, or skimming the last paper HERs they received, compared with 95% in the residential program. – The HERs provided an aggregate uplift in participation (6%) and savings (2%) in other PPL energy efficiency programs. There was very little difference between the treatment and control groups in the average number of other programs in	– Program staff and implementer interviews (n=2) – Treatment group surveys (n=151) – Control group surveys (n=150) – EEMIS and program databases

Program	Key Findings	Data Sources
	which PPL customers participated. – The HERs did not appear to influence customers to make any of seven energy savings improvements or any of seven energy saving behaviors except turning down the thermostat. – Over three-fourths of surveyed customers reported being very or somewhat satisfied with the HERs, which was significantly higher than the Residential program's PY6 satisfaction results.	
Winter Relief Assistance Program	– The program met or exceeded all its PY7 and Phase II planned energy savings and planned participation, except for its planned participation in PY7. – Program staff reported being very satisfied with the LEAP tracking system and reported that the program ran smoothly in PY7. – The program manager reported that CAP enrollment increased 25% in PY7 and that referrals through CAP were likely a strong contributor to PY7 participation. – Most surveyed participants (71%) reported being very satisfied with the program. – The program used mail-in postcards as its targeted marketing strategy and had less success with the cards in PY7 than in PY6, but the online application launched during PY6 and the toll-free number contributed to participation in PY7. – Most surveyed participants (83%) could recall examples of energy saving ideas provided during the in-home energy audit, and nearly all (94%) reported taking at least one of the steps to save energy.	– Program implementer interview (n=1) – Participant surveys (n=141) – Program database and participant records
De Facto Heating Pilot (component of the WRAP Program)	– The Pilot did not meet its plans for energy savings, participation, or cost-effectiveness for PY7. It will not continue in Phase III. – Selecting qualified participants and homes from the 2,000 income-eligible customers and getting them to participate was very difficult. – Average project costs per home were higher than anticipated, limiting the number of participants to 11 instead of 20 under a fixed program budget. – Two of the three surveyed participants reported high satisfaction with the contractor, the money they saved with the heat pump, and the money they saved with the WRAP measures; all three were satisfied with their home's comfort and were satisfied overall with the program. – None of the three survey participants reported using portable space heaters or plan to use room air conditioners after participating in the Pilot.	– Program implementer interview (n=1) – Installation contractor interview (n=1) – Participant interviews (n=3) – Program database
Non-Residential Sector		
Continuous Energy Improvement Program	– The program met or exceeded its PY7 and Phase II planned energy savings and planned participation. – Interviewed staff reported that the program is working	– Program staff and implementer interviews (n=2)

Program	Key Findings	Data Sources
	well, with schools taking ownership of the program and doing SEMP plans on their own. – Customer satisfaction exceeded the planned target of 80% (100% reported being very or somewhat satisfied). – Surveyed school district energy managers and school champions reported that the greatest challenges involved organizing and gaining commitment from others involved in the schools and not having enough time to dedicate to the program. – Overall SEM adoption was high across all program participants. However, the number of schools with full adoption declined from PY6 due to infrequent updates of program planning materials. – Most survey participants reported that the program was extremely or somewhat influential in their decision to implement energy efficiency projects.	– Participant surveys (n=23) – Program database and participant records
Custom Incentive Program	– The program exceeded its planned energy savings for PY7 but not for Phase II; it also did not meet planned Phase II participation, primarily because several very large projects were deferred by customers into Phase III. – Customer satisfaction exceeded the planned target of 80% (87% reported high satisfaction rating). For the majority of program elements, customer satisfaction increased from PY6. – Surveyed customers suggested improvements to the program, including providing better communication about timing, completing the review of materials and application steps more quickly, providing more options for rebated equipment, and improving the wait list. – Surveyed customers chose to upgrade equipment to replace old or broken equipment, save money or energy, or make improvements to existing systems. – The most important reported criteria for determining whether to go forward with a project was the return on investment, energy and operating costs, and initial costs.	– Program staff and implementer interviews (n=2) – Participant surveys (n=24)
Prescriptive Equipment Program	– The program exceeded its planned PY7 and Phase II energy savings planned but did not meet its planned Phase II participation. – The program did not meet its goal of 80% customer satisfaction; 77% of surveyed participants reported high satisfaction. – The limited-time higher incentives for HVAC equipment and heat pump water heaters had a minimal effect on participation. – There is very limited uptake in rebates for agricultural equipment, but the program received applications for six different agricultural measures in PY7 for the first time. – Most surveyed participants were satisfied with	– Program staff and implementer interviews (n=2) – Lighting participant surveys (n=68) – Equipment participant surveys (n=12) – Program database and participant records

Program	Key Findings	Data Sources
	elements of the program. However, satisfaction with the time it took to receive the rebate has been on the decline since PY5, likely due to the preapproval process in PY6 and wait list in PY7. – Surveyed participants suggested improvements to the application communications, wait list, and application and rebate processing times so they can better manage their projects.	
Master Metered Low-Income Multifamily Housing Program	– The program exceeded its planned energy savings in PY7 but did not meet the plan for Phase II. The program will not be offered in Phase III as a standalone program but all multifamily programs are eligible for other programs in Phase III. – Program staff reported that upfront costs, tight operating budgets, and a reluctance to take on additional debt were the most important reasons why some building owners/operators did not participate after receiving an audit or did not do comprehensive upgrades. – Interviewed staff reported that they were pleased with the addition of nursing home buildings to the program in PY7; it helped them meet program goals without increasing marketing and outreach. – Cadmus did not find any customer complaints or safety violations for PY7. – Most surveyed tenants (78%) reported high satisfaction with the installation contractors, but this was significantly lower than in PY6 (95%); nearly all respondents (94%) who completed the tenant energy education workshop reported high satisfaction with the workshops. – LEDs constituted 94% of products installed in tenant units, and 77% of respondents reported high satisfaction with the LEDs.	– Program staff and implementer interviews (n=2) – Leave-behind tenant postcards (n=44) – Tenant education workshop satisfaction surveys (n=156) – Program database and participating building records (n=50) – EEMIS database

A.7.4 Statewide Evaluator Audit Activities and Findings

This section presents the activities of the SWE Team's audits of PPL's portfolio of programs. It provides summary information and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

A.7.4.1 Residential Program Audit Summary

A.7.4.1.1 Appliance Recycling

In PY7, the PPL Appliance Recycling Program includes rebates for room air conditioners, refrigerators, and freezers. For all programs, the SWE confirmed the accuracy of the ex-ante savings adjustments and the weighted average calculations versus the 2015 TRM. Cadmus used the NTGRs that were determined in PY6 for the Appliance Recycling Program for the PY7 program.

GDS notes that JACO Environmental, the implementation Conservation Service Provider (ICSP) for PPL, abruptly went out of business during PY7 and that this lead to a decrease in program participation. However, PPL still surpassed its savings targets for this program.

The SWE Team found no reportable errors and agrees with PPL's verified gross savings findings for the Appliance Recycling Program.

A.7.4.1.2 Residential EE Behavior and Education

PPL's reported savings are based on a methodology employed by Allcott and Rogers which is a regression technique that uses only post-treatment data and controls for differences in control and participant base usage patterns using pre-treatment usage independent variables as opposed to fixed effects parameters. The approach conforms with the UMP protocol and the IPMVP Option C. Participants were randomly assigned to treatment and control groups, and Cadmus analyzed pre-treatment average daily energy consumption to ensure that the treatment and control groups were evenly balanced.

PPL performed a participation uplift analysis to identify the possibility of double counting savings attributed to both the Residential Energy-Efficiency Behavior and Education Program and other programs. The estimated impact was a total of 2,127 MWh/yr in PY7, representing 5.4% of the program's total PY7 *ex post* savings. These savings were subtracted from the residential portfolio, not from the Behavior and Education Program.

The SWE Team reviewed the billing analysis output, equations, and statistics and confirmed that the approach is sound and the conclusions reasonable. The SWE Team agrees with PPL's verified gross savings findings for the Residential Energy-Efficiency Behavior and Education Program.

A.7.4.1.3 Residential Home Comfort

The SWE Team reviewed each of the eleven strata of the RHC Program (Audits, Weatherization, Air-Source Heat Pumps (ASHP), Ductless Heat Pumps (DHP), Central Air-Conditioner, ECM Furnace Fans, Whole House Fans, Fuel-Switching, Pool Pumps, New Homes, and Manufactured Homes, to verify saving in PY7. Five of these strata were added in PY7: air sealing, ECM furnace fans, whole house fan, central air conditioner, and above-group pool pumps.

Approximately 83% of the verified energy savings, and 89% of the verified demand savings, occur in the Efficient Equipment – HVAC program. This program includes Air-Source Heat Pumps (ASHP), Ductless Heat Pumps (DHP), Central Air-Conditioner, ECM Furnace Fans and Whole House Fans.

Several changes in the 2015 TRM significantly impacted reported and verified savings in PY7:

- Beginning with the 2015 TRM, ASHP stipulated values for SEERb, EERb, and EERe are based on the customer's existing cooling equipment, as opposed to default values established in prior TRMs.
- The 2015 TRM pool pump algorithms broke out HOU by filter mode and clean mode and used EDC data gathering for CFs.
- DHPs were the top contributors to program savings in PY7, accounting for over half of the program's reported energy savings. Participation increased from 1,177 in PY6 to 1,582 participants in PY7. The large increase in energy savings was attributed to increased enrollment and to the updates to the DHP algorithm in the 2015 TRM, which involved adding an oversize factor and duct leakage factor,

to account for the fact that the baseline unit is typically oversized and that a percentage of the energy is lost to duct leakage (in ducted systems, but not ductless systems).

The SWE Team confirmed that Cadmus performed a records review of each major stratum of the RHC Program using samples that exceeded the required number to achieve the targeted confidence and precision. This process eliminated the need for the SWE Team to conduct additional desk audits. Instead, the SWE Team reviewed a small sample of the existing records review to verify the accuracy of the information, and that the calculated savings values used the appropriate TRM values and algorithms. The SWE Team confirmed that all verified per-measure savings, participant counts, and program energy and demand impacts were consistent with the 2015 TRM.

Based on its review of Cadmus's records, the SWE Team confirmed that the reported savings of the RHC Program were appropriately adjusted, and that the verified gross energy and demand savings calculations were reasonable and accurate.

A.7.4.1.4 Residential Retail

The Residential Retail program for PY7 provides incentives for both upstream lighting purchases as well as downstream rebates on refrigerators and HPWHs.

For the rebated equipment subsection of the program, the SWE Team reviewed the data tracked in PPL's database as well as the records reviews completed by Cadmus. The SWE Team confirmed that PPL's tracking system was using the correct version of the PA TRM deemed savings values or savings algorithm calculations. The SWE Team also verified a small sub-sample of Cadmus's desk reviews for rebated equipment to confirm accurate make/model look-up functions and assignment of efficiency status. All energy and demand savings appear accurate and reasonable. While the year-over-year installation applicability to PY7 has improved over the lag that was noted in PY6, about one-third of the HPWHs were installed before the beginning of PY7.

For the upstream lighting component of the program, the SWE Team reviewed the data tracked in PPL's database and tracking system to verify that PPL was using the appropriate savings values and algorithms from the 2015 TRM or 2014 TRM for PY7. A small amount of savings reported in PY7 was the result of an oversight of a PY5 invoice; this savings was determined under the 2013 TRM lighting algorithms. The SWE reviewed the evaluation team's sample that was pulled from the larger database in order to check for proper use of the CFs, ISRs, HOUs, and other deemed values.

The SWE also reviewed the cross-sector sales information provided by PPL and noted that the approach was identical to that of PY6, and resulted in using the conservative estimate of 12% of residential bulbs sales showing up in non-residential sockets. This approach was born from the PY4 cross-sector analysis done by PPL and applied to PY7 sales numbers for residential LEDs.

Based on the review described above, the SWE Team agrees with PPL's verified gross savings findings for the Residential Retail Program.

A.7.4.1.5 Student and Parent Education

The Student and Parent Energy Efficiency Education Program provides school-based energy efficiency education and take-home energy efficiency kits that include low-cost items to install at home. The program includes five unique delivery components: student cohorts for elementary, primary, and

secondary schools, parent workshops, and participating classroom teachers. For the initial verification effort, the SWE Team verified that the program evaluation activities were consistent with PPL's evaluation plan. Cadmus used a combination of database review, records reviews, and phone or internet surveys to calculate verified gross savings.

The SWE Team verified that, for each measure type, savings were properly calculated and aligned with TRM savings and algorithms. The SWE Team also reviewed the survey data files and confirmed the calculation of ISRs for the various technologies, where appropriate. Finally, the SWE Team reviewed Cadmus's calculation of realization rates for the sample of participants in each delivery component, and confirmed the correct application of these realization rates to the program population as a whole.

The SWE Team found no reportable errors and agrees with PPL's verified gross savings findings for the Student and Parent Energy Efficiency Education Program.

A.7.4.2 Low-Income Program and Audit Summary

A.7.4.2.1 E-Power Wise Program

PPL's E-Power Wise Program provides low-income customers with kits containing basic measures such as CFLs, faucet aerators, low-flow showerheads, and LED nightlights. For its evaluation of the program, Cadmus adjusted the energy and demand savings resulting from 2015 TRM algorithms by applying ISRs determined through surveys of program participants. Ex-ante savings adjustments were made as a result of the review of the Energy Efficiency Management Information System (EEMIS) against records in the implementer CSP database. Several kit records were duplicated in the EEMIS, but not in the implementer CSP data. Overall, the program realization rates for energy and demand were 91% and 40%, respectively.

The SWE Team reproduced Cadmus's per-measure calculations using these ISRs, reviewed the calculation of behaviorally based savings, and verified that the energy and demand savings reported in PPL's PY7 annual report were accurate.

A.7.4.2.2 Wise Home Pilot – A Component of the E-Power Wise Program

PPL introduced the Wise Home Pilot in PY7, which targeted the manufactured home segment within the E-Power Wise Program's eligible participants. The pilot offered two types of weatherization treatments through direct-install: one provided a full treatment that included air sealing and duct sealing, and the other was a partial treatment that only included air sealing. Both treatments included simple weatherization treatments and water efficiency treatments.

Cadmus identified 78 data-entry errors in its review of the EEMIS data, but these had minimal impact on the overall realization rate. The evaluation for the Wise Home Pilot included a randomized control trial and billing analysis to evaluate energy savings based on differences in consumption before and after the home weatherization between treatment and control groups, where applicable.

The SWE Team reviewed the billing analysis output, equations, and statistics and confirmed that they did impact the pilot realization rate. A review of data entry procedures would help to control issues around data entry errors.

A.7.4.2.3 Low-Income EE Behavior and Education

PPL began offering the Low-Income EE Behavior and Education program midyear in PY6 and continued it through PY7. PPL used the same regression analysis as the one employed to estimate program impacts for the Residential EE Behavior and Education program. PPL also performed a savings uplift analysis to identify possible double counting of savings. The uplift analysis concluded that 2.1% of PY7 *ex post* savings were attributable to other efficiency programs, equating to 223 MWh/yr. These savings were subtracted from the residential portfolio to correct for double-counting, but not from the Low-Income EE Behavior and Education savings estimates.

The SWE Team reviewed the billing analysis output, equations, and statistics and confirmed that the approach is sound and the conclusions reasonable. The SWE Team agrees with PPL's verified gross savings findings for the Low-Income Residential Energy-Efficiency Behavior and Education Program.

A.7.4.2.4 Low-Income WRAP

The program evaluation for the PY7 WRAP included a billing analysis of participating customers with a monthly fixed-effects model. The billing analysis was conducted on participants from PY4 and PY5. Only baseload jobs were installed in PY5; therefore, the low-cost and full-cost savings per job were based on customer usage analysis of only PY4 participants because there were no PY5 data for these jobs. The full-cost job savings estimate was based on usage from more than 500 PY4 homes, consistent with the Phase II Evaluation Framework guidance. The SWE Team confirmed that the billing analysis followed PPL's program evaluation plan and the Pennsylvania Mass Market protocol. The SWE Team also reviewed the billing analysis output, equations, and statistics and confirmed that the approach is sound and the conclusions reasonable.

PPL also performed customer-specific modeling using the Princeton Scorekeeping Method (PRISM) to provide an alternative weather-normalization methodology. The SWE confirmed that the PRISM approach provided similar savings estimates as the monthly fixed-effects models.

The SWE Team agrees with PPL's verified gross savings findings for the Low-Income WRAP.

A.7.4.2.5 De Facto Heating Pilot – A Component of the WRAP)

PPL introduced the De Facto Heating Pilot in PY7. The pilot targets low-income households that use an inefficient or unsafe electric heat source, such as portable electric space heaters or an electric stove, in place of their inoperable fossil fuel heating system. Through the pilot, PPL Electric Utilities replaced the inoperable heating system of 12 participants with an efficient heat pump system. Some participants were also eligible to receive a heat pump water heater and full-cost products and services through the Winter Relief Assistance Program (WRAP).

PPL originally targeted up to 20 homes for installation of new ductless mini-splits. However, during the pilot, one house was found to already have ducts installed and the pilot was modified to include air source heat pumps. The pilot was also expanded to allow a customer who used kerosene, an electric stove, and an electric space heater to participate in the pilot.

As the De Facto Heating measure began as an IMP to be incorporated into the 2016 TRM, the SWE Team confirmed the calculated savings for each measure was consist with the 2016 TRM section 2.2.3 for ductless mini-split heat pumps and the 2015 TRM for the remaining measures. The SWE Team found

that the tracking database had accurate data fields and that the algorithms were in general agreement with the TRM. The Team also confirmed that Cadmus followed the December 2015 PPL Electric Utilities EM&V Plan De Facto Heating Pilot Program and the use of the draft 2016 TRM for the mini-split heat pump savings. It was also confirmed that Cadmus made the appropriate adjustments when the high-efficiency heat pump system was added to the pilot.

A.7.4.3 Non-Residential Program Audit Summary

The SWE Team reviewed project files to audit the accuracy of the savings values stored in the program-tracking database and to confirm that calculations were performed in accordance with the applicable TRM, or by some other reasonable methodology. The SWE Team reviewed non-residential projects from PPL's Master Metered Low-Income Multifamily Housing (MMMF), Prescriptive Equipment Lighting, Prescriptive Equipment Non-Lighting, and Custom Incentives programs in PY7. Several projects were selected from each quarter within each program, for a total of 24 projects. For the most part, PPL's project documentation was complete, well organized, and clearly labeled, except for two projects that had small inconsistencies between the documentation and the tracking system. The details of the review can be found below.

The SWE Team reviewed PPL's PY7 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table A-142, showing relative precision at the 85% confidence level.

Table A-142: Compliance across Sample Designs for PPL's PY7 Non-Residential Programs

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Custom Incentive	4.3%	8.6%	✓
Master Metered Low-Income Multifamily Housing	9.9%	7.6%	✓
Prescriptive Equipment	1.8%	2.8%	✓
Prescriptive Equipment (GNI)	1.0%	5.3%	✓
Continuous Energy Improvement	3.8%	46.6%	✓

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups. Details about each program evaluation sample are provided in Appendix A.7.4.3.2.

As part of the audit process, the SWE Team performed six ride-along site inspections of non-residential projects to oversee PPL's on-site evaluation practices. The projects selected for ride-along inspection encompassed lighting upgrades, RTU upgrades, and a VFD project. The SWE Team approved all sampled projects. Details of all six projects and their associated findings are presented below.

The SWE Team performed a verified savings analysis on seven submitted projects, checking the accuracy of the calculations, appropriateness of the evaluation method, and level of rigor selections. The SWE Team found the level of rigor chosen by the evaluation contractor to be reasonable, based on project size and uncertainty. In its PY5 and PY6 annual report, the SWE Team recommended that Cadmus

provide more detailed documentation and more consistently record the evaluation work and corresponding outcomes. The detailed site reports and supporting information provided in PY7 fulfilled this request and clearly presented the methodologies, assumptions, and calculations used in the evaluations. The results of the verified savings analysis are presented below.

A.7.4.3.1 Project Files Review

The SWE Team reviewed non-residential projects from PPL's Master Metered Low-Income Multifamily Housing (MMMF), Prescriptive Equipment Lighting, Prescriptive Equipment Non-Lighting, and Custom Incentives programs in PY7. Several projects were selected from each quarter within each program, for a total of 24 projects. Project files included project-level savings calculation workbooks, applications, invoices, inspection forms, and specification sheets. For the most part, PPL's project documentation was complete, well organized, and clearly labeled except for two projects that had small inconsistencies between the documentation and the tracking system.

Table A-143 presents an overview of the projects that were reviewed by the SWE Team and the findings.

Table A-143: PY7 Project Files Review for PPL

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q1	PPL-13-07989	Custom	Ammonia compressor process refrigeration system	Yes	Yes	No	Yes	N/A	Yes, eQuest modeling
PY7Q2	PPL-13-07498	Custom	Compressed air retrofit including controls, air receiver tank and high-pressure to low-pressure demand conversion	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PPL-13-08365	Custom	Installed a 1,500-ton steam turbine chiller to utilize the exhaust heat from its CHP unit to generated steam to run the chiller and offset the electricity the two 900-ton chillers would have used.	Yes	No, 1,615,462 kWh in Tracker but 1,202,014 kWh in Analysis	No	Yes	Yes	N/A
PY7Q3	PPL-13-11790	Custom	EMS	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	1398412	MMMF	Lighting and light control retrofit (mostly LED fixtures)	Yes	Yes	No	Yes	Yes	N/A

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q1	1238822	MMMF	LED lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	1653152	MMMF	Lighting retrofit T12s to T8 and incandescent to LED, controls	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	919635	MMMF	LED lighting retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	1804304	MMMF	T12 to T8 retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	841819	MMMF	Lighting, showerheads, aerators, and thermostatic shower restriction valves	Yes	No, 46,837 in tracker but 35,043 or 51,086 in bundle	No	Yes	Yes	N/A

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q4	1952839	MMMF	Lighting and vending machine controls	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PPL-13-07619	P. Equip Non-Lighting	Mini-split ASHP 19 SEER	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PPL-13-08217	P. Equip Non-Lighting	HVAC (ductless heat pump)	Yes	Yes	No	Yes	Yes	N/A
PY7Q1	PPL-13-11248	P. Equip Non-Lighting	Refrigeration (high-efficiency evaporator fans)	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PPL-13-12355	P. Equip Non-Lighting	Refrigeration (high-efficiency evaporator fans)	Yes	Yes	No	Yes	Yes	N/A

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q4	PPL-13-10648	P. Equip Non-Lighting	Refrigeration (high-efficiency evaporator fans)	Yes	Yes	No	Yes	Yes	N/A
PY7Q4	PPL-13-12190	P. Equip Non-Lighting	Ice maker	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PPL-13-09184	P. Equip Lighting	Lighting retrofit (LED, T5, fridge cases, etc.)	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PPL-13-09236	P. Equip Lighting	Lighting retrofit (LED, T5, fridge cases, etc.)	Yes	Yes	No	Yes	Yes	N/A
PY7Q2	PPL-13-11365	P. Equip Lighting	Lighting retrofit (interior and exterior)	Yes	Yes	No	Yes	Yes	N/A

Quarter	Project Number	Program	Project Description	Are all files included?	Do values match program tracking data?	Equipment discrepancy between invoices and calculations?	Sufficient info for SWE to follow?	For TRM measures, are correct algorithms and HOU values used?	For Custom measures, is the methodology clear and auditable? Is it a sensible approach?
PY7Q2	PPL-13-12055	P. Equip Lighting	Dusk-to-dawn LED floodlight retrofit	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PPL-13-12100	P. Equip Lighting	Lighting retrofit (incandescent to LED)	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PPL-13-12477	P. Equip Lighting	Lighting retrofit (indoor and outdoor LED)	Yes	Yes	No	Yes	Yes	N/A
PY7Q3	PPL-13-11701	P. Equip Lighting	Lighting retrofit (indoor LED)	Yes	Yes	No	Yes	Yes	N/A

Project PPL-13-08365 in the Custom Incentives Program had 1,202,014 kWh/yr reported as the savings total in analysis in the project file, but 1,615,462 kWh/yr reported in the tracker. After consulting with PPL, the number reported in the tracker is correct, and the value of 1,202,014 in the "analysis in the project file" was apparently taken from an analysis done by the implementer, EPS, in file "PPL-13-08365 Custom Analysis.xls". This was the value prior to verification by the evaluator. PPL correctly reported the verified savings value, not the EPS result.

Project 841819 in the MMMF Program had 46,837 kWh/yr in the tracker but either 35,043 kWh/yr or 51,086 kWh/yr in the bundle, depending on the section. The SWE was unable to square the Appendix C calculator and the bundle-reported savings with the savings in the tracking database. After consulting with PPL, they noted that the savings in the tracker were correct and the bundle was incorrect. The discrepancy in the Appendix C calculator is due to the implementer using 13.5W as the installed wattage for the Front White Cylinder Sconces in EEMIS instead of 14 W.

A.7.4.3.2 Sample Design Review

PPL's PY7 annual report provides detailed information about the sample design and selection for the PY7 gross impact evaluation of non-residential programs. Four PPL non-residential programs reported savings in PY7: Custom Incentive Program, Master Metered Low-Income Multifamily Housing Program, Prescriptive Equipment Program (includes lighting and non-lighting strata), and Continuous Energy Improvement Program.

A.7.4.3.2.1 Custom Incentive Program

The Custom Incentive Program offers financial incentives to customers for installing extensive energy efficiency projects, retro-commissioning existing equipment, making repairs, optimizing equipment, or installing equipment measures or systems not covered by the Prescriptive Equipment Program or the TRM. A threshold of 500,000 kWh/year savings was used to delineate the small and large strata for the program. The large stratum had 18 projects in PY7, and these were evaluated at a high level of rigor with pre-installment measurements. The sampling strategy of this program is presented in Table A-144.

Table A-144: PPL's PY7 Sampling Strategy – Custom Incentive Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Small	64	85%/15%	10	10
Large	18 (all projects in large stratum)	N/A	18	18
Program Total	**82**	**85%/15%**	**28**	**28**

The achieved precision values for energy and demand are listed in Table A-145.

Table A-145: Observed Coefficients of Variation and Relative Precision – Custom Incentive Program

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Small	0.6271	28.67%	0.9018	41.23%
Large	0.0	0.0%	0.0	0.0%
Program Total		**4.3%**		**8.6%**

The achieved precision values of 4.3% for energy and 8.6% for demand at the 85% confidence level met the SWE Team requirements of 85/15 confidence/precision as specified in the Evaluation Framework.

A.7.4.3.2.2 Master Metered Low-Income Multifamily Housing (MMMF) Program

This is a new program that started at the beginning of Phase II. Twenty projects were selected, from a total population of 55 projects that were completed in PY7, as samples for site visits and records review. The sample design targeted precision of +/–15% at the 85% confidence level. The detailed sampling strategy for the MMMF Program is shown in Table A-146. During the evaluations from each of the strata listed below, Cadmus measured three specific program components: common area lighting, direct installation in apartments, and direct installation in common areas. EM&V and precision calculations were reported for these program types.

Table A-146: PPL's PY7 Sampling Strategy – MMMF Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Multifamily	41	85%/15%	10	10
Nursing homes	14	85%/15%	10	10
Program Total	**55**	**85%/15%**	**20**	**20**

The achieved precision values for energy and demand are listed in Table A-147.

Table A-147: Observed Coefficients of Variation and Relative Precision – PPL's MMMF Program

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Multifamily – common area lighting	0.0963	4.79%	0.3581	17.82%
Multifamily – direct install – apartments	0.0456	2.84%	0.0427	2.67%
Multifamily – direct install – common areas	0.7603	73.15%	–	–

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Nursing home – common area lighting	0.3016	15.01%	0.1920	9.56%
Nursing home – direct install – apartments	N/A	0.00%	N/A	0.00%
Nursing home – direct install – common areas	N/A	N/A	–	–
Program Total		**9.85%**		**7.62%**

The program total achieved precision for energy and demand met the SWE Team requirements.

A.7.4.3.2.3 Prescriptive Equipment Program

The Prescriptive Equipment Program targets customers from the small C/I, large C/I, GNI, and agricultural sectors. Sample design was at the measure level; all the measures were stratified into two groups: lighting and equipment (non-lighting) projects. Four substrata were assigned to lighting measures based on the reported savings. The substrata for lighting projects were small, small-medium, medium-small, and large.

For the equipment measures, the sample plan targeted +/–15% precision at the 85% confidence level. No site visits were performed for the equipment measures in PY7 because the specs for the types of products rebated could not be easily verified on-site. The sampling strategy and corresponding evaluation activities for the non-lighting stratum are shown in Table A-148.

Table A-148: PPL's PY7 Sampling Strategy – Prescriptive Equipment Program, Non-Lighting

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activities
Equipment Total	119	85%/15% at the stratum level	49	49	Records review
			9	4	Telephone verification

The sample design for the lighting measures targeted +/–10% precision at the 90% confidence level, and stratified ratio estimation was used to estimate savings for the program. The detailed sampling strategy for lighting projects is shown in

Table A-149.

Table A-149: PPL's PY7 Sampling Strategy – Prescriptive Equipment Program, Lighting

Substratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Small	1,080	N/A	N/A	10
Small-medium	199	N/A	N/A	7
Medium-small	61	N/A	N/A	6
Large	25	N/A	N/A	12
Total	**1,365**	**90%/10%**	**N/A**	**35**

The achieved precision values for both energy and peak demand for the Prescriptive Equipment Program are presented in Table A-150. The table shows that PPL exceeded the requirement of 85%/15% confidence/precision for this program. The GNI sector contributed gross savings of 24% of the total lighting savings, so Cadmus reported the relative precision values at 85% confidence level for both energy and peak demand for the GNI sector in this program separately in the PY7 annual report, in accordance with the Evaluation Framework. The observed coefficients of variation and relative precisions are provided in Table A-151.

Table A-150: Observed Coefficients of Variation and Relative Precisions – PPL's Prescriptive Equipment Program

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
Lighting	0.01	1.80%	0.09	3%
Equipment	0.07	2.94%	0.003	4%
Program Total		**1.77%**		**2.80%**

Table A-151: Observed Coefficients of Variation and Relative Precisions – PPL's Prescriptive Equipment Program – GNI Sector

Sector	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
GNI	0.09	0.99%	0.22	5.27%

A.7.4.3.2.4 Continuous Energy Improvement Program

The Continuous Energy Improvement (CEI) Program targets school districts, for which PPL provides technical support to develop and implement a strategic energy management plan (SEMP). This program was new in Phase II and no savings were reported in PY5, so PY6 was the first year that savings were reported. The sampling strategy of this program is presented in Table A-152. The population and

sampling changed from school districts in PY6 to schools in PY7, in accordance with the program and evaluation design.

Table A-152: PPL's PY7 Sampling Strategy – CEI Program

Stratum	Population (Schools)	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Schools	44	N/A	44	42
Program Total	**44**	**N/A**	**44**	**42**

The achieved precision values for energy and demand are listed in Table A-153.

Table A-153: Observed Coefficients of Variation and Relative Precision – CEI Program

Stratum	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Energy	Relative Precision at 85% C.L. for Energy	Observed Coefficient of Variation (C_v) or Proportion in Sample Design for Demand	Relative Precision at 85% C.L. for Demand
School district	N/A	3.83%	N/A	46.57%
Program Total	N/A	3.83%	N/A	46.57%

The relative precision for energy in PY6 was 29%, which was expected due to the low sample size available. This improved to be within the Evaluation Framework limits for PY7. However, demand is well outside the recommended target of 15%. However, the program was designed to deliver energy savings as there are no demand reduction compliance requirements in Phase II.

A.7.4.3.3 Ride-Along Site Inspections

Table A-154 summarizes the SWE Team's PY7 ride-along site inspections of PPL's non-residential project installations. For PY7, all PPL PY7 site inspection findings are categorized as:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or evaluation contractor savings calculations or reports.

Table A-154: PPL's PY7 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PPL-13-11947	VFDs	The ex ante savings were calculated using an incorrect peak and regression analysis; the evaluation contractor used a more appropriate approach for verified savings.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
PPL-13-12356	HVAC (RTUs)	At the site visit, it was determined that the incorrect HOU was used in the ex ante; the evaluation contractor has corrected for this in the ex post.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.

Project ID	Technology	Finding	Finding Type	Resolution
MMMF-1436246	Lighting	Minor variations in the fixture counts were discovered on-site.	Eval	The verified savings evaluation did account for the site findings and the SWE Team had no further recommendations for this project.
PPL-13-11832	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PPL-13-11882	Lighting	The SWE Team found that the evaluation contractor's review of the project is accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PPL-13-12424	Lighting	Minor variations in the fixture counts were discovered on-site.	Eval	The verified savings evaluation did account for the site findings and the SWE had no further recommendations for this project.

A.7.4.4 Net-to-Gross and Process Evaluation Audit Summary

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in PPL's PY7 annual report to determine whether they were consistent with the reporting templates provided by the SWE. The SWE Team's audit of the process reports also included a review of process-related methods and research activities to determine whether they were consistent with the approved evaluation plan, and a review of the linkage between findings, conclusions, and recommendations.

Overall, the SWE Team found that the evaluations appeared to be consistent with the Phase II evaluation plan, with four exceptions:

- For a few of the interviews and surveys, Cadmus did not achieve the planned number of completions; only one of the surveys had a targeted level of confidence/precision, and Cadmus did not report the impact the reduced number of completions had on confidence/precision.
- PPL and Cadmus substantially revised the evaluation plan for the Wise Home Pilot after PPL was unable to enroll the planned number of eligible customers, and Cadmus followed the revised plan.
- Cadmus and PPL moved the planned contractor and designer interviews and additional benchmarking research to Phase III for the Custom Incentive Program but did not provide an explanation for the change.
- Cadmus and PPL decided not to conduct interviews with agricultural trade allies in the Prescriptive Rebate program due to several complications.

The SWE Team determined that the sampling approaches for the process evaluation activities were appropriate. The participant surveys either attempted a census or used a simple or stratified random sampling approach. Most survey samples either had enough cases to achieve at least 90/10 confidence/precision, or were drawn from such small populations that achieving that standard would have required reaching a large percentage of the population. For the in-depth interviews with program staff, implementers, or other program actors, the sampling was purposive. In a few instances, Cadmus

completed interviews or surveys with fewer respondents than planned; Cadmus discussed why this occurred and any impacts this had on the findings.

The SWE Team deemed the reporting to be generally well done, with a few exceptions (see the list below). Overall, the evaluation contractor presented findings in a clear manner and the report generally included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, conclusions, and recommendations. The PY7 annual report provided all the required elements, including a summary of methods, high-level findings, and a table of recommendations with descriptions of whether or not the EDC was implementing or considering the recommendations. All programs drew on multiple sources to inform most findings and recommendations. Listed below are areas where additional information would be valuable, although not required:

- It would be valuable to include the survey mode (web, phone, mail) used to conduct each survey in the sample and disposition tables as well as in the text so the reader does not have to refer to the text to find which mode was used. In addition, for multi-mode surveys (e.g., a web and phone survey), it would be valuable to report the sampling and disposition information separately by mode rather than in the aggregate.
- Several recommendations included multiple specific recommendations that could be separated. Combining too many recommended actions into one recommendation can be confusing, particularly if one recommended action can be taken without taking the other recommended actions.
- Two recommendations were too vague and did not include specific actions to take. All recommendations should include actionable tasks or ideas.
- The results in a few sections of the report would be easier to process if provided in a table instead of the bullets or short paragraphs currently used.
- Some survey findings from the low-income program were reported in the residential program chapter but did not include the information about the data collection methods. Adding these details to each chapter would improve the readability of the report so that the reader does not have to go back and forth between chapters to get the full details.

Detailed summaries of the SWE Team's review of the process evaluation by program are in Appendix B.

The remainder of this section summarizes the activities and key findings of the SWE Team's NTG audits of PPL's PY7 programs.

Table A-155 summarizes the results of the SWE Team's audit of Cadmus's NTG assessment of the PPL programs.

Table A-155: Summary of SWE Team Review of PPL NTG Evaluations

Elements Reviewed in PPL Annual Report	SWE Findings
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Yes, with exceptions noted
NTG method used – the common method or another	Usually common method, with acceptable modifications Also used billing analysis and demand elasticity model where common method not required

NTG common method applied correctly	Yes

The following subsections present detailed discussions of the SWE Team's NTG audits of PPL programs in PY7 and summarize the findings, specifically the audit of NTG reporting and related files. The results are provided for residential, low-income, and non-residential programs.

Residential Programs

Cadmus estimated NTG for two residential programs: The Residential Retail Program and the Residential Home Comfort Program. Cadmus did not conduct NTG research for three other programs. For the Appliance Recycling Program (ARP), Cadmus reported the PY6 NTG values, citing no significant changes to program delivery and the target market. It reported an assumed NTGR of 1.0 for the Student and Parent Energy-Efficiency Education Program, based on the voluntary participation of teachers and schools and the fact that energy efficiency measures are provided at no cost to the teachers, who pass them on to students as part of the curriculum. Finally, Cadmus noted that the impact evaluation for the Residential Energy-Efficiency Behavior & Education Program produces net savings via the RCT analysis, and argued that therefore estimation of NTGR is not applicable.

Cadmus correctly used the SWE Team's common approach for all downstream programs and used a reasonable approach for estimating NTG for an upstream program component. Cadmus reported the NTG methodology in the PPL PY7 annual report and showed calculations in corresponding Excel workbooks for each program, and provided the survey instruments.

Cadmus used the common method for downstream program components, following the common method to score the intention and influence components to determine the free ridership score. While the provided Excel workbooks demonstrate proper and error-free use of the common method, the SWE Team found the description of the downstream NTG methods to be somewhat unclear: while Cadmus did explain a high-level summary of the survey methods, it did not explain the free-ridership or spillover calculation algorithm. Cadmus did provide an Appendix in the PY5 Annual Report, and the methodology was unchanged in PY6 and PY7. In the PY7 annual report, Cadmus provided a high-level summary of the methods used for estimating ARP NTGR in PY6, stating it followed the SWE's "Common Approach for Measuring Net Savings for Appliance Retirement Programs" and summarizing the four major factors in the net savings analysis: free-ridership, secondary market impacts, induced replacement, and spillover.

Cadmus used a demand elasticity model to estimate free-ridership and NTGR for the upstream lighting component of the Residential Retail Program. The description of the demand elasticity method was very clear. Noting that its demand elasticity approach did not quantify market effects, Cadmus suggested that if market effects were accounted for then the NTGR for the upstream lighting component of the Residential Retail Program "would be higher than 59%." While the SWE Team acknowledges the merit of this methodological claim, and approves of Cadmus's choice to refrain from quoting a specific alternative NTGR, the SWE Team interprets "59%" as a typo, as Cadmus reported 39% free-ridership and an NTGR of 61%.

A summary table in the PPL PY7 annual report's overview section shows the program-level NTGR for the Residential Retail Program, which appears to be a savings-weighted mean of the component NTGRs. However, the report does not explain this, and the Excel workbooks provided do not include the calculations used for estimating program-level NTGR. The SWE Team found this issue in Cadmus's PY6

report as well, and noted the issue in the PY6 SWE annual report. In response to the draft of the PY6 report, Cadmus clarified that the program-level NTGR was a savings-weighted average, and said it would note that in future reports. The SWE Team confirmed via email with Cadmus that the PY7 result is also a weighted mean, but would have preferred that Cadmus note that methodological detail in its PY7 report.

Cadmus used a hybrid approach to estimate NTGR for the Residential Home Comfort Program: it used PY5 results for audit and weatherization measures, and conducted primary data collection and analysis for equipment measures. Cadmus reported using a savings-weighted approach to combine these various estimates into a program-level free-ridership, spillover, and NTGR for PY7. The PY7 Home Comfort Program workbook that was provided to the SWE encompassed only the new "Efficient Equipment" program stratum primary data collected and analyzed in PY7 and did not include these weighted calculations, so the SWE Team is unable to confirm the accuracy of weighted program-level calculations. While Cadmus reported program-level free-ridership and spillover values in the Overview of Portfolio chapter, it reported only program-level NTGR in the Residential Home Comfort Program chapter. The SWE Team recommends that Cadmus include program-level free-ridership and spillover values in all program-specific chapters.

Cadmus did not estimate NTGR for manufactured homes or new construction projects. The Cadmus report explained that it did not estimate manufactured home NTGR since there was only one participant. The report did not provide a reason for not estimating NTGR for new construction, but subsequent clarification from Cadmus indicates that the reasons was that there were too few participating builders, as in PY6, and referred to the PY6 report for additional details.

The SWE Team did not question Cadmus's assumption of an NTGR of 1.0 for the Student and Parent Energy-Efficiency Education Program in its PY5 annual report. However, the SWE Team disagrees with Cadmus's arguments for that assumption. It is possible that some of the program participants would have installed the measures even if there had been no program. Therefore, the fact that the measures were distributed at no cost to the recipient through the intervention of school faculty does not mean there were no free-riders. The SWE Team noted its disagreement in the PY6 annual report, and repeats it again here.

Table A-156 summarizes the SWE Team's review of PPL's NTG activities by program.

Table A-156: Summary of NTG Audit of PPL's Residential Programs

Program	NTG Method	Review Comments
Residential Retail Program	The common method was used for downstream components. A demand elasticity model was used to estimate FR in upstream lighting.	Cadmus used the common method for downstream program components and a demand elasticity model for upstream lighting. The description of the latter was clear, but the description of the downstream methods lacked detail (namely, Cadmus did not explain the NTGR calculation algorithm).
Appliance Recycling Program (ARP)	Not calculated: used PY6 values.	Because there were no significant changes to program delivery or the target market, Cadmus used the PY6 NTGR for the PY7 NTGR.
Student and Parent Energy-Efficiency	NTGR was assumed to be 1.0.	Cadmus assumed no FR or SO for this program. The SWE Team disagrees with this assumption but allows it for PY7.

Program	NTG Method	Review Comments
Education Program		
Residential Home Comfort Program	The common method was used for equipment measures. PY5 results were used for audit and weatherization NTGR. Did not calculate NTGR for new construction or manufactured homes.	Cadmus used a savings-weighted approach to combine PY5 results (for audit and weatherization measures) and PY7 results for equipment measures. The Excel workbook provided to the SWE Team did not include this weighted calculation, so the SWE Team is unable to confirm the accuracy of weighted program-level calculations. While the Overview of Portfolio chapter reports program-level FR and SO values, the Residential Home Comfort Program chapter does not include these values (instead, it includes only the program-level NTGR). The SWE Team recommends that Cadmus include program-level FR and SO values in all program-specific chapters. Cadmus did not estimate NTGR for manufactured homes or new construction projects. While Cadmus explained that it did not estimate manufactured home NTGR due to a small participant population, it did not provide a reason for not estimating NTGR for new construction. The SWE Team recommends that Cadmus report its reasoning for not calculating NTGR for new construction.
Residential Energy-Efficiency Behavior & Education Program	Not estimated; impact analysis accounts for FR and SO.	Cadmus reported that no net savings calculations were needed for this program, as the impact evaluation estimates net savings.

Table A-157 summarizes the free-ridership, spillover, and NTG estimates reported in PPL's PY7 annual report for residential programs.

Table A-157: Summary of NTG Estimates for PPL's Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR[a]	Sample Size[b]
Estimated	Residential Retail Program[c]	0.39	0.00	0.61	84
	Residential Home Comfort Program	0.42	0.04	0.61	224
Assumed NTGR = 1.0	Student and Parent Energy-Efficiency Education Program	0.0	0.0	1.0	N/A
	Residential Energy-Efficiency Behavior & Education Program	N/A	N/A	1.0	N/A
Referenced from PY6	Appliance Recycling Program (ARP)	0.40	0.00	0.60	N/A

NOTES:
[a] NTGR = 1 – free-ridership + spillover. In some cases, the NTGR shown in the table may not equal exactly 1 – free-ridership + spillover because of rounding.
[b] The samples provided at least 85/15 precision/confidence.
[c] Program-level NTGR combines downstream and upstream NTG values. Downstream NTGR was estimated from surveys with 84 participants. Upstream NTGR was estimated using sales data.

A.7.4.4.1 Low-Income Residential Programs

Cadmus did not report NTG values for any of the three PPL low-income programs. The PPL PY7 annual report provided the following reasons for doing so:

- The Low-Income Energy-Efficiency Behavior & Education Program produces net savings through the RCT analysis
- Low-Income WRAP's program design should not generate free ridership
- Since PPL does not plan to continue the program in Phase III, no interviews were conducted with decision-makers in PY7's Master Metered Low-Income Multifamily Housing program.

A.7.4.4.2 Non-Residential Programs

Cadmus estimated NTG for three non-residential programs: The Prescriptive Equipment Program (PEP), Custom Incentive Program (CIP), and Continuous Energy Improvement (CEI) Program. Due to the difficulty in reaching program decision makers, Cadmus did not collect new NTG survey data for the Master-Metered Low-Income Multifamily (MMMF) Program, and instead applied a savings-weighted average of PY5 NTGR and PY6 NTGR to PY7 rebated lighting projects. Cadmus did not report the weighted average MMMF NTGR in the PPL annual report. Cadmus did not estimate NTG for a fifth non-residential program, the School Benchmarking Program, as it does not generate savings.

Cadmus reported using the SWE Team's common approach for PEP and CIP. Cadmus used survey data for CEI, and asked participants to rate the program's influence on decisions, including developing tools to implement its strategic energy management plan and to implement operational or behavioral activities.

Cadmus described the NTG methodology in the PPL PY7 annual report and showed calculations in corresponding Excel workbooks for each program. For each program that served both the C/I and GNI sectors, Cadmus provided a single NTGR estimate for the two sectors.

Table A-158 summarizes the SWE Team's review of the NTG methodology by program. While the provided Excel workbooks demonstrate proper and error-free use of the common method, and Cadmus provided the survey instruments with the Excel workbook, the SWE Team found description of the NTG methods to be somewhat unclear: while Cadmus did provide a high-level summary of the survey methods, it did not explain the free-ridership calculation algorithm.

Table A-158: Summary of NTG Audit of PPL's Non-Residential Programs

Program	NTG Method	Review Comments
Prescriptive Equipment Program (PEP)	The common method was used.	Cadmus used the common method, but the description of the methods in the annual report could have been clearer.
Custom Incentive Program (CIP)	The common method was used.	Cadmus used the common method, but the description of the methods in the annual report could have been clearer. Cadmus found evidence of SO but lacked sufficient data to quantify it.
Master-Metered Low-Income Multifamily (MMMF) Program	Not calculated: applied a savings-weighted average of PY5 and PY6 NTGR to PY7 rebated lighting projects.	Because program decision makers are a hard-to-reach population and Cadmus collected data from them in PY5 and PY6, it applied a savings-weighted NTGR average from PY5 and PY6 to PY7 rebated lighting projects. The SWE Team approves of this method. Cadmus did not report the resulting NTGR used for PY7; the SWE Team suggests that Cadmus report the PY7 NTGR in the PPL report.
Continuous Energy Improvement (CEI) Program	Billing analysis, supported by assessment of	Cadmus used survey data, where participants reported very high program influence on savings-related decisions.

Program	NTG Method	Review Comments
	program influence.	
School Benchmarking Program	NTGR was not estimated.	NTG was not estimated, as the program does not generate savings.

Table A-159 summarizes the free-ridership, spillover, and NTGR estimates reported in Cadmus's annual report for non-residential sector programs.

Table A-159: Summary of NTG Estimates for PPL's Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Prescriptive Equipment Program (PEP)	0.23	0.00	0.77	77
	Custom Incentive Program (CIP)	0.39	0.00	0.61	21
	Master Metered Low-Income Multifamily (MMMF) Program	N/A	N/A	Not reported	N/A
	Continuous Energy Improvement (CEI) Program	0.00	0.00	1.00	23
Not estimated	School Benchmarking Program	N/A	N/A	N/A	N/A

NOTES:
[a] The samples provided at least 85/15 precision/confidence.

A.7.5 Statewide Evaluator Final Recommendations

The SWE Team has the following seven recommendations for PPL's consideration.

- For residential product programs, the SWE recommends that PPL consider implementing an online model number look-up mechanism for customers, including incentive levels, to minimize confusion when tiered rebates are offered for the same type of appliance.
- The SWE recommends that PPL investigate the feasibility of using product placement as a lower-cost mechanism for generating sales lift for residential product programs.
- The SWE recommends that consideration be given to expanding the De Facto Heating participant group as much as possible to improve available evaluation data.
- The SWE recommends that PPL consider an LED lighting sales survey in the next available program year to update the 2015 survey data used for cross-sector sales analysis.
- For non-residential product programs, the SWE recommends that PPL consider incorporating a way for applicants to track the status of their application online.
- For certain non-residential programs, alert customers and trade allies at the beginning of the year that a wait list may occur in the future, by posting information on the website explaining why a wait list was implemented and when it is expected to be removed.
- For all programs, the SWE recommends that PPL consider improving the application process by providing examples of completed applications on the website and providing a contact to answer questions.

APPENDIX B | PY7 PROCESS EVALUATION FINDINGS BY EDC

This appendix provides details on the SWE Team's audits of the EDCs' process evaluations. The process evaluation audits examined whether the EDCs' evaluation contractors completed the tasks in the evaluation plan, used an adequate sampling approach, included required elements per the report template in the annual report (methods, findings, conclusions, and recommendations), and provided actionable recommendations supported by findings or conclusions. The SWE Team's scope did not include a detailed listing of all possible ways in which the evaluations could have been improved; however, it did identify some places where a more detailed analysis might prove valuable.

B.1 DUQUESNE LIGHT COMPANY

B.1.1 Residential Programs

Navigant provided process evaluations for six residential programs: The Residential Energy Efficiency Program (REEP), Residential Appliance Recycling Program (RARP), School Energy Pledge Program (SEP), Whole House Energy Audit Program (WHEAP), Home Energy Reports (HER) Program, and Low-income Energy Efficiency Program (LIEEP).

For the PY7 process evaluation of the above programs, Navigant reviewed program documents, including program websites, interviewed the residential program coordinator and HER manager, developed logic models, reviewed the program tracking system, and surveyed program participants.

For each program, the SWE provides a brief program description, summary of the process evaluation findings, and summary of the SWE's audit of the findings. The SWE Team notes two general comments about the findings, conclusions, and recommendations for the process evaluations of Duquesne's programs:

1) When pointing out differences between groups such as a difference between market-rate and low-income respondents, Navigant did not provide statistical significance. Therefore, in several cases it is not clear if the differences seen fall within the bounds of what would be expected. For example, Navigant stated that market-rate HER recipients were more likely to recall the number of reports received than were their low-income counterparts. However, statistical significance was not reported, so the reader does not know if the difference should be highlighted or not.

2) Throughout the report, Navigant uses means to report satisfaction and influence responses to scale questions. For example, Table 9 provides mean satisfaction scores, on a 5-point scale, across six program aspects. However, the sample size is small (15) and seemingly applies only to PY7, not PY5 and PY6, which are also displayed. Furthermore, providing means of 5-point scales is not as helpful to the reader as showing the range of responses, as was done in Figure 22. It is particularly helpful to show the ranges when the narrative discusses details about respondents who were dissatisfied. Providing the range of responses allows the reader to see how many respondents were dissatisfied, as opposed to trying to figure out how many were dissatisfied.

B.1.1.1 Residential Energy Efficiency Program (REEP)

B.1.1.1.1 Brief Overview of the Program and Its Success

The REEP was largely unchanged in PY7 compared with PY6. The program attempts to achieve residential energy savings through rebates on energy efficient equipment, upstream incentives on efficient lighting, and distribution of kits containing free energy efficient equipment (CFL and LED

lighting and smart power strips) to customers who complete an online energy audit or attend an event sponsored by one of several cooperating organizations (program outreach partners). As in PY6 and PY5, REEP exceeded savings goals for less than budgeted. In PY7 the program achieved 103% of its energy savings goals and spent 86% of its targeted budget.

B.1.1.1.2 Summary of the Process Evaluation Findings

Navigant reviewed the June 1, 2015 to May 31, 2016 TRM and program materials and surveyed 59 rebate participants (55 market-rate, 4 low-income) and 15 kits participants, for 74 surveyed participants. These 74 respondents also informed the impact analysis.

B.1.1.1.2.1 Rebate Participants

As in PY6, Navigant reported that rebate participants most commonly learned about the rebates online, at retail stores, or from contractors. Events and online information were the two sources of information reported to be the most influential by participants. It was unclear why n=55 in Figure 2, where the source of awareness is provided, and n=59 in Table 6, where the influence of each source is reported.

Participants were generally satisfied with the program. Of the seven program aspects that respondents rated on a 1-to-5 satisfaction scale, the mean score increased in PY7 compared with PY6. Two program aspects received slightly lower mean scores in PY7 compared with PY6, and one did not change.

For any respondents reporting a 3 or lower satisfaction score, Navigant asked the respondents about their dissatisfaction and provided five statements that captured the reasons for dissatisfaction. However, it was not clear how many respondents were dissatisfied with each of the statements. For example, in one case Navigant reported "Respondents would prefer to make fewer calls than was necessary to Duquesne to fulfill their rebate or accept their application," but in another statement, Navigant reported that "one respondent indicated he or she had still not received their rebate." It would help the reader to know how many respondents expressed dissatisfaction with each element.

B.1.1.1.2.2 Kit Participants

PY7 customers who received energy efficiency kits (n=15) most commonly learned about the kits through online sources (8), family and friends (3), or via email (2). This differed from PY6, when online sources were noted by only 15% of respondents. The influences of each source of information were rated similarly by respondents. The mean scores ranged from 3 to 4, and as noted above, using means of rating values is somewhat problematic.

Satisfaction generally was high; participants rated the products' energy savings lower than other program aspects. Most participants indicated they likely would recommend the program to others; the average likelihood rating in PY7 was higher than in PY6 (4.2 versus 4.4), with no respondents indicating they would be "very unlikely" or "extremely unlikely" to recommend the program to others. Participants' recommendations on how to improve the program were diverse. Respondents made the following recommendations for the kits:

- Market kits through TV and print materials (2)
- Provide a brighter nightlight (2)
- Provide more energy efficiency tips (2)
- Offer more products in kits (2)
- Provide more information about products (2)

B.1.1.1.3 Summary of the Process Evaluation Audit

Navigant generally summarized findings well and drew well-reasoned findings. In several places, such as Table 9, it provided data from prior evaluations, which was helpful in identifying trends over time. It could have provided this same context in graphs such as Figure 5.

Navigant reported means for participant satisfaction and influence ratings. Using mean rating scores and trying to draw meaningful conclusions about any observed changes is somewhat problematic due to the relatively small sample sizes. For example, n ranged from 1 to 17 for the influence that each source of awareness had on rebate recipients. Reporting the mean can be acceptable with large sample sizes, but when sample sizes are small, reporting the distribution of scores can provide a more accurate description of responses.

Additionally, it would be helpful if the evaluation contractor consistently provided the number of respondents that reported specifics regarding their dissatisfaction with the rebate program. Providing numbers would give the reader some insight into the scale of the dissatisfaction.

B.1.1.2 Residential Appliance Recycling Program (RARP)

B.1.1.2.1 Brief Overview of the Program and Its Success

The RARP seeks to produce residential-sector demand reduction and annual energy savings by removing operable and inefficient primary and secondary refrigerators and freezers from the power grid in an environmentally safe manner. RARP offers a $35 incentive for eligible refrigerators and freezers. The program used the same implementation contractor (JACO) as did the other appliance recycling programs across Pennsylvania in the beginning of PY7. However, JACO went out of business in PY7, resulting in administrative problems for Duquesne. The utility had to contact potentially affected customers and ensure that they received their incentive checks. According to Navigant, customers reported that Duquesne handled the issue well. According to the program website, Duquesne eventually contracted with ARCO to administer the program.

The RARP collaborates with other Duquesne programs such as the LIEEP and the Public Agency Partnership Program (PAPP). The RARP achieved 115% of its PY7 gross savings goals, spending 253% of its planned budget; however, Navigant reported that the planned budget understated RARP implementation costs. These costs will be adjusted in Phase III.

B.1.1.2.2 Summary of the Process Evaluation Findings

Navigant reviewed the TRM and program materials and surveyed 109 RARP participants in PY7 about their awareness and satisfaction with the program.

The most commonly cited ways that participants first heard about the program was through family or friends (25%), TV (18%), and bill inserts (16%). The remaining 41% of participants first learned about the program through one of seven other methods. Respondents also reported on all sources from which they heard about the program. Family or friends (32%), bill inserts (27%), and TV (23%) were the most commonly cited.

Similar to what was found in PY6, participants noted high program satisfaction with most program aspects. However, in PY7 the “time it took to receive the incentive” received the lowest mean score in Phase II. In PY7 the mean score was 3.6, compared with 4.4 and 4.3 in PY6 and PY5, respectively.

Navigant noted that the lower score in PY7 was likely a result of the turmoil caused by JACO's exit from the program.

Of the entire sample (n=111), more than half of the respondents (54%) had no suggestions for program improvement. The remaining 46% reported ways the program could be improved. Of the whole sample, and consistent with the problems experienced by JACO's exit, the most commonly cited problem was slow rebate processing (18%), followed by the low amounts of program advertising (14%) and low incentive amounts (10%).

Respondents chose to participate largely because of the cash incentive (53%) and the convenience of participating (29%). Far fewer respondents elected to participate for other reasons. While the incentive was the reason they chose to participate, participants reported, on average, that the convenience of picking up the old appliance, the free pickup, and the recycling of the old appliance were slightly higher influences than the incentive (mean scores of 4.1, 4.0, and 4.0 compared with 3.6).

B.1.1.2.3 Summary of the Process Evaluation Audit

Navigant generally summarized findings well and drew well-reasoned findings. The reporting of sample sizes was not always clear, as different sample sizes were reported in different graphs and tables in the residential process evaluation report. For example, while the Duquesne annual report for PY7 reports an achieved process evaluation sample of 109 RARP participants, Figure 10 of the process evaluation report (RARP Participant Reasons for Participating) reports an *n* of 135. The reader assumes the *n* for Figure 10 is number of responses rather than number of respondents, but the report does not make that clear.

As was discussed above in the REEP section, providing mean values for scale questions seems less appropriate than providing the range of responses. In cases where the sample size is larger, perhaps report the mean and the range to help the reader fully understand the data and provide the reader with a number of respondents who were dissatisfied or not influenced.

B.1.1.3 School Energy Pledge Program (SEP)

B.1.1.3.1 Brief Overview of the Program and Its Success

The SEP is designed to teach elementary students about energy efficiency through in-school assemblies and lesson materials and has not changed throughout Phase II. The program helps families save energy at home through distribution of free energy efficiency tool kits (SEP Energy Efficiency Kits), which contain energy efficiency items (four CFL bulbs, one smart strip, and two nightlights) and information about energy savings opportunities. In return for a family's commitment to install the energy efficiency items (by completing the application and pledge form), the participating school receives an incentive of $25. The program failed to meet goals by achieving 2% of the targeted PY7 energy savings and using 32% of the budget. In PY7, the program conducted SEP at one school. SEP will be replaced in in Phase III with a program that reaches middle- and high-school students.

B.1.1.3.2 Summary of the Process Evaluation Findings

Navigant interviewed the program manager to understand the administration of the program and surveyed 27 program participants (14 market-rate, 13 low-income) to assess program satisfaction and NTG.

The program manager noted that program goals had not been met because the program had reached market saturation. The program, in operation since 2009, has reached all schools and will not be revisiting schools because they do not want to provide kits to households that may have been reached via siblings during earlier presentations.

The 27 parent participants reported high satisfaction scores. Mean scores on a 1-to-5 satisfaction scale across six program aspects ranged from 4.4 to 4.9, with the energy savings from the kits receiving the lowest mean score and the items in the kit receiving the highest mean score. Across all six program aspects, only one respondent provided a score of less than 3. That respondent was dissatisfied with Duquesne as their electricity provider did not elaborate.

The parent participants reported a range of influences for why they elected to participate. The most commonly cited reason, the information provided by their children (7), was the most commonly cited reason in PY5 and PY6 too. Other reasons to participate in PY7 included the desire to save energy (6), the desire to reduce their bills (4), and the information sent home.

Eleven parent participants made the following suggestions for improving the program:

- Offer more products in the kits (3)
- Provide more education for the students (3)
- Increase advertising (3)
- Implement the program earlier in the school year (1)
- Provide more energy efficiency tips (1)

B.1.1.3.3 Summary of the Process Evaluation Audit

Navigant summarized findings adequately. As was discussed above in the REEP section, using mean scores for relatively small sample sizes is not as informative as knowing the distribution of scores. The dissolution of this program in Phase III makes the results of this evaluation less important. However, perhaps results from this evaluation can inform aspects of the SEP replacement.

B.1.1.4 Whole House Energy Audit Program (WHEAP)

B.1.1.4.1 Brief Overview of the Program and Its Success

The WHEAP, not changed since PY6, provides both comprehensive and walk-through residential home energy audits to market-rate and low-income residential customers. The program provides customers with information on potential energy efficiency upgrades for their home and educates customers on general energy efficiency practices. Auditors speak one-on-one with participating customers and provide customers with tailored findings. Low-income customers receive the audit for free, whereas market-rate customers receive the audit for $149. Where appropriate, all WHEAP participants receive installation of CFLs, energy efficiency nightlights, faucet aerators, low-flow showerheads, smart strips, and pipe wrap.

Comprehensive audits for low-income customers are restricted to customers with electric space and water heating. If a low-income customer has gas heating, the program provides a no-cost walk-through audit.

Savings from the program result largely from the installation of lighting measures: 97% of savings in PY7 came from lighting, up from 80% in PY6. Any savings resulting from the auditor making operational or

safety improvements while on-site are not captured by the program, and any refrigerator replacements made because of auditor findings are credited to the LIEEP.

The WHEAP achieved 11% of its savings target and spent 146% of its budget in PY7, following the same pattern identified in PY6.

B.1.1.4.2 Summary of the Process Evaluation Findings

In PY7 Navigant conducted a review of program data and surveyed program participants. Navigant relied on data collected in PY6 from staff, and implementers shed light on some of the findings from their analysis of the participant survey and database. The participant survey revealed the following findings:

- The 22 surveyed participants (9 market-rate, 13 low-income) heard about the program from at least one of nine sources. The two most commonly cited sources of program awareness were online (5) and family or friends (5).
- Generally, respondents rated sources of program information where they interacted with a person as more influential than sources such as bill inserts and mail. Higher mean scores were noted for program sources such as family or friends, a local community agency, and interactions with program staff compared with sources such as mail and retail store information.
- Participants rated their satisfaction across eight program aspects on a 5-point satisfaction scale, and the mean scores ranged from 4.1 to 4.7, with samples sizes ranging from 17 to 22. The lowest mean scores were for the overall performance of Duquesne as an electricity provider and the energy savings resulting from the installed items. The highest mean score related to the courtesy and professionalism of the auditor. Additionally, almost all respondents indicated they would likely recommend the program to others, providing a score of 4 or 5.
- Several respondents reported dissatisfaction:
  - One respondent provided consistently low satisfaction scores, explaining that his auditor did not provide CFLs and did not seem knowledgeable, his energy consumption did not go down, and he would not recommend the program to others.
  - Two low-income respondents were dissatisfied with the size of the refrigerator they received through the LIEEP.
  - Two low-income respondents noted dissatisfaction with the lack of reduction in their energy bills.
- Of the 22 participants, 10 suggested five recommendations to improve the program, including increasing the scope of service (3) and improving advertising (2). One respondent each recommended providing different recommendations, more information about installed items, and replacing equipment with items of equal size and value.
- Two respondents reported installing rebated items post WHEAP participation. One added insulation, and the other purchased appliances. Program data demonstrated a similar trend. Of 138 participants (both low-income and market-rate) in PY7, 10 participated in another Duquesne program. Both of these findings were similar to PY6 findings.
- Similar to in PY6, most participants could not recall the recommendations from their audit. Three respondents recalled recommendations for appliances.

B.1.1.4.3 Summary of the Process Evaluation Audit

Navigant provided a good overview of the PY7 findings. The SWE recommends the following changes:

- With the small samples sizes in Table 44, it may be helpful to provide some broader categories for the sources of information; for example, group sources by those that involved person-to-person interaction versus less direct mechanisms like bill inserts and mail.
- Displaying the range of responses instead of means would make it easier to follow the discussion about dissatisfaction. A chart showing the range would provide the sample sizes for those who were dissatisfied, and the reader could more easily link that chart with the dissatisfaction discussion.
- The sample size in Figure 17 equals 22, but the sum of responses is less than 22. The SWE assumes the data for this figure allowed for multiple responses, so the sum should at least equal the total sample size. Also, functionally there is no difference between those who reported "don't know" and those who made no recommendation, so those responses should be combined.
- The second paragraph under Section 7.4.1.2 states that most respondents could not recall their audit recommendations, but later the paragraph describes a fourth respondent who could not recall the recommendation they received. It is unclear what the difference is between the group and the fourth respondent.

B.1.1.5 Home Energy Reports (HER) Program

B.1.1.5.1 Brief Overview of the Program and Its Success

The HER Program provides residential customers with a regularly scheduled report about their energy usage as it compares with that of neighbors with similar homes. The reports also provide energy savings tips, and studies have shown that this type of information can lower energy usage by 1%–2%. In PY7, 225,000 residential customers (200,000 market-rate, 25,000 low-income) received reports, up from 50,000 when the program started in PY4. The program did not operate in PY5 or PY6. In PY7, the HER Program accounted for about 63% of residential savings, not counting upstream lighting and kit savings.

Duquesne had a Phase II savings target for the HER Program, and despite not operating in the first two years of Phase II (PY5 and PY6), the program achieved 94% of its Phase II target in PY7, or 279% of its PY7 goal. The program spent 44% of its budget to achieve those goals.

B.1.1.5.2 Summary of the Process Evaluation Findings

Navigant completed 134 (59 market-rate, 75 low-income) phone surveys with HER Program recipients and 30 phone surveys with customers who opted out of receiving a report.

HER Program recipients reported how many reports they recalled receiving, and more than one-quarter could not recall the number of reports they received. Navigant shows that market-rate recipients were slightly more likely (32%) to not recall the number of reports compared with low-income recipients (21%), but it was not clear if this difference was statistically significant. Respondents generally reported reading six or fewer reports in the last year.

Three-quarters of respondents reported that the purpose of the reports was to compare their energy use to that of similar homes (44 of 126), persuade them to use less energy (33 of 126), and show their household energy use (17 of 126). The remaining respondents, all with less than 10 mentions, reported that the purpose was to help them use less energy (4), tell them if their household was using too much energy (2), or they reported some other reason (7). Eight respondents did not know the purpose of the reports.

The large majority of respondents (90%) indicated they were satisfied or neutral in their ratings of the reports, and about 10% were dissatisfied with the reports. Navigant reported slight differences between low-income and market-rate recipient scores but did not report the statistical significance.

The large majority of respondents reported that the reports were moderately or extremely accurate in regards to their home's energy consumption. Fewer than 10% reported that the reports were inaccurate.

The three most commonly cited pieces of information deemed valuable by respondents were the comparison of energy usage to prior years, the comparison of energy usage to that of similar homes, and the energy saving tips. A small percentage of respondents reported that no aspect of the reports was valuable. Navigant noted noticeable differences between low-income and market-rate respondents when examining the most valuable pieces of information in the reports. For example, approximately 38% of market-rate respondents valued the comparison of their home with other homes, whereas 21% of low-income respondents valued this element.

Most respondents, including those who opted out of receiving reports, reported making some energy efficiency upgrade to their home in the last 12 months. A higher percentage of opt-out customers reported purchasing small energy efficiency devices than did their market-rate or low-income HER Program counterparts. Recipients reported installing more energy efficiency measures in the last 12 months than did those who opted out of receiving reports. Low-income recipients appeared more likely than market-rate recipients to say that the program influenced their decision to make energy efficiency upgrades.

Those who opted out of receiving reports were asked why. Of the 30 opt-out customers, 2 indicated they never opted out and 10 did not recall receiving the report. Of the remaining 18, 10 elected not to receive the reports because they did not find the reports contained valuable information. The remaining 8 provided seven different responses, including that they felt shamed by the reports (2) and did not have time to read the reports (2).

B.1.1.5.3 Summary of the Process Evaluation Audit

Navigant presented the data about the HER Program clearly and displayed the distribution of scale data as opposed to relying on means as it did in other sections. However, some additional analysis in this section would have been valuable. For example, it would be helpful to see an analysis of the reported most valuable information in the report by the number of reports read over the last year. Various nonparametric tests would be appropriate for such an analysis, which might suggest whether those who read more reports value more or different aspects of the report. Perhaps Navigant conducted this type of analysis and nothing interesting resulted from it, but it is not clear that this deeper level of analysis, which could yield insights for program managers, took place.

There were a few instances in this section where excluding some answers from the analysis could have made things more clear. For example, in Section 8.3.2.1 the reader sees that of the 30 respondents who were surveyed as opt-out customers, 2 reported that they never stopped receiving the HERs. If they claim to still receive the HERs, then they are not opt-outs and should be excluded from the opt-out analysis, making the sample size 28.

In Section 8.3.2.1, Navigant stated that seven opt-out recipients did not recall receiving reports and three "did not know." Functionally, for analysis, what is the difference between not remembering and not knowing? These responses should be combined into one "don't know" category.

There were several places in the HER section that noted differences between low-income and market-rate recipients, but there was no analysis indicating if the differences were statistically significant. For example, the discussion in Section 8.3.1 showed results by market-rate and low-income respondents, but it is unclear if the differences are significant. The SWE suggests conducting this analysis to highlight differences between the groups where they exist, and not elevate differences where they do not exist.

There are two terminology changes that the SWE suggests for this section:

- Navigant used the term "non-low-income" to refer to those recipients who do not meet low-income eligibility guidelines. However, elsewhere in the report, program participants who are not low-income were referred to as "market-rate." Is there a reason to not use the term "market-rate" for the HER Program?
- Customers who receive a HER are not "participants" in the traditional sense of the word, and customers who opt-out are certainly not "participants." Customers who receive the HER are "recipients," and customers who opt out of receiving reports are "opt-out customers." One cannot be an "opt-out participant."

B.1.2 Low-Income Group

B.1.2.1 Low-Income Energy Efficiency Program (LIEEP)

B.1.2.1.1 Overview of the Program and Its Success

Duquesne's LIEEP consists of services provided through REEP, RARP, SEP, and WHEAP when implemented with low-income customers. Additionally, LIEEP coordinates public entities through PAPP and the low-income smart strip installations done through the Low Income Usage Reduction Program (LIURP). The above activities achieved 80% of the PY7 energy savings target, while spending 25% of the PY7 target budget.

Because LIEEP is an amalgam of programs, Navigant provided a review of the projected versus actual savings that came from each component of LIEEP. This review shows that the projected savings for each component did not match the actual savings attributed to each program. The REEP component delivered more savings than projected (35% actual compared with 21.7% projected), RARP delivered less savings (10.4% actual compared with 24.5% projected), SEP and WHEAP delivered less savings (1.4% actual compared with 24.3% projected), and the HER Program delivered more savings (53.2% actual compared with 30.6% projected).

B.1.2.1.2 Summary of the Process Evaluation Findings

In Section 9 of the report about the LIEEP, Navigant provides information about the following components of the program:

LIEEP REEP Kits

- How kit participants learned about the kits
- How satisfied kit participants were with the kit program
- What recommendations kit participants had for program improvement

LIEEP RARP

- How participants learned about RARP
- How satisfied participants were with the program
- What recommendations participants had for program improvement
- What reasons participants had for participating

LIEEP WHEAP

- A review of program data regarding refrigerator replacements in PY7

Due to small sample sizes and the identical implementation of the SEP and WHEAP for market-rate and low-income participants, Navigant's analysis of SEP and WHEAP low-income participants is largely included in the SEP and WHEAP sections of the report.

B.1.2.1.2.1 LIEEP Kits

The 25 low-income kit recipients reported hearing about the efficiency kits through 10 sources. The most commonly cited source was online (6), followed by a newsletter (4). One or two respondents reported eight other sources, including new media, Duquesne representatives, and friends or family.

Kit recipients appeared to be largely satisfied with the kits. Across six program aspects, respondents reported mean scores of 3.8 to 4.4 on a 5-point satisfaction scale in PY7. Across all aspects, mean scores were lower in PY7 than in PY6, but the sample size in PY6 was considerably lower than in PY7 (7 compared with 25).

Most participants noted that they would recommend the program to others, but a specific number of participants was not provided.

Sixteen participants reported on ways the kit program could be improved. According to Navigant, recommendations included marketing the kits more, providing a better nightlight, providing more products in kits, offering more products, and providing more efficiency tips.

B.1.2.1.2.2 LIEEP RARP

The 40 LIEEP RARP surveyed participants learned about the program largely through friends and family and TV ads.

LIEEP RARP participants reported high levels of satisfaction across seven components of the program. The mean satisfaction scores ranged from 4.2 to 4.8, with participants reporting the lowest satisfaction with the incentive amount and the highest satisfaction with the courtesy of the team that hauled the old appliance away.

Of the 40 respondents, 16 made recommendations for program improvements. Recommendations included increasing program advertising, increasing rebate processing time, maintaining pickup schedules, providing larger rebates, and offering more variety in appliances.

Close to half of respondents recommended the program to another person in the last 12 months, and the large majority would likely recommend the program to someone in the future.

Respondents reported participating in the program because it was convenient to participate (13), the cash incentive was helpful (11), there was no cost to participate (2), and the old appliance was disposed of properly (2). When asked which of these aspects was most influential, participants generally identified proper disposal, convenience, and no cost. The cash incentive was less influential.

B.1.2.1.2.3 LIEEP WHEAP

Navigant noted in PY6 that the refrigerator replacement program experienced "significant" backlogs when Duquesne was operating this program. By hiring a CSP to take over the program in PY7, the program reduced the backlog and reduced the amount of time between receiving an audit and receiving a new refrigerator.

B.1.2.1.3 Summary of the Process Evaluation Audit

Navigant provided the results of the LIEEP-specific participant surveys. Because LIEEP is an amalgam of other programs and in some instances low-income participant data were combined with market-rate participant data, Navigant had an organizational challenge explaining where each program element would be discussed. A table outlining where each program would be discussed and the topics covered would help the reader find specific sections of the report more easily.

The LIEEP section of the report would benefit from displaying counts rather than percentages in some of the figures. For instance, Figure 30 provides percentages across 10 categories with a sample size of 25. Additionally, these 10 categories could be grouped into broader categories to help the reader understand broader themes. For example, what is the functional difference between a "customer call" and a "Duquesne rep" as a source of awareness about LIEEP kits?

In Table 57, the sample sizes are not offered, making it difficult for the reader to assess some of the meaning behind the mean satisfaction scores. Similar to other areas of the report, it would be helpful to see the range of responses to the scale questions rather than the means, particularly when the sample sizes are small.

Figure 31 and the narrative before it, do not seem to align. While the narrative states "five surveyed participants recommended the LIEEP kit component provide more types of products…," the figure appears to show that fewer than 15% of the 24 respondents – three respondents – recommended that the program "offer more products in kits."

The sample sizes in Table 58 do not align with the sample sizes reported elsewhere in the report. The range of samples sizes in Table 58 goes from 72 to 83, yet only 40 low-income RARP participants were surveyed.

B.1.2.1.3.1 Market Intelligence

B.1.2.1.3.1.1 Summary of the Market Intelligence Section

As part of the NTG surveys, survey participants of all residential programs were asked about their awareness of other Duquesne programs. The highest level of awareness reported was the REEP rebate participants' awareness of the RARP, and the lowest level of awareness was among market-rate REEP kit recipients about the SEP. Sixty-three percent of REEP rebate respondents knew about RARP, and no REEP market-rate kit recipients knew about SEP.

SEP and WHEAP had the lowest levels of awareness, with 12% and 16% of other program respondents being aware of these programs. RARP and the HER Program had the highest levels of awareness across respondents of all program types.

B.1.2.1.3.1.2 Summary of the Market Intelligence Audit

Navigant effectively showed the details about which survey respondent group had the most and least awareness of other program types. However, it did not include an overall awareness value of each program in the graphic, which can clarify awareness of all programs. Furthermore, in the narrative Navigant did calculate an overall awareness of the program, seemingly by averaging the percentages in Figure 34. So the average of 32%, 13%, 8%, 9%, 10%, 7%, 19%, and 21% equals 15%, which is the reported value for awareness of WHEAP by non-WHEAP respondents. However, the actual percentage is 16% when one calculates the total number of respondents (65) who knew about WHEAP and divide that figure by the total number of non-WHEAP respondents (409). While the difference between the two methods is slight when examining WHEAP awareness, the difference is greater in other areas. For example, averaging RARP awareness percentages shows that 44% of non-RARP respondents were aware of RARP, and calculating the actual value shows 48% awareness. This makes RARP the most known program, whereas relying on averages of averages shows the HER Program as the most known program.

B.1.3 Commercial and Industrial Program Group

B.1.3.1 Commercial and Industrial Program

B.1.3.1.1 Brief Overview of the Program and Its Success

Duquesne provides a commercial program to targeted market segments such as offices, public agencies, retail, and healthcare segments. Commercial segments not directly targeted by tailored implementation contractors or specialized Duquesne staff fall under the Commercial Program Group (CPG) umbrella. Whether targeted or not, all commercial programs provide the same measures and incentive levels, to ensure fair and transparent treatment of customers across all segments. All programs falling under the CPG provide auditing of building energy use, targeted financing and incentives, project management and installation of energy efficiency measures, and technical training.

Similar to the commercial program, the industrial program consists of three targeted programs for primary metals, chemical products, and mixed industrial companies. All other industrial customers fall under the Industrial Program Group umbrella. As with the targeted commercial program, the targeted industrial program promotes specific technologies and targets specific market segments.

B.1.3.1.2 Summary of the Process Evaluation Findings

The survey of commercial and industrial participants largely covered NTG issues that are discussed elsewhere in this report. There was one open-ended process-related question that asked respondents to comment about their experience with the program, and 36 of 59 respondents provided answers. Analysis of this question revealed that the large majority of customers had positive experiences with the results and administration of the program. A few participants expressed some dissatisfaction with the time the application process took, and some reported that it took a long time to receive their rebate checks. One respondent noted dissatisfaction with his communication with program staff regarding the application guidelines and requirements.

B.1.3.1.3 Summary of the Process Evaluation Audit

The SWE Team determined that the reporting followed the SWE guidelines. However, the analysis would benefit from specific numbers of respondents who reported each discussed element. For example, report the number of participants who reported that it took a long time to receive rebate checks rather than saying "multiple" respondents.

B.2 METROPOLITAN EDISON COMPANY

Four EDCs—Met-Ed, Penn Power, Penelec, and West Penn—operate the identical set of nine energy efficiency programs. Since the evaluation contractor, ADM, together with its process evaluation subcontractor, Tetra Tech, took unified process evaluation approaches to these programs across the four EDCs, the annual reports of the four EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described in this section pertains to all four FirstEnergy utilities.

For the residential and non-residential programs, all the FirstEnergy utilities conducted large-scale process evaluations during PY6, fulfilling most of the process evaluation requirements for Phase II as planned. The following audit summary of the FirstEnergy utilities covers the small-scale supplemental process evaluation activities conducted during PY7.

Most of the process results are reported in the four EDCs' annual evaluation reports. The one exception is that the evaluation contractor reported results from a general population survey of the EDCs' customers in a separate memo and did not refer to this survey in the annual reports. In summary, the annual evaluation report succinctly reported useful evaluation findings based on well-documented evidence, with the above-noted exception of not including information from the general population survey, which was a major data source for the upstream lighting program. The separate memo did succinctly report useful findings based on well-documented evidence, but those findings apparently did not inform the conclusions and recommendations provided in the annual evaluation reports. The SWE Team notes a few comments and recommendations related to sampling for the future process evaluations of the FirstEnergy programs.

B.2.1 Residential Programs

The ADM/Tetra Tech team reported on process evaluations for four residential programs: The Residential Appliance Turn-In, Residential Energy Efficient Products, Residential Home Performance, and Residential Low-Income programs.

A large-scale process evaluation was conducted in PY6 for all the residential programs. Therefore, there were no process evaluation activities in PY7 for the Residential Appliance Turn-In and Residential Low-Income programs. For the other two programs, small-scale supplemental process evaluation activities occurred. For the Residential Energy Efficient Products Program, the ADM team conducted in-depth interviews with participating retailers in the upstream lighting and electronics programs and conducted a general population customer survey. For the Residential Home Performance Program, Tetra Tech conducted homebuilder and rater interviews for the program's new construction subcomponent.

B.2.1.1 Residential Energy Efficient Products Program

B.2.1.1.1 Overview of the Program and Its Success

The Residential Energy Efficient Products Program provides incentives for installing ENERGY STAR–qualified appliances (e.g., clothes washers, dehumidifiers, refrigerators), energy efficient HVAC equipment (e.g., central air conditioners, ASHPs, ground source heat pumps, mini-split heat pumps), and energy efficient water heaters (including HPWHs and solar water heaters). The program also provides incentives to customers for the maintenance (tune-ups) of existing HVAC equipment and incentives to retailers for point-of-sale price cuts for customers purchasing energy efficient lightbulbs. In PY7, the Residential Energy Efficient Products Program was under budget for all four EDCs. Two EDCs, Met-Ed and Penn Power, fell short of their savings objectives as projected in the EE&C plan, respectively achieving 93% and 20% of target energy savings.

B.2.1.1.2 Summary of the Process Evaluation Findings

Based on in-depth interviews with participating retailers in the upstream lighting program (5 stores) and electronics program (2 stores), Tetra Tech reported retailers' close working relationships with the program implementers and their high satisfactions with the breadth of eligible measures and the program overall.

Though the level of program marketing activities varied by retail and by individual store locations within the same retail, all the participating retails' corporate-level contacts said at least some of their stores have held program-sponsored in-store events, having program signage and price stickers displayed, and speaking with customers about lighting specs, energy efficiency, and non-energy benefits.

Participating stores are preferentially placing LEDs in more prominent locations and have less shelf space devoted to incandescent lamps. Of their lighting shelf spaces, participating stores allocate about 55% to incandescent lamps, 15% to CFLs, and 30% to LEDs. Nonparticipating stores (though they participated in Phase I) allocate 72%, 23%, and 5% respectively.

To adapt to the rapidly changing lighting market, some interviewees suggested that the program should be more flexible to midyear changes in measure eligibility and should leverage market intelligence of participating retailers and manufacturers to adapt program design and customer marketing efforts.

The separately reported general population survey found that although customers are still more familiar with LEDs and halogens, about one-third of recent lighting purchasers had used LED screw-ins and about half of those had first done so in the past year. LED users reported high satisfaction with LED bulbs, particularly their long life span, efficiency, brightness, light quality, and lower operating costs. However, some confusion still exists regarding the various lighting technologies and their relative efficiency levels. The survey also produced price-sensitivity data ($3.19 is a "great bargain" for LED bulbs, and $6.11 is "starting to get expensive") and found that 16% of non-LED users reported they are likely to install LEDs within the next year. Other key findings were that customers generally did not indicate awareness of having purchased program-discounted bulbs and that customers' preferred methods of communication were bill inserts (56%), direct mailing (51%), and email (24%).

B.2.1.1.3 Summary of the Process Evaluation Audit

Although PY7 evaluation activities were limited in scope, the ADM/Tetra Tech team used these limited resources to shed light on important research topics, and generally summarized findings well and drew

well-reasoned findings. The ADM/Tetra Tech team successfully completed interviews with the census of participating retail chains as planned. The primary weakness in the reporting was the lack of any information about the general population survey in the annual report.

B.2.1.2 Residential Home Performance Program

B.2.1.2.1 Overview of the Program and Its Success

The Residential Home Performance Program comprises several components. The whole-house direct-install component provides diagnostic assessments, followed by the direct installation of low-cost measures or incentivized installation of building shell measures. The energy conservation kits component provides direct delivery of CFLs, LED nightlights, a furnace whistle, and for those with electric water heating, aerators, aerator adapters, and an energy savings showerhead. The program provides these measures to customers who completed an online or phone audit or submitted an online or phone request as well as through a new school education component. The new home component provides incentives to builders who choose to build new homes to higher efficiencies through the installation of efficient building shell measures, HVAC systems, appliances, lighting, or other features. The HERs provide customers with comparative electric energy usage data and offer tips and advice on behavioral and low-cost energy saving measures. In PY7, the Residential Home Performance Program was under budget for all four EDCs, and all four EDCs significantly exceeded savings targets as projected in the EE&C plans.

B.2.1.2.2 Summary of the Process Evaluation Findings

PY7 process evaluation activity was limited to builder and rater interviews for the program's new construction subcomponent.

Participating builders' overall satisfaction with the program is moderate. They view implementer CSP Performance Systems Development's (PSD) support and relationship favorably. They are commonly dissatisfied with the paperwork and logistical burdens, especially coordination with HERS raters and the time lag between application submittal and rebate arrival. Although still interested in future participation, nonparticipating builders do not participate because of high incremental costs and excessive documentation associated with the program's incentive application.

Builders project the new homes market will remain the same or experience modest growth in the next year, while participating builders—many of whom report creating their own energy efficiency packages—perceive declining value in the ENERGY STAR New Home certification.

Raters are satisfied with the program, especially with PSD. They uniformly reported their biggest challenge to be appealing to builders for their service value. All raters project that their rating business will stay constant in the coming year.

B.2.1.2.3 Summary of the Process Evaluation Audit

The ADM/Tetra Tech team summarized findings well and drew well-reasoned findings. However, market size data of builders and raters were absent in the report; this would provide more information about the representation of the interviews that were conducted, thus strengthening the methodology. The SWE Team recommends including in the report the population size of participating and nonparticipating builders and raters working in the area as well as sample size.

B.2.2 Non-Residential Programs

ADM/Tetra Tech reported on process evaluations for five non-residential programs: Energy Efficient Equipment – Small, Energy Efficient Buildings – Small, Energy Efficient Equipment – Large, Energy Efficient Buildings – Large, and Government and Institutional Program.

Except for Energy Efficient Buildings – Small and Energy Efficient Buildings – Large, there were no process evaluation activities in PY7 because the ADM/Tetra Tech team had conducted process evaluations of all the other non-residential programs in PY6. For the respective programs that were evaluated in PY7, the ADM/Tetra Tech team conducted in-depth interviews with participating contractors and surveyed participants.

B.2.2.1 Energy Efficient Buildings – Small and Large

B.2.2.1.1 Brief Overview of the Programs and Their Success

These programs include energy conservation kits consisting of CFLs, and custom whole-building projects such as new construction, retro-commissioning, and building envelope improvements. In PY7, Energy Efficient Buildings Programs – Small and Energy Efficient Buildings – Large were under budget for all four EDCs. Two EDCs, Met-Ed and Penn Power, fell short of their EE&C Plan savings projections for PY7, respectively achieving 70%/65% (Small/Large) and 78%/94% (Small/Large) of target energy savings.
The ADM/Tetra Tech team conducted surveys with participants and in-depth interviews with participating contractors. Participants of the programs' custom component (Small and Large) are highly satisfied, and 69% of participants reported recommending the program to others. Satisfaction with the conservation kit program component (Small) was also very high, but participants suggested upgrading lamps to LEDs. Overall, the ADM/Tetra Tech team reported that small businesses require the most assistance with the application process.

The ADM/Tetra Tech team reported evidence that contractors are actively playing important roles in communicating with potential customers about potential savings, return on investment, and other non-energy benefits. These contractors commonly faced difficulties with documentation and paperwork requirements, pre-approval wait times, eligibility requirements, and frequent QA inspections by the implementation CSP. Contractors generally reported that the implementation CSP was accessible for troubleshooting when needed.

B.2.2.1.2 Summary of the Process Evaluation Audit

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. However, the report did not discuss population and sample size of the participating contractors, which would provide more information about the representation of the interviews that were conducted and strengthen the methodology.

In addition, the SWE Team points out that, for all four EDCs, both the target and achieved sample sizes for both the kits and custom components of Energy Efficient Buildings – Small, actually well exceeded the required 85/15 confidence/precision level shown in the sampling strategy table. The SWE Team has no objections to this greater-than-required precision and confidence but would recommend that the sampling table show the actual target confidence and precision levels.

B.3 PENNSYLVANIA ELECTRIC COMPANY

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penelec, and so the annual evaluation reports of the four FirstEnergy EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described for Met-Ed in Section B.2 pertains to all four FirstEnergy utilities, including Penelec.

B.4 PENNSYLVANIA POWER COMPANY

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including Penn Power, and so the annual evaluation reports of the four FirstEnergy EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described for Met-Ed in Section B.2 pertains to all four FirstEnergy utilities, including Penn Power.

B.5 WEST PENN POWER

FirstEnergy's evaluation contractor, ADM/Tetra Tech, took unified process evaluation approaches to these programs across the four FirstEnergy EDCs, including West Penn, and so the annual evaluation reports of the four FirstEnergy EDCs report identical information about the process evaluation. Therefore, the SWE Team's audit summary described for Met-Ed in Section B.2 pertains to all four FirstEnergy utilities, including West Penn.

B.6 PECO ENERGY COMPANY

B.6.1 Residential Programs

Navigant reported on process evaluations for eight residential programs: Smart Home Rebates (SHR), Smart House Call (SHC), Smart Appliance Recycling (SAR), Smart Usage Profile (SUP), Smart Energy Saver (SES), Smart Builder Rebates (SBR), Smart A/C Saver (SACS), and Smart Multifamily (SMF) Solutions.

For the process evaluations of the above programs, Navigant reviewed program documents and data; interviewed utility and implementation staff as well as staff of market actors affiliated with the program (HVAC installers and builders); and surveyed program participants and nonparticipants. The document and program data review informed identification of program goals, activities, and updates, and in some instances, identification of program trends and data-tracking errors. The research issues addressed by the primary data-collection activities (in-depth interviews and surveys) varied among programs but generally included the effectiveness of program administration, implementation, and delivery, and customer program satisfaction, participation, challenges, and recommendations.

The depth of presentation of questions asked and feedback provided by Navigant in PECO's PY7 annual report highlighted findings that are of value to the administrator and implementer.

For each program, a brief program description, summary of the process evaluation findings, and review (audit) of the annual report follow below. The SWE Team notes one general comment about the findings, conclusions, and recommendations for the process evaluations of PECO programs: many recommendations were drawn from key findings rather than from conclusions. Connecting findings to conclusions and then recommendations would help the reader better judge the quality of the recommendations.

B.6.1.1 Smart Home Rebates (SHR) Program

B.6.1.1.1 Brief Overview of the Program and Its Success

The SHR Program attempts to achieve energy savings by providing incentives to PECO customers through retailer and HVAC installer sales channels.[75] The program offers incentives for high-efficiency appliances and HVAC equipment. The program also provides up-stream buy-down incentives to manufacturers of CFL and LED measures and/or retailers. In PY7, SHR reported gross annual energy and demand savings of 142,472 MWh and 20.6 MW, respectively.

B.6.1.1.2 Summary of the Process Evaluation Findings

Navigant employed several data-collection methods to gather information for the process evaluation. For lighting measures, it reviewed program materials, interviewed program manager and implementation staff, and conducted an in-store intercept survey of 530 customers and a shelf survey of 17 stores. For non-lighting measures, Navigant conducted 11 in-depth interviews with HVAC installers and 200 telephone surveys with HVAC and appliance rebate participants. Navigant also reviewed the participation tracking databases. Based on these data, eight key findings emerged:

1) There were errors as well as gaps in the PY7 participation tracking data. Gaps in the tracking data for air conditioners resulted in discrepancies between reported and verified savings for central and room air conditioners.
2) About 71% of surveyed customers reported being aware of PECO's LED store discounts in PY7. In PY5, a notably higher proportion of surveyed customers (86%) were aware of PECO's LED store discounts.
3) About 12% of PY7 lighting participants were identified as low-income. Energy and demand savings from these participants were not claimed as low-income savings.
4) The shelf surveys revealed that increasing shelf space occupied by LEDs has corresponded with decreasing shelf space occupied by CFLs. The proportion of lighting shelf space dedicated to efficient bulbs has not changed substantially over the past five years.
5) The most commonly cited reason for not purchasing LEDs was cost ("too expensive").
6) Satisfaction with PECO has remained high since PY5.
7) The majority of HVAC participants (71%) learned of the program primarily from contractors, installers, or builders.
8) Downturn in the number of installations, either from seasonal shifts or from PECO scaling back the program, affected smaller "mom-and-pop" HVAC installation companies much more than larger companies.

B.6.1.1.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

For the data-collection tasks requiring sampling, the SWE Team determined that the sampling approach for those tasks followed the approved sampling plans, and the report incorporated the required tables showing the sampling strategy. Navigant used a random sampling approach for the customer surveys and a stratified random sampling approach for the participant survey, focusing on two strata: lighting

[75] Almost all reported savings (99%) occurred in the residential sector. Note that both residential and non-residential customers could receive an incentive, since the program delivers the incentive through a retailer and HVAC installer channels.

and non-lighting (HVAC and appliances) measures. Navigant achieved sample sizes that provided 85/15 confidence/precision per data-collection activity and/or stratum.

The SWE Team also determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations, except in one area: there were no references to the statistical test(s) used to evaluate the strength of differences reported between PY5, PY6, and PY7. It would have been useful to know, for example, whether the proportion of respondents aware that PECO provided LED store discounts was statistically significantly different from PY5 to PY7. Navigant reports the sample sizes and proportions but does not report either the variability or a statistical assessment of the difference. The reporting could have benefitted from this additional level of detail.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. Most recommendations were clear and actionable and were supported by the findings. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

B.6.1.2 Smart House Call (SHC) Program

B.6.1.2.1 Brief Overview of the Program and Its Success

The SHC Program is built around direct-install and contractor-installed measures. Electric-heat customers as well those with central air-conditioning living in single-family or multifamily dwellings with three or fewer units are eligible to participate. Program participants pay $50 for a walk-through assessment or $100 for a more in-depth audit. During the assessment or audit, an energy advisor installs appropriate direct-install measures and provides recommendations for the homeowner to consider. Those who opt for an in-depth audit receive an audit report that includes the full cost, incentive amount, and discounted cost of recommended contractor-installed measures as well as recommendations to consider on an un-incented basis. Reported PY7 SHC gross energy and demand savings were 6,742 MWh and 1 MW, respectively.

B.6.1.2.2 Summary of the Process Evaluation Findings

Navigant conducted a program database and materials review, a participant survey, and in-depth interviews with program staff. Based on these data, five key findings emerged:

1) Participant satisfaction was high. Those reporting some dissatisfaction provided the following reasons:

- **a.** Water pressure declined after low-flow faucet aerators and showerhead were installed.
- **b.** CFLs and LEDs did not reach full brightness fast enough.
- **c.** CFL and LED bulbs did not work with dimmers.
- **d.** TVs and other electronics did not function properly when they were plugged into the same smart strip outlet.
- **e.** Customers did not see savings on their bills after measures were installed.
- **f.** Information received did not have enough detail to learn anything new.
- **g.** The energy adviser (in some cases) did not do a thorough job during the audit.

2) Although participants recalled receiving additional energy efficient upgrade recommendations, they did not commonly cite having been referred to other Smart Ideas programs for which they may be eligible.
3) Participants generally scheduled an audit once they learned of the program.
4) The top three channels through which participants heard about the program were bills inserts, mailers, and word of mouth.
5) The program manager noted that the limited time discounts, which PECO offered, have been particularly successful in increasing customer interest in assessments and program participation.

B.6.1.2.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

For the data-collection tasks requiring sampling, the SWE Team determined that the sampling approach for those tasks followed the approved sampling plans, and the report incorporated the required tables showing the sampling strategy. Navigant used a random sampling approach for the participant survey and achieved sample sizes that provided 85/15 confidence/precision.

The SWE Team also determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable.

B.6.1.3 Smart Appliance Recycling (SAR) Program

B.6.1.3.1 Brief Overview of the Program and Its Success

The SAR Program provides services and an incentive to customers who elect to have a refrigerator or freezer removed from their home.[76] An independent implementation contractor, ARCA, operates the program and handles the application and pickup processes, collects data about participants and their appliances, and recycles the collected units in its regional facility. There was one notable change to the program in PY7: PECO hired ARCA to operate the program because a prior contractor, JACO, became insolvent in Q2 of PY7. JACO's bankruptcy curtailed the program's energy savings impact. Reported PY7 SAR gross annual energy and demand savings were 8,843 MWh and 1.2 MW, respectively.

B.6.1.3.2 Summary of the Process Evaluation Findings

Data sources for the process evaluation included PY7 Q1–Q4 participation data, a telephone survey of 200 program participants, and an in-depth interview with the program manager. Based on these data, two key findings emerged:

[76] Although the program serves both residential and non-residential customers, most of the recycled units and savings come from the residential sector. Almost all reported savings (99%) occurred in the residential sector.

1) JACO's bankruptcy was likely responsible for SAR failing to reach its PY7 and Phase II goals. JACO's closure also interfered with the delivery of participant rebates.
2) Program satisfaction dropped after JACO's closure. For example, among the customers whose units were picked up months after the originally scheduled date, average satisfaction was 10% lower compared with participants whose units were picked up on time.

B.6.1.3.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan except the interview with the implementer. Due to JACO's closure and the timing of ARCA's contractual agreement with PECO, Navigant was unable to interview the implementer for the PY7 evaluation.

For the data-collection task requiring sampling, the SWE Team determined that the sampling approach yielded an adequate sample and the report incorporated the required table showing the sampling strategy. Navigant used a stratified random sampling approach for the participant survey. Two strata focused on the measures (refrigerators and freezers), and three strata focused on the participant experience—when the rebate check was delayed, when the pickup was delayed, and when the participant withdrew from the program. The sample provided 85/15 confidence/precision per stratum.

The SWE Team also determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and were supported by the findings. Recommendations were drawn from key findings.

B.6.1.4 Smart Usage Profile (SUP) Program

B.6.1.4.1 Brief Overview of the Program and Its Success

The primary goal of SUP is to achieve cost-effective energy savings by providing residential customers with energy-use feedback (either mailed or emailed HERs) to encourage adoption of energy efficient behaviors. PECO also uses the program as a tool to enhance customer engagement and encourage participation in other PECO energy efficiency programs. SUP is an opt-out program in which the implementer enrolls participants based on an RCT design. Enrolled customers can opt out of the program by calling or emailing the program implementer. All participants also have access to an online web portal where they can track changes in their usage over time, establish energy savings goals, and review tips for saving energy and money.

Only savings from the SUP in PY7 count toward PECO's compliance goals for Phase II. During PY7 the program significantly exceeded its Phase II savings target of 20,000 MWh of gross energy savings. During PY7, the SUP achieved verified savings of 39,041 MWh.

B.6.1.4.2 Summary of the Process Evaluation Findings

Navigant conducted analysis of participation data and in-depth interviews with the program manager and implementer. Based on these data, four key findings emerged:

1) Since PECO plans to increase the number of households receiving HERs in Phase III, the behavioral savings from this program will likely represent a significantly greater percentage of the residential portfolio's savings.
2) The SUP uplift analysis shows that program participants are being successfully channeled into the SHC Program. Participants are not, however, successfully channeled into other PECO programs.
3) Very few household characteristics are used to tailor program messaging in the reports to households.
4) A low proportion of SUP participants receive electronic HERs in addition to mailed reports. Yet data tracked by the implementer show a higher rate of customer engagement and a lower rate of customer complaints to the PECO call center from participants who receive reports electronically.

B.6.1.4.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

None of the data-collection activities in PY7 required sampling.

The SWE Team also determined that the reporting followed the SWE's guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.6.1.5 Smart Energy Saver (SES) Program

B.6.1.5.1 Brief Overview of the Program and Its Success

The SES Program seeks to educate students about the benefits of energy efficiency through engaging information and fun activities. By reaching students at a young age, PECO expects that students will adopt energy efficient habits early on and continue to engage in energy efficient behavior throughout their lives. In addition to changing behavior through education, the SES encourages the installation of low-cost, energy efficient measures provided to each student through the PECO Smart Energy Saver Kits at no cost. In PY7 the SES distributed 12,324 full or slimmed-down kits and achieved residential-sector energy and demand savings of 2,413 MWh/yr and 0.3 MW, respectively.

B.6.1.5.2 Summary of the Process Evaluation Findings

Navigant did not conduct process evaluation for the SES during PY7 because PECO plans to discontinue the program after PY7. Navigant did, however, develop two process recommendations based on data from the impact evaluation:

1) The nightlight measure in the kit resulted in minimal energy savings because the baseline conditions verified through the student installation surveys indicated that in two-thirds of cases the nightlights were not replacing existing nightlights. In the TRM, it is assumed that kit nightlights are replacing existing nightlights.

2) The teacher survey responses indicated that the program implementation deviates from the program plan, as more than half of student installation surveys are filled out in the classroom rather than at home, and not all unused kits make it back to the program.

B.6.1.5.3 Summary of the Process Evaluation Audit

Navigant noted no process evaluation activities in PY7 in its revised plan. It did, however, develop a few process recommendations based on data from the impact evaluation.

The SWE Team determined that the reporting of the findings followed the SWE guidelines. The annual report included descriptions of the methods in the impact section, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.6.1.6 Smart Builder Rebates (SBR) Program

B.6.1.6.1 Brief Overview of the Program and Its Success

The SBR Program is intended to accelerate the adoption of energy efficiency in the design, construction, and operation of new single-family homes by leveraging the U.S. EPA's ENERGY STAR Homes certification. The program provides rebates for new homes that achieve ENERGY STAR certification. A base rebate of $400 is offered per home, plus $0.10 per kWh of savings achieved. In PY5, the program was expanded to allow gas-heated homes in PY6. This was the only significant change to the program from PY5 to PY7. This change represents a divergence from the program offering outlined in the Phase II plan in order to meet Phase II savings targets, which appears likely at the current pace.

B.6.1.6.2 Summary of the Process Evaluation Findings

Navigant conducted a program materials review and in-depth interviews with the program manager, implementer, and participating builders. Based on these data, six key findings emerged:

1) All surveyed builders (n=7) were very satisfied with their experience working with the rater and the program implementation staff. Builders reported lower satisfaction with marketing and training assistance, as well as the time it takes to receive a rebate. Prompt payment of incentives is a high priority for builders.

2) It took an average of 131 days for builders to receive incentive payment after the project was completed in PY7. The new Phase III implementer has a different application and incentive payment process, with a goal of 60 days for application approval and incentive payment to the builder.

3) Builders reported that additional cost and lack of educated HVAC contractors were the key challenges their firm faces when building homes to ENERGY STAR standards.

4) About 84% of all homes built by surveyed builders received a rebate through the SBR, which indicates there is little room for increasing ENERGY STAR home market penetration among participating builders. Currently, the program's PY7 market penetration ranges from 1% to 14% across counties in PECO's territory.

5) The implementer's outreach in PY6 and PY7 suggests that incentive amounts for ENERGY STAR homes are not sufficient to overcome cost barriers to participation.
6) Five of seven builders expected their program activity to increase or remain the same in PY8; two builders expected a decrease in program activity in PY8 due to limited construction activity in PECO's territory.

B.6.1.6.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

None of the data-collection activities in PY7 required sampling.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable. Recommendations were drawn from key findings rather than from conclusions.

B.6.1.7 Smart A/C Saver (SACS) Program – Residential

B.6.1.7.1 Brief Overview of the Program and Its Success

In the residential SACS Program, PECO remotely shuts down a customer's central air-conditioning unit on short notice during conservation event days that coincide with the highest peak demand. In return, participants receive financial incentives for allowing PECO to control their equipment. The program experienced a small drop in participation in PY7, amounting to approximately 5.5%. Total verified gross savings were 40.5 MW for the residential SACS Program in PY7. There are no energy savings goals for this program.

B.6.1.7.2 Summary of the Process Evaluation Findings

Navigant conducted an in-depth interview with the program manager, a phone survey with program participants (n=70), and a review of program data and marketing materials. Based on these data, four key findings emerged:

1) Navigant received insufficient advanced metering infrastructure data for the level of analysis needed in PY8 and beyond.
2) Over 90% of surveyed participants (n=70) reported high satisfaction with the program (rating of 4 or 5 on a scale of 1–5). High satisfaction may be related to high incentive and low frequency of conservation events in PY7.
3) Two-thirds of surveyed participants reported "don't know" when asked how many events they experienced in PY7. Those who reported a number of events provided various estimates, ranging from 1 to 11. PECO called only one event in PY7. Collectively, these findings indicate that participants are not aware of events.
4) Surveyed participants noted that they are motivated by the incentive to participate, and more than one-third noted they would not participate if the incentives were cut by half. However, participants have not dropped out to date. A similar pattern was observed in PY4 and PY5; participants reported

unwillingness to accept a lower incentive. However, when the incentive dropped from $120 per summer to $80 per summer, very few participants dropped out of the program.

B.6.1.7.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

For the data-collection task requiring sampling, the SWE Team determined that the sampling approach yielded an adequate sample and the report incorporated the required table showing the sampling strategy. Navigant used a random sampling approach for the participant survey. The sample provided 85/15 confidence/precision.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods and a summary of key findings and recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods and findings.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable. Recommendations were drawn from key findings rather than from conclusions.

B.6.1.8 Smart Multifamily (SMF) Solutions Program

Since energy savings from this program come from both residential and non-residential sectors, the SWE Team discusses this program under both the residential and non-residential program sections in this appendix.

B.6.1.8.1 Brief Overview of the Program and Its Success

The purpose of the SMF Solutions Program is to increase awareness of energy savings opportunities in multifamily buildings and to assist multifamily residents and building owners and managers in acting on those opportunities. The program is designed for both multifamily property owners and multifamily customers. This program offers two paths to participation. The direct-install path offers cost-free CFLs, low-flow showerheads, and low-flow faucet aerators for apartment units, condos, and common areas. The prescriptive path offers incentives to multifamily landlords who install high-efficiency equipment in common areas. Total verified gross energy and demand savings were 1,867 MWh/yr and 0.3 MW, respectively, for the residential SMF Solutions Program in PY7.

B.6.1.8.2 Summary of the Process Evaluation Findings

Navigant conducted in-depth interviews with the program manager and implementer and surveyed 48 program participants. Based on these data, five key findings emerged:

1) Free-ridership levels in PY7 increased significantly over PY6 (from 0.17 to 0.38 in the non-residential sector and from 0.25 to 0.43 in the residential sector). Since the majority of energy savings are from direct-install CFLs (72% of gross reported energy savings in PY7), participants generally stated that they would have installed CFLs, even without the program.

2) The majority of participants (71%) were contacted directly by the implementer. Among landlords, 19% reported learning about the program by word of mouth. These findings are consistent with the marketing efforts discussed with the program manager and implementer, who reported a large direct-mail and cold-call effort to reach out to potential landlords.

3) Only 46% of landlords recalled receiving a list of incentivized energy efficiency equipment recommended through the program.
4) The majority of landlords were not aware of or able to recall incentivized offerings through the program's prescriptive channel. Additionally, only 50% of landlords recalled receiving an audit report as part of the direct-install project, and 25% of those reported that the program representative did not review the report with them.
5) Participants (both landlords and tenants) generally noted a high degree of satisfaction with the program.

B.6.1.8.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

For the data-collection task requiring sampling, the SWE Team determined that the sampling approach followed the approved sampling plan and the report incorporated the required tables showing the sampling strategy. Navigant used a stratified random sampling approach for the participant survey, focusing on strata defined by unit project size. Navigant achieved sample sizes that provided 85/15 confidence/precision per overall program and sector.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.6.2 Low-Income Programs

B.6.2.1 Low-Income Energy Efficiency Program (LEEP)

B.6.2.1.1 Brief Overview of the Program and Its Success

LEEP provides income-eligible customers with a variety of measures intended to reduce their electricity bills. There are four LEEP components and associated target markets:

1) Market for component 1: Residential customers with a household income at or below 150% of the Federal Poverty Line (FPL), plus LEEP requirement of household usage levels that exceed a monthly average of 600 kWh for electric baseload for non-electric-heating customers, 500 kWh for CAP customers, and 1,400 kWh for electric-heating customers
2) Market for component 2: Customers who participate in PECO's LIURP during PY5–PY7
3) Market for component 3: Residential customers with a household income at or below 150% of the FPL participating in community events for low-income residents
4) Market for component 4: Residential customers, homeowners, and/or tenants with a household income at or below 150% of the FPL who do not meet the LEEP usage requirement for weatherization services under components 1 and 2 above

In PY7, PECO made two changes to the program: insulation services were expanded to floors, and requirements for refrigerator replacement were increased. The latter reduced eligible participants from 45% of PY6 customers to 15% of PY7 customers. Total verified gross annual energy and demand savings were 18,304 MWh/yr and 2.4 MW, respectively, for the LEEP in PY7.

B.6.2.1.2 Summary of the Process Evaluation Findings

Navigant conducted 90 surveys with program participants in components 1, 2, and 4 and 19 site visits with participants in component 1. It also reviewed program materials and conducted in-depth interviews with the program manager and implementer. Based on these data, five key findings emerged:

1) The majority of participants (89%) stated that they were extremely satisfied with the program. A small number expressed dissatisfaction; these cases were due primarily to customer misunderstandings of schedules and project next steps.

2) CFL socket saturation was increased in the low-income community. Prior participant surveys revealed that the first-year CFL ISR for component 3 participants fell in PY6 compared with PY4 and PY5. The PY7 survey indicates that the ISR increased slightly. Also, 57% of participants no longer had incandescent bulbs in their homes, and 60% of replaced bulbs were incandescent.

3) While participants who recalled the educational materials rated them as useful, the materials did not provide customers with prioritized next steps or a clear call to action. A majority of component 3 survey respondents reported that they did not receive, or could not remember receiving, the materials.

4) LEEP comprehensive program (components 1 and 2) outreach is targeted to PECO customers on the CAP rate tariff. While LEEP is reaching some customers with critical needs, defining customers through the CAP rate tariff alone has the potential to miss eligible customers.

5) The majority of LEEP customers (55%) are served through component 3 (free CFL giveaways).

B.6.2.1.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

For the data-collection task requiring sampling, the SWE Team determined that the sampling approach followed the approved sampling plan and the report incorporated the required tables showing the sampling strategy. Navigant used a stratified random sampling approach for the participant survey, focusing on three strata: program components 1, 2, and 4. Navigant achieved sample sizes that provided 85/15 confidence/precision per stratum.

The SWE Team also determined that the reporting followed the SWE's guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.6.3 Non-Residential Programs

Navigant reported on process evaluations for six non-residential programs: The Smart A/C Saver (SACS), Smart Equipment Incentives (SEI), Smart Construction Incentives (SCI), Smart Multifamily (SMF) Solutions, Smart On-Site (SOS), and Smart Business Solutions (SBS) programs.

For the process evaluations of the above programs, Navigant reviewed program documents and databases; interviewed utility and implementation staff and staff of market actors affiliated with the program (contractors, distributors, and building science or design consultants); and surveyed program participants. The document and program data review informed identification of program goals, activities, and updates. The research issues addressed by the primary data-collection activities (in-depth interviews and surveys) varied among programs but generally included the effectiveness of program administration, implementation, and delivery, and customer and market actor program satisfaction, participation, challenges, and recommendations.

The depth of presentation of questions asked and feedback provided by Navigant in PECO's PY7 annual report highlighted findings that are of value to the administrator and implementer.

For each program, a brief program description, summary of the process evaluation findings, and review (audit) of the annual report follow below. The SWE Team notes one general comment about the findings, conclusions, and recommendations for the process evaluations of PECO programs: findings, conclusions, and recommendations were clear and actionable and supported by gathered data.

B.6.3.1 Smart A/C Saver (SACS) Program – Commercial

B.6.3.1.1 Brief Overview of the Program and Its Success

In the commercial SACS Program, PECO remotely shuts down a customer's central air-conditioning unit on short notice during conservation event days that coincide with the highest peak demand. In return, participants receive financial incentives for allowing PECO to control their equipment. In PY7, PECO had 3,063 active thermostats representing 1,686 participants.

B.6.3.1.2 Summary of the Process Evaluation Findings

The findings are the same as those reported in Appendix B.6.1.7.

B.6.3.1.3 Summary of the Process Evaluation Audit

The findings are the same as those reported in Appendix B.6.1.7.

B.6.3.2 Smart Equipment Incentives (SEI) Program

This program applies to the C/I and GNI sectors.

B.6.3.2.1 Brief Overview of the Program and Its Success

The SEI Program offers incentives for projects with prescriptive measures (e.g., lighting and VFDs) and custom projects. A main goal of the program in Phase II is to encourage the installation of efficient non-lighting equipment. In PY6, the program launched a new trade ally program that financially rewards trade allies for achieving energy savings objectives. Additionally, the implementer initiated a "limited time offer" in which participants were eligible for additional incentive money if they completed the

project before January 31, 2016. In PY7, SEI was successful at moving its measure mix toward non-lighting measures. The program incentivized 1,329 C/I and 469 GNI retrofit projects in PY7. Two-thirds (67%) of C/I and less than half (44%) of GNI PY7 energy savings came from lighting measures, including lighting controls.

B.6.3.2.2 Summary of the Process Evaluation Findings

Navigant conducted a program marketing materials and database review, 86 online surveys with participating customers (51 C/I, 35 GNI), and in-depth interviews with program managers, implementation staff, and seven trade allies. Based on these data, four key findings emerged:

1) Trade allies reported that the trade ally incentive, which was implemented in PY6, encouraged them to deliver more projects through the program. Although this incentive was a great tool to engage trade allies in the program, it did not provide control over what types of projects were generated in the program.

2) In Phase II, SEI succeeded at reducing the percentage of lighting projects from PY5 to PY7 by increasing the number of custom projects.

3) In Phase III, the decreased incentives may decrease the uptake of non-lighting measures. Interviews and survey responses indicate that in some cases PY7 incentives barely covered the cost of the engineering requirements in the rebate application.

4) The "limited time offer" marketing campaign was successful. It brought in more projects in February and March, rather than later in May and June.

B.6.3.2.3 Summary of the Process Evaluation Audit

Navigant completed all PY7 activities listed in the evaluation plan except a focus group with participating contractors. Instead, Navigant completed in-depth interviews with participating contractors or trade allies.

For the data-collection task requiring sampling, the SWE Team determined that the sampling approach followed the approved sampling plan and the report incorporated the required tables showing the sampling strategy. Navigant used a stratified random sampling approach for the participant survey, focusing on two strata: C/I and GNI participants. Navigant achieved sample sizes that provided 85/15 confidence/precision per stratum and program.

The SWE Team determined that the reporting followed the SWE's guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report and supporting documentation included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. Conclusions were integrated into sections describing key findings.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by conclusions and/or findings.

B.6.3.3 Smart Construction Incentives (SCI) Program

B.6.3.3.1 Brief Overview of the Program and Its Success

The SCI Program aims to accelerate adoption of energy efficient design and construction practices so that new C/I facilities in the PECO territory are more energy efficient than the current stock. The program covers both new construction and buildings undergoing major renovation; the latter is defined as construction that involves the complete removal, redesign, and replacement of two or more major building systems. The target markets for the program are decision-makers for the design and/or construction of new facilities, renovation contractors, and developers. The program provides facility designers and builders with training, design assistance, and financial incentives to incorporate energy efficient systems into their building designs. In PY7, the program achieved gross realization rates of 87% for energy and 72% for demand.

B.6.3.3.2 Summary of the Process Evaluation Findings

Navigant conducted an abbreviated process evaluation of the program in PY7, relying on data from in-depth interviews with the program manager and implementation staff and a review of program data and documents. From this research, six key findings emerged:

1) During the site inspections, the evaluation team found several incomplete projects. Navigant credited the program with verified savings only in the portions of each project that were complete and occupied in accordance with the Pennsylvania TRM requirements for new construction projects. As a result, the energy savings realization rates dropped from over 112% (had the buildings been fully complete and occupied) to 87%.

2) Navigant identified several causes for the incomplete projects:

- **a.** Overzealous pursuit of projects despite tight deadlines by the implementer
- **b.** Empathy for customers rushing to be included in Phase II of the program
- **c.** Implementer confusion about TRM rules for completion and occupancy
- **d.** Ambiguous language in the program application about certificates of occupancy

3) The implementer M&V team did select a subset of the project population to receive post-installation inspections (which would have alerted the program manager of a project's completion status). The post-installation inspection reports were frequently not reviewed in detail by program and implementation staff beyond ensuring their existence.

4) The SCI improved in PY7 compared with PY6 and PY5, in part due to the program's PY6 efforts to identify and requalify committed trade allies.

5) The new construction projects in the program have long lead times and require consistent and committed long-term partners to guide them through the program.

6) Over 75% of the portfolio savings are coming from either lighting or custom projects. The majority of savings from custom projects typically come from lighting measures.

B.6.3.3.3 Summary of the Process Evaluation Audit

Navigant completed all PY7 activities listed in the evaluation plan. None of the data-collection activities in PY7 required sampling. The SWE Team determined that the reporting followed the SWE's guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The annual report and supporting documentation included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. Conclusions

were integrated into sections describing key findings. Overall, the recommendations were clear and actionable and supported by conclusions and/or findings.

B.6.3.4 Smart Multifamily (SMF) Solutions Program

Since energy savings from this program come from residential and non-residential sectors, the SWE Team discusses this program under both the residential and non-residential program sections in this appendix.

B.6.3.4.1 Brief Overview of the Program and Its Success

The purpose of the SMF Solutions Program is to increase awareness of energy savings opportunities in multifamily buildings and to assist multifamily residents and building owners and managers in acting on those opportunities. The program is designed for both multifamily property owners and multifamily customers. This program offers two paths to participation. The direct-install path offers cost-free CFLs, low-flow showerheads, and low-flow faucet aerators for apartment units, condos, and common areas. The prescriptive path offers incentives to multifamily landlords who install high-efficiency equipment in common areas. In Phase II, to date the program has not seen any participation in the prescriptive channel, and 100% of verified savings resulted from direct-install measures.

B.6.3.4.2 Summary of the Process Evaluation Findings

The findings are the same as those reported in Appendix B.6.1.8 above.

B.6.3.4.3 Summary of the Process Evaluation Audit

The findings are the same as those reported in in Appendix B.6.1.8 above.

B.6.3.5 Smart On-Site (SOS) Program

B.6.3.5.1 Brief Overview of the Program and Its Success

The SOS Program is designed to incentivize customers to install CHP projects that maximize operational savings and minimize operational and maintenance costs. CHP systems that are sized to match the minimum electric and thermal loads achieve the optimal savings. PECO provides SOS Program with incentives based on a declining tiered incentive rate by installed capacity with a separate performance payment. Each tier has a fixed per-MW incentive paid toward the incremental capacity within each tier. Capacity-based incentives are not paid for incremental capacity above 10 MW. No SOS projects were completed in PY6. Six projects were completed in PY7.

B.6.3.5.2 Summary of the Process Evaluation Findings

Navigant conducted in-depth interviews with the program manager and implementation staff and interviewed all participating customers and project developers. Based on these interviews, six key findings emerged:

1) The SOS creates significant uncertainty and risk for PECO due to the complexity of the projects and the magnitude of the projects' energy savings. About 17% of the Phase II MWh savings goal was completed in the last two days of the phase, and projects making up 7% of the Phase II MWh goal did not get completed during the phase. Projects that did not finish during the phase took between 15 and 28 months from the time of application to completion, making it difficult for PECO to react to any need to adjust its plan to meet the portfolio savings goals.

2) Developers unanimously oppose restrictions on participation based on system size and phase deadline.
3) One developer suggested that the move toward containerized systems for systems as large as 1.5 MW can shorten the development cycle. That developer also noted that smaller systems are not typically designed by specialized firms and are prone to more issues. Further investigation of program data revealed that containerized systems did not complete faster than two traditional projects completed in PY5.
4) Obtaining an operating permit from the Pennsylvania DEP can delay projects considerably. All developers pointed to the DEP as the source of considerable delay and uncertainty.
5) Three out of four developers said they had issues with the interconnection agreement.
6) Several participants noted issues with customer service, including responsiveness and consistency of messages across staff.

B.6.3.5.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan.

All participants and developers were interviewed. Thus, there were no data-collection process-evaluation-related tasks that required sampling.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. Note that conclusions were integrated into sections describing key findings.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.6.3.6 Smart Business Solutions (SBS) Program

B.6.3.6.1 Brief Overview of the Program and Its Success

The SBS Program is a direct-install program, designed to encourage and assist small business owners to improve the efficiency of their existing facilities through turnkey installation and rapid project completion. The program includes lighting and refrigeration measures that typically are low-cost and deliver reliable, prescriptive energy savings and costs per unit. PECO scaled back program activity considerably in PY7 due to cost overruns in PY6. The gross program savings in PY7 were approximately 4,971 MWh, compared with 13,413 MWh in PY6.

B.6.3.6.2 Summary of the Process Evaluation Findings

For process evaluation, Navigant relied on data from two research activities: in-depth interviews with program managers and review of program data. Four key findings emerged from these efforts:

1) The program fell short of the Phase II objectives by about 15% and overspent the budget by about $1 million.
2) The program was able to ramp up and down easily. The PECO program manager was able to vary the length of time between the on-site audit and the delivery of the efficiency project proposal to

increase or decrease the number of projects—and therefore control the amount of savings—coming in each month.

3) PY7 savings still revolved around linear fluorescent upgrades of T12s to T8s and T5s, accounting for 76% of program savings. The TRM in Phase III will shift the baseline for linear fluorescent upgrades from T12s to T8s, drastically reducing the amount of savings PECO can claim for T12 upgrades.

4) There may be a missed opportunity for PECO to offer customers a more comprehensive approach to energy savings. On-site visits offer the sales auditor an opportunity to review and propose more efficiency options than those incentivized through the SBS.

B.6.3.6.3 Summary of the Process Evaluation Audit

Navigant completed all the PY7 activities listed in the evaluation plan. None of the data-collection activities in PY7 required sampling. The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations. The report included sufficient detail for the SWE Team (and other readers) to assess the methods, findings, and recommendations. However, the reporting lacked conclusions, which affected how recommendations were developed. Recommendations were drawn from key findings rather than from conclusions.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The recommendations were clear and actionable and supported by findings.

B.7 PPL

B.7.1 Residential Programs

Cadmus reported on PY7 process evaluations for three of four residential programs: The Residential Energy-Efficiency Behavior & Education Program (Cadmus conducted a full process evaluation in PY6 and a limited evaluation in PY7), Residential Home Comfort Program, Residential Retail Program (Residential Lighting and Efficient Equipment), the Student and Parent Energy Efficiency Education Program. In accordance with the evaluation plan, Cadmus did not perform a PY7 process evaluation for the Appliance Recycling Program since the program was evaluated in prior years and no major changes occurred in PY7 except that it was suspended in Q2 of PY7.

For the process evaluations of the above programs, Cadmus reviewed program documents and data; interviewed utility and implementation staff; and surveyed program participants and nonparticipants. The document and program data review informed identification of program goals, activities, and updates, and in some instances, development of program theory and logic models. The research issues addressed by the primary data-collection activities (in-depth interviews and surveys) varied among programs but generally included the effectiveness of program administration, implementation, and delivery, and customer and market actor program satisfaction, participation, challenges, and recommendations.

Cadmus followed the evaluation plan for each program's process evaluation with three exceptions, which Cadmus explained in the PY7 annual report: (1) Cadmus did not achieve the planned goal of surveying manufactured home participants in the Residential Home Comfort Program because there was only one participant (see Section 7.4.2 of the annual report). (2) Cadmus did not obtain the targeted

number of Residential Home Comfort Program participant surveys to achieve the planned 90/10 confidence/precision. (3) Cadmus increased the number of planned surveys of heat pump water heater participants and residential customers for the Residential Retail Program, to achieve the targeted number of completes (see Section 7.4.2 of the annual report).

The findings were clearly presented, and overall the conclusions were well supported by the findings. The conclusions were mostly concise and informative, but the SWE Team noted two conclusions that did not have, but likely could have had, accompanying recommendations. The recommendations followed from the conclusions, and most of the recommendations were clear and actionable. The SWE Team did note two recommendations that included multiple recommendations that could be separated, and two recommendations that were too vague and not clearly actionable.

For each program, a brief program description, summary of the process evaluation findings, and review (audit) of the annual report follow below. The SWE Team notes three comments about the methods discussions for the process evaluations of all programs:

1) The sample and disposition tables for the surveys conducted as part of the process evaluation are missing the survey mode (web, phone, mail) used to conduct each survey. The addition of the survey mode would complete the tables and make it so the reader does not have to refer to the text to find which mode was used. The SWE Team notes that it did not include survey mode in this table's template provided to the EDCs, but that the mode would be a good addition.

2) Including more information about the methods used to conduct analyses, such as the type of analysis (e.g., means, medians, frequencies, percentages, qualitative coding.) and type of test (e.g., Chi-square, t-test) and values of the statistical tests conducted, would be very informative.
Including more methodological details about the survey of Low-Income Energy-Efficiency Behavior & Education Program participants would be helpful, since it was used for calculating program savings from the free LED bulb.

B.7.1.1 Residential Energy-Efficiency Behavior & Education Program

B.7.1.1.1 Brief Overview of the Program and Its Success

The Residential Energy-Efficiency Behavior & Education Program informs customers about their home energy consumption and encourages them to adopt low-cost energy savings home improvements and behaviors through HERs. Customers receive a HER sent by mail every other month, or by email every month if a valid email address is on file. HERs contain the customer's household energy use data, a neighbor comparison of energy use, and three low-cost energy savings steps.

The implementer for this program is OPower, which selects eligible customers and produces and distributes the HERs. An RCT is used to determine who receives reports, in which customers selected by OPower are randomly assigned by Cadmus to either a treatment group (recipients of HERs) or a control group (non-recipients). The control group is unaware of the HERs and is used as a comparison for measuring the treatment group's energy savings resulting from the program.

Because of its strong savings performance in PY6, the program ceased delivery of HERs at the end of Q2 in PY7. As a result, treatment-group customers received about three paper HERs by mail and five emailed HERs in PY7.

The Residential Energy-Efficiency Behavior & Education Program exceeded its PY7 and Phase II planned MWh/yr savings and nearly met its planned participation. The program planned 30,749 MWh/yr savings, and at the end of PY7 achieved 39,078 MWh/yr savings, or 127% of planned savings. The program also planned 128,000 participants and achieved 126,290 participants, or 99% of planned participation.

B.7.1.1.2 Summary of the Process Evaluation Findings

In PY7, Cadmus conducted a limited process evaluation of the program. Cadmus interviewed one program staff and one implementer, and monitored two key performance indicators on a monthly basis: HERs recipients and the call center. The process evaluation findings from PY7 are summarized below:

- The program manager and implementer did not report any implementation challenges in PY7.
- Due to higher than expected savings, the program ceased delivery of HERs at the end of Q2 in PY7; this will help set up participants to make a transition to a new behavior program design for Phase III.
- The program did not meet its planned participation in PY7 due to attrition during PY6, but still exceeded its planned energy savings.
- The shortened report delivery period during PY7 resulted in fewer customer calls to the call center.
- Cadmus created demographic profiles for surveyed participants.
- The HERs provided an aggregate uplift in participation in (12%) and savings from (5%) other PPL energy efficiency programs.

B.7.1.1.3 Summary of the Process Evaluation Audit

The research activities were consistent with the Phase II evaluation plan, which calls for one process evaluation per program per phase. In PY6, Cadmus performed a full process evaluation that included interviews with staff and participants and a review of databases, program materials, and other documents. In PY7, Cadmus followed the plan for process evaluation activities for that year, which was more limited and included fewer activities than in PY6.

In the PY7 report, Cadmus adequately explained the evaluation methods and findings, and included the necessary tables. The recommendations were actionable and follow from the conclusions, and ample evidence was provided to support the conclusions. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations. In addition, Cadmus included some findings from its evaluation of this program, such as readership of the HERs, in the Low-Income Energy-Efficiency Behavior & Education Program chapter and not in this chapter.

B.7.1.2 Residential Home Comfort Program

B.7.1.2.1 Brief Overview of the Program and Its Success

The Residential Home Comfort Program achieves residential energy savings by offering energy efficient products, rebates, education, and services for new construction and retrofitting of existing homes. The range of services offered allows customers to customize solutions to decrease their home's energy usage. CLEAResult is the implementer. The program has five components:

1) New homes, which encourages construction of energy efficient new homes through two paths:

- **a.** The prescriptive path offers a $2,000 rebate to builders for installing a specific package of six efficient products: SEER 16+ ASHP, EF 2.3+ HPWH, ENERGY STAR refrigerator, ENERGY STAR dishwasher, R20+ wall insulation, and R49+ ceiling insulation.

   b. The HERS approach offers builders a rebate of $0.30 per kWh/yr saved (up to $2,000) for homes built with any combination of a specific package of products.

2) Manufactured homes, which offers a $1,200 rebate to buyers of an ENERGY STAR–manufactured home and an additional rebate of up to $300 for the installation of efficient heating.

3) Audits provide customer rebates for professional comprehensive home energy audits or a less comprehensive home survey.

4) Weatherization, based on recommendations from an audit, provides rebates for ceiling and wall insulation and for air sealing.

5) Energy efficient equipment provides rebates for purchasing high-efficiency ASHPs, DHPs, above- or in-ground pool pumps, central air-conditioning, ECM furnace fans, whole house fans, and fuel switching.

In PY7, PPL added additional rebates to the program, including $100 for air sealing from Building Performance Institute–certified contractors, $100 for purchasing and installing an ECM furnace fan, $200 for purchasing and installing a whole house fan, $250 for a 16+ SEER central air conditioner, and $150 for installing a variable-speed above-ground pool pump.

The Residential Home Comfort Program exceeded its planned energy savings and participation for PY7 and Phase II. In PY7, the program achieved 131% of planned MWh/yr energy savings and 109% of planned participation. In all of Phase II, the program achieved 122% of its MWh/yr planned energy savings and 103% of planned participation.

B.7.1.2.2 Summary of the Process Evaluation Findings

In PY7, Cadmus conducted interviews with program staff and the implementer (n=2), cross-program participant surveys (n=286), and a program database review. Cadmus also measured two key program performance indicators: customer satisfaction and customer complaints. The following findings emerged from the evaluation:

- Overall, the program is meeting planned energy savings and participation.
- The conversion rate for those who followed through on installing measures after an energy audit was 38% for PY7.
- High up-front costs of an audit continued to be a barrier to participation in PY7; the rebate, which covers a high percentage of the cost, was sent after the audit and thus did not reduce up-front costs.
- DHPs achieved the most savings in PY7.
- The new homes prescriptive path (n=2) and manufactured home offerings (n=1) continued to not perform as well as planned. For the manufactured home offerings, the implementer noted difficulties in promotion, an insufficient incentive amount, and a low percentage of manufactured homes that use electric heat.
- The rigidity of the prescriptive path, in which contractors had to install specific products, led to lower participation; builders believed the product requirements were too strict.
- The HERS new home approach performed much better than planned in PY7 due to the increased flexibility that builders have in installing measures to qualify a home for incentives.
- The new products added in PY7, particularly the central air conditioners, were successful at increasing energy savings.

- Most of the program offerings strata had increased participation year over year in Phase II; only fuel switching, manufactured homes, and the new construction prescriptive offerings saw declines from PY6 to PY7.
- The program met its customer satisfaction goal of 80% satisfied customers (81% reported being very satisfied, 17% somewhat satisfied) but did not meet its customer complaint goal of zero customer complaints.
- Customers were most satisfied with the equipment and their contractor and least satisfied with the application and the time it took to receive the rebate. Unsatisfied customers recommended providing clearer rebate information, improving the rebate process, and increasing rebate amounts.
- Nearly one-fourth (24%) of application forms were returned to customers due to missing information, and this varied by program offering type.
- Customer satisfaction with PPL increased throughout Phase II; in PY7 83% reported high satisfaction and 36% reported that their opinion of PPL increased after participating.
- In PY7, 68% of participants learned about the program from a contractor or vendor, and 19% through a retailer. Nearly half of participants (48%) reported recommending the program to someone else.
- About one-fourth of surveyed participants reported awareness of other PPL programs. This varied by the type of program offerings customers received.
- Survey participants reported participating to replace old equipment (53%), to get new equipment with specific features (24%), and to reduce energy costs (17%).
- Cadmus created demographic profiles for surveyed participants.

B.7.1.2.3 Summary of the Process Evaluation Audit

The research activities were consistent with the Phase II evaluation plan, which calls for one process evaluation per program per phase. In PY6, Cadmus performed a full process evaluation that included interviews with the full cast of program actors and a review of program databases, documentation, and forms. Cadmus followed the plan for process evaluation activities for PY7, except it was unable to meet the goal of surveying manufactured home participants since there was only one in PY7.

The methodology sections adequately explained the evaluation and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used would be very informative. Cadmus met the targeted number of completed interviews for the E-Power Wise Program evaluation. For the Wise Home Pilot evaluation, Cadmus met the targeted number of completed interviews but achieved only 44 of 60 planned participant surveys. While the survey mode was reported in the text, adding the mode used for surveys (web, phone, mail) in Table 12-33 would complete the table and inform the reader without having to refer to the text where the survey mode is reported. This is particularly true for the satisfaction follow-up surveys that used web and phone but were reported in the sampling and disposition table in the aggregate.

For the data-collection task requiring sampling, the participant survey, Cadmus attempted a sample size of 349 that provided 90/10 confidence/precision but achieved fewer survey respondents (n=286) (see Table 7-17 in the Annual Report). While the Framework does not specify any required confidence/precision levels for process evaluation or any requirement to discuss achieved confidence/precision levels, it would be valuable to discuss the impact that the reduced sample size had on the minimum confidence and precision achieved. At a minimum, this would allow the reader to compare the process evaluation as conducted to what was in the evaluation plan. Note that the SWE

Team does not suggest the report should include the achieved confidence and precision levels for each assessment performed, but rather the minimum confidence and precision levels that the sample size would afford, assuming a reasonable estimate of the greatest amount of variance likely (e.g., an assumed proportion of 0.50 in nominal or scaled responses).

Program findings were clearly summarized and presented in tables and figures. The recommendations were actionable and followed the conclusions, which were supported by ample evidence. Two recommendations (third and fourth), however, included multiple actions that could be separate recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.1.3 Residential Retail Program (Residential Lighting and Efficient Equipment)

B.7.1.3.1 Brief Overview of the Program and Its Success

The Residential Retail Program has two components: upstream lighting and downstream rebated equipment. The implementer, Ecova, manages both components. The upstream lighting component offers incentives to manufacturers to discount the price of energy efficient screw-in LED bulbs sold in stores. The implementer also distributes information about energy efficient lighting and recycling, and maintains CFL recycling bins at participating retailers throughout the PPL territory and in municipal and community locations.

The rebated equipment component of the program provides a direct rebate to customers for the purchase of energy efficient refrigerators and HPWHs. This component also includes efficient fossil-fuel water heaters eligible for rebates under the fuel switching pilot. The implementer provides educational and promotional materials to participating retailers and maintains a call and rebate-processing center.

For PY7, PPL introduced a tiered rebate for HPWHs, in which customers could receive a $300 rebate for models with an energy factor of 2.3 or higher, and an additional $100 for models with an energy factor of 2.75 or higher. The program also mailed 45,000 LEDs to participants in the Low-Income Energy Efficiency Behavior & Education Program, distributed 3,000 LEDs at a low-income customer holiday dinner event, and ramped down incentives at big box stores while maintaining promotions at independent hardware and grocery stores.

The Residential Retail Program exceeded its planned energy savings for PY7 and Phase II. The program achieved 128% of planned MWh/yr energy savings in PY7 and 107% in all of Phase II. The program did not establish planned participation for PY7 or Phase II but achieved 225,783 participants in PY7 and 624,277 participants in all of Phase II.

B.7.1.3.2 Summary of the Process Evaluation Findings

Cadmus conducted process evaluations separately for the rebated equipment and for the upstream lighting components of the program. For the rebated equipment process evaluation, Cadmus reviewed database records, interviewed one program staff member and one implementer, and conducted cross-program surveys that included 132 participants in the Residential Retail Program's rebated equipment component, 62 refrigerator participants, and 70 HPWH participants.

The following findings emerged from the evaluation of the rebated equipment component:

- Overall, this component of the program exceeded its planned energy savings for PY7.

- The program was delivered efficiently and effectively, particularly after the implementer took over management of the rebate processing after PY6. Rebate processing times averaged three weeks, lower than in PY6.
- Some participants expressed disappointment with lower refrigerator rebates due to changes in ENERGY STAR qualification criteria for various models.
- A larger percentage of surveyed participants reported satisfaction with the program in PY7 (79%) than in PY6 (69%). Recipients of rebates for HPWHs were more satisfied than recipients of refrigerator rebates. Unsatisfied respondents suggested a simpler rebate structure or process and higher rebates for refrigerators.
- Over three-fourths (76%) of survey participants reported high satisfaction with PPL in PY7, down from 85% in PY6. Nearly one-third (32%) reported that their opinion of PPL improved after participating in the program.
- Nearly half of surveyed participants (42%) learned about the program through a retailer; others learned about it through their contractor, the PPL website, and other marketing channels like bill inserts, TV, or the Internet.
- Cadmus created demographic profiles for surveyed participants.

For the upstream lighting component process evaluation, Cadmus reviewed database records and lighting manufacturing invoices, interviewed one program staff member and one implementer, conducted general residential population surveys with 337 residential customers (70 of whom purchased LEDs from participating retailers), and conducted cross-program surveys with 301 Low-Income Energy Efficiency Behavior & Education Program participants. The following findings emerged:

- The program was delivered efficiency and effectively, and the quality of the data from the various sources (manufacturing invoices, program database) was very good.
- Home improvement, club, mass market, and independent retail channels sold the most qualifying bulbs.
- LED purchasers were not significantly different demographically than nonpurchasers except in regard to income, in which LED purchasers reported higher income than nonpurchasers.
- Nearly four out of five (79%) surveyed PPL customers reported awareness of LEDs, and 78% had seen them for sale at retailers in PY7, which was unchanged from PY6. However, most surveyed customers (85%) were unaware that PPL discounted LED bulbs.
- About three-fourths (76%) of surveyed customers reported they were very or somewhat likely to install LEDs in the next 12 months. Of those who reported they were not likely to install LEDS, the most common responses cited were high costs (27%), no expectations to replace bulbs (17%), and having bulbs in storage (10%).
- The most to least important features of LED bulbs, as measured by surveyed customers who rated each very important, are longevity, brightness, energy use/wattage, cost, and color quality, and variety of types.
- In PY7, about 70% of surveyed customers reported purchasing any type of screw-in bulbs, and 28% had purchased LEDs in the previous six months, a significant increase from PY6.
- Respondents who purchased LEDs from participating retailers reported an average price of $7.51 per bulb; respondents who purchased LEDs from any retailer reported an average price of $8.10 per bulb.
- Nearly half (44%) of respondents reported currently using LEDs in PY7, up from 30% in PY6. More respondents in PY7 (32%) reported replacing CFLs with LEDs than in PY6 (22%).

- In PY7, nearly three-fourths (73%) of respondents with LEDs were overall very satisfied with them; these respondents reported the highest satisfaction with brightness and longevity and the least satisfaction with cost and the variety of bulb types.
- Over half of respondents (58%) were not aware that not all LEDs qualify for ENERGY STAR certification.
- The reported willingness to pay $5 or more for LEDs dropped in PY7 compared with PY6, but 90% of respondents were willing to pay $3 per LED. Non-LED users reported higher sensitivity to price changes than LED users.
- Most respondents who disposed of CFLs in PY7 (60%) reported throwing the bulbs in the trash. Of those who had not disposed of a CFL, 47% reported that they would throw CFLs in the trash to dispose of them. About one-fourth of each group reported they recycled or would recycle CFL bulbs to dispose of them. Of those who said they did not or would not recycle CFLs, 72% reported that they would be more likely to recycle if PPL recycle bins were available in more locations; only 7% of surveyed respondents reported awareness of PPL's recycle bins.
- About three-fourths (74%) of respondents reported high satisfaction with PPL, which was similar to findings from PY6.
- Cadmus created demographic profiles for surveyed participants.

B.7.1.3.3 Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan, except Cadmus interviewed more HPWH participants than initially planned, to update net savings analysis, and interviewed more residential customers than planned, to find a sufficient number of customers who purchased LEDs from participating retailers for statistical confidence/precision.

The methodology section mostly explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, and the types and values of any statistical tests conducted, would be very informative. More methodological details about the survey of Low-Income Energy Efficiency Behavior & Education Program participants would be helpful, since it was used for calculating program savings from the free LED bulb. For the data-collection tasks requiring sampling, Cadmus achieved planned sample sizes that provided 90/10 confidence/precision per survey sample per program component; for interviews that did not require sampling, Cadmus met the targeted number of completes. Adding the mode used for surveys (web, phone, mail) in Tables 3-10, 3-16, and 3-18 would complete the tables and help inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with mostly actionable recommendations following conclusions and sufficient evidence supporting the conclusions. In Section 3.4.7.2, the SWE Team found an error in the first paragraph stating that 76% is higher than 85%; it should be changed to "lower." Two conclusions (second and fifth) also did not have, but likely could have had, accompanying recommendations, and two recommendations (fifth and sixth) are vague in terms of the specific actions PPL should take. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.1.4 Student and Parent Energy-Efficiency Education Program

B.7.1.4.1 Brief Overview of the Program and its Success

The Student and Parent Energy-Efficiency Education program provides school-based energy efficiency education through classroom presentations for students, training for teachers, and community workshops for parents. Some of the schools were in low-income neighborhoods. All participants receive educational materials, a home energy worksheet (HEW) to complete and return to the program, and a take-home energy efficiency kit of low-cost items that can be installed at home. Participating students are in grades 2–12; kits are tailored to each grade level and contain items such as LED lamps, low-flow showerheads, faucet aerators, smart power strips, and electroluminescent nightlights. The classroom workshops meet Pennsylvania academic standards for the appropriate grade levels. National Energy Foundation is the program implementer.

For PY7, PPL made three changes to the program. It increased the number of student and parent workshop participants, launched a poster contest to get students and classrooms involved in extracurricular activities related to energy efficiency, and included an online HEW process for older students.

In PY7, the Student and Parent Energy-Efficiency Education program exceeded one of its two planned goals. The program achieved 108% of its planned annual participation but only 85% of its planned annual MWh/yr savings. In all of Phase II, the program fell short of meeting its planned goals. It met 86% of its planned MWh/yr savings and 97% of its planned three-year participation.

B.7.1.4.2 Summary of the Process Evaluation Findings

Cadmus conducted database and QA/QC review of records and two interviews with the program manager and the implementer. Cadmus analyzed the census of 19,249 implementer-administered HEWs returned by participating students, 1,015 parent workshop HEWs, 2,229 implementer-administered parent surveys, and open-end responses from 1,918 implementer-administered classroom teacher, teacher workshop, and parent workshop evaluation surveys. Cadmus also measured four key program performance indicators: program enrollment, new school enrollment, teacher workshop participation, and classroom and parent workshop participation.

The following findings emerged from the evaluation:

- The program met one of its planned PY7 goals (annual participation) but did not meet the planned energy savings; the program also did not meet either of its two planned goals for all of Phase II. This was due in part to a change in how installation rates were measures in PY7 versus PY6 and low installation rates of products in the kit.
- Interviewed staff reported a smooth delivery of the program in PY6 and PY7.
- All four key performance indicator goals were met or exceeded in PY7. Program enrollment was successful, new school enrollment reached 30% of all participants, 150 teachers enrolled, and the number of returned HEWs exceeded 72%.
- The implementer's targeted marketing and personalized outreach efforts increased program awareness and helped increase participation, particularly for new schools.
- Cadmus created participant profiles of classroom teachers, workshop teachers, classroom parents, and workshop parents.
- Most classroom teachers (81%) and workshop teachers (84%) rated their overall impressions of the program the program as excellent.

- Classroom parents reported that the kit and products were easy to install and use, they would continue using them upon completion of the program, and they would like to see the program continued. Most also reported changing the way they had used energy in their home since participating in the program.
- Most workshop parents (98%) reported that they found the workshop components very or somewhat helpful.
- Teachers and parents recommended areas for improvement, which included providing more student interaction opportunities, reducing the paperwork of the HEW, and improving the presentations.

B.7.1.4.3 Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan. The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, would be very informative. None of the interviews or surveys required sampling, and Cadmus met the targeted number of completes. Adding the mode used for the survey (web, phone, mail) in Table 8-15 would complete the table and inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with actionable recommendations following conclusions and ample evidence supporting the conclusions. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations. In addition, the description of the program is unclear as to whether all or some of the participating schools are in low-income neighborhoods; this should be noted in future reports to clear any confusion about whether or not it is primarily a low-income program.

B.7.2 Low-Income Programs

Cadmus reported on process evaluations for three low-income programs: The E-Power Wise Program, the Low-Income Energy-Efficiency Behavior & Education Program, and the Low-Income Winter Relief Assistance Program (WRAP).

For the process evaluations of the above programs, Cadmus reviewed program documents and data; interviewed the utility staff, implementer, and staff at community-based organizations; and surveyed program participants. The document and program data review informed identification of program goals, activities, and updates, and in some instances, development of program theory and logic models. The research issues addressed by the primary data-collection activities (in-depth interviews and surveys) varied among programs but generally included the effectiveness of program administration, implementation, and delivery, and customer and market actor program satisfaction, participation, challenges, and recommendations.

Cadmus followed the evaluation plan for each program's process evaluation with three exceptions, two of which were minor and one of which was a reasonable adjustment to an unexpected situation. Cadmus explained these exceptions in the PY7 annual report. PPL and Cadmus revised the initial Wise Home Pilot evaluation plan due to complications enrolling customers (see Section 12.7.1.2 in the annual report). The revised plan included a limited process evaluation, which Cadmus followed except for achieving fewer participant satisfaction surveys than planned (n=44/60). In the other two exceptions, Cadmus achieved larger samples than planned, conducting two additional interviews for the E-Power

Wise Program evaluation (see Section 12.4.2 in the annual report) and increasing the number of planned WRAP participant survey completions to include more low-cost and full-cost job participants (see Section 9.4.2 of the annual report). In addition, Cadmus attempted a census in surveying the 11 De Facto Pilot participants, achieving completions with 3 of the participants. This is not strictly a deviation from the plan, as the plan was to *attempt* a census, and Cadmus attempted to survey all 11 participants (see Section 9.7.4 of the annual report).

The findings were presented in a clear manner with one exception. Cadmus included some findings from the Residential Energy-Efficiency Behavior & Education Program in the Low-Income chapter but not in the Residential chapter. The conclusions were overall well supported by the findings and were mostly concise and informative. The SWE Team noted five conclusions that did not have, but likely could have had, an accompanying recommendation and one conclusion that contained a repetitive sentence that should be removed. The recommendations followed from the conclusions and were clear and actionable.

For each program, a brief program description, summary of the process evaluation findings, and review (audit) of the annual report follow below. The SWE Team notes two general comments about the methods discussions for the process evaluations of all programs.

First, the sample and disposition tables for the surveys conducted as part of the process evaluation are missing the survey mode (web, phone, mail) used to conduct each survey, however, this was discussed in the text of the report. The addition of the survey mode would complete the tables and make it so the reader does not have to refer to the text to find which mode was used. The SWE Team notes that it did not include survey mode in this table's template provided to the EDCs, but that the mode would be a good addition. Second, including more information about the methods used to conduct analyses, such as the type of analysis (e.g., means, medians, frequencies, percentages, qualitative coding) and the types (e.g., Chi-square, t-test) and values of the statistical tests conducted, would be very informative.

B.7.2.1 E-Power Wise Program and Wise Home Pilot

B.7.2.1.1 Brief Overview of the Program and Its Success

The E-Power Wise is a program that educates low-income customers about energy efficiency. The program targets customers with incomes at or below 150% of the FPL in single-family housing and in multifamily housing where each unit is metered (not master metered). E-Power Wise uses a "train-the-trainer" model, in which the program implementer, Resource Action Program, Inc. (RAP), trains community-based organization staff to provide energy workshops in locations that are accessible to low-income customers. Customers attending the sessions receive free energy efficiency training and a take-home kit. The program also mails a promotional card to eligible customers for them to opt-in to receive a free energy savings kit.

In PY7 the program increased the number of kits distributed by 1,500 over PY6 and, as a result, added three new agencies. The program also updated the content of the trainings and take-home DVD to focus more on the installation of the products in the free take-home kits.

E-Power Wise met or exceeded its planned MWh/yr energy savings and planned participation for PY7 and Phase II. In PY7, the program achieved 132% of its planned MWh/yr savings and 100% of its planned participation. In all of Phase II, the program achieved 101% of its planned MWh/yr energy savings and 100% of its planned participation.

In PY7, the program added the Wise Home Pilot, with RAP and Franklin Energy as the implementers. The pilot targeted manufactured homes and provided eligible low-income homes with needed weatherization measures (full weatherization for electric-heated homes, partial weatherization for non-electric-heat homes). The pilot was structured as an RCT, with two large treatment groups of participants and a large control group of nonparticipants, but due to low enrollment, Cadmus and PPL changed the evaluation plan and study design to include two smaller treatment and control groups for measuring energy savings.

The PY7 Wise Home Pilot evaluation plan and report did not specify planned energy savings. The pilot initially planned an enrollment of 600 participants but had achieved about half (333) at the time of the evaluation.

B.7.2.1.2 Summary of the Process Evaluation Findings

In PY7, Cadmus reviewed the program database and completed two interviews with the E-Power Wise program manager from PPL and the implementer, and five interviews with the community-based organizations. Cadmus analyzed 776 customer surveys returned from the energy savings kits, which represented 15% of the total participation. Cadmus also tracked a key performance indicator for the program, the number of agencies distributing kits for the program.

Based on these data, several key findings emerged:

- The program met or exceeded its planned MWh/yr energy savings and planned participation goals for PY7 and Phase II.
- The implementer and PPL continue to provide a very well managed program; PPL and implementer program managers speak each week and work together to ensure that kit distribution remains steady throughout the program year.
- The number of agencies that distribute kits for the program increased by three in PY7, which is aligned with the program's goal of increasing the number of agencies.
- Agencies recommended removing the furnace whistle from the kit. They found that many customers frequently ask questions about the furnace whistle because they don't understand how to use or install it.
- Interviewed agencies are very satisfied with the program overall. Some agencies are not too satisfied with the training provided by the implementer or communications with PPL.
- Four of five interviewed agencies reported using their own outreach channels to promote the program, and one agency reported doing very little program promotion.
- Four of five interviewed agencies reported distributing kits in one-on-one meetings with clients because they were getting little participation via workshops; one agency reported continuing the workshops about energy savings kits.
- Three of the five interviewed agencies reported that program saturation was still a concern because they frequently see the same clients.
- Interviewed agencies reported that clients are most interested in general ways to save money and reduce energy, specific ways to save on heating and cooling costs, faucet aerator and showerhead installation and use, and plug loads. Clients ask most about how and why their energy bill differs from their neighbor's, the impact of showers on energy usage, and how to use furnace whistles and smarts strips.
- Most surveyed participants reported that the Quick Start Guide was very effective in helping them become more energy efficient and that they learned a lot about energy savings through the program.
- Cadmus created demographic profiles for surveyed participants.

In PY7, Cadmus reviewed the E-Power Wise Home Pilot database and conducted three stakeholder interviews with the pilot staff from PPL and the implementers, one interview with the participating technician, and 44 follow-up participant satisfaction surveys via web and phone. Cadmus also analyzed 40 leave-behind postcards and 243 participant enrollment surveys conducted by PPL and the implementers. Cadmus conducted a limited process evaluation focused on the logistics of pilot delivery, delivery challenges, and a key performance indicator, participant satisfaction. The following key findings emerged:

- The pilot met its key performance indicator goal of 80% participant satisfaction. Nearly all participants (96%) reported being very or somewhat satisfied.
- Most participants (75%) reported being very or somewhat satisfied with their home's comfort and temperature control after participating, up from 44% before participation.
- Most participants reported being very or somewhat satisfied with other pilot elements, including information received, time to complete the project, technician's knowledge, quality of work, and availability. Most participants (90% or more) also rated all these elements as very or somewhat important. However, the three elements rated as most important—technician's quality of work, knowledge, and availability—received the lowest satisfaction ratings.
- Cadmus created participant profiles based on demographic and housing characteristics.
- Surveyed participants most frequently reported LED lightbulbs, insulation, weather stripping, and duct sealing as the most important products they received.
- Since participating, over one-third of surveyed participants reported never adjusting their thermostat or only adjusting it as needed, and all reported that they had not started manually changing their thermostats more often.
- Most surveyed participants (84%) reported that their monthly energy bills did not change or had decreased since participating.
- Over two-thirds of survey respondents reported that they did not know or knew very little about other rebates and energy efficiency programs. The Appliance Recycling Program, Low-Income Home Energy Assistance Program (LIHEAP), and WRAP were the most cited programs. The technician, however, was not instructed to promote other programs and reported not doing it very often.
- There are far fewer manufactured homes in the study region that have electric heating, and more homes with non-electric heating that enrolled than initially anticipated, which led to major changes in the pilot and study design, substantial delays in implementation, and customer attrition.
- PPL used direct mailers, phone calls, and information sessions and flyers at manufactured home parks to inform customers of the program, but used the E-Power Wise branding instead of Wise Home Pilot branding on printed materials.
- Customer distrust played a large role in low recruitment, particularly the fact that the pilot was free.
- Delays in implementation pushed the installations and weatherizations into winter instead of being performed in summer as planned. This caused some unanticipated delays due to weather, holidays, and shorter days.
- The technician and surveyed participants reported challenges with installing advanced power strips due to having to move large or heavy furniture. Some participants also declined the low-flow showerheads.
- The technician reported that explaining what was involved in the project and why it was free, and collecting data about the home, were the most challenging and time-consuming aspects of the customer interaction.

B.7.2.1.3 Summary of the Process Evaluation Audit

The E-Power Wise Program process evaluation activities were consistent with the evaluation plan, except that Cadmus conducted two additional informal interviews to explore changes in program delivery. The Wise Home Pilot evaluation plan was revised due to complications recruiting enough eligible customers to perform the initially planned RCT, which also led to implementation delays and pilot design changes. The revised plan called for a limited process evaluation, and the process evaluation activities conducted by Cadmus were consistent with the revised evaluation plan.

The methodology sections adequately explained the evaluation and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the software and type of analysis used, would be very informative. Cadmus met the targeted number of completed interviews for the E-Power Wise Program evaluation. For the Wise Home Pilot evaluation, Cadmus met the targeted number of completed interviews but achieved only 44 of 60 planned participant surveys. While the survey mode was reported in the text, adding the mode used for surveys (web, phone, mail) in Table 12-33 would complete the table and inform the reader without having to refer to the text. This is particularly true for the satisfaction follow-up surveys that used web and phone but were reported in the sampling and disposition table in the aggregate.

Program and pilot findings were clearly summarized, with actionable recommendations following conclusions and ample evidence supporting the conclusions. The report also included tables of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.2.2 Low-Income Energy-Efficiency Behavior & Education Program

B.7.2.2.1 Brief Overview of the Program and Its Success

The Low-Income Energy-Efficiency Behavior & Education Program is the low-income version of the Residential Energy-Efficiency Behavior & Education Program. The program informs low-income customers (at or below 150% of the FPL) about their home energy consumption and encourages them to adopt no-cost energy savings home improvements and behaviors through HERs. Customers receive a HER sent by mail every other month, or by email every month if a valid email address is on file. HERs contain the customer's household energy use data, a neighbor comparison of energy use, and three no-cost energy savings steps.

The implementer for this program is OPower, which selects eligible customers and produces and distributes the HERs. An RCT is used to determine who receives reports, in which customers selected by OPower are randomly assigned by Cadmus to either a treatment group (recipients of HERs) or a control group (nonrecipients). The control group is unaware of the HERs and is used as a comparison for measuring the treatment group's energy savings resulting from the program.

The program made three changes in PY7. First, the program added 20,000 customers to the treatment group, for a total of 90,000 customers in the program. Second, it added Winter of 68 and LIHEAP modules to the program during Q3 to increase participation in LIHEAP and elicit customers to reduce their thermostat temperature setting. And third, about 45,000 high-energy-use treatment-group customers were mailed a free LED bulb as part of the Residential Retail Program, which claimed the savings from the bulbs.

The Low-Income Energy-Efficiency Behavior & Education Program exceeded its PY7 and Phase II planned MWh/yr savings and nearly met its planned participation. The program achieved 128% of its planned MWh/yr energy savings and 97% of its planned participation at the end of PY7 and Phase II.

B.7.2.2.2 Summary of the Process Evaluation Findings

Cadmus conducted two interviews with the program manager and the implementer and administered two stratified random sample phone surveys: a treatment-group survey (n=151) and a control-group survey (n=150). Cadmus also measured two key program performance indicators: number of HERs recipients and number of calls received at the implementer call center. The following findings emerged from the evaluation:

- The program exceeded its PY7 and Phase II planned MWh/yr savings and nearly met its planned participation. This happened in part due to very strong savings performance from customers who joined the program at inception (versus those added in PY7) and to the ramp-up in savings expected in PY6 occurring in PY7 because of a delay in program launch.
- The program manager and implementer reported that the program worked well and that customers received HERs as planned during PY7.
- Due to attrition in PY6, the program did not meet its key performance indicator goal of increasing participation to 90,000 customers, but it did meet its call center goal for reducing calls compared with PY6.
- Cadmus created participant demographic profiles of treatment-group customers.
- Most of the surveyed customers (89%) reported reading, partially reading, or skimming the last paper HERs they received, compared with 95% in the residential program.
- Surveyed treatment-group customers mostly agreed that the HERs were easy to understand, the information in them was useful, and the neighbor comparison was accurate, but only slightly agreed that the HERs got others in their household involved in saving energy.
- A significantly higher percentage of treatment-group respondents reported they were very familiar with energy efficiency programs and rebates from PPL compared with control-group respondents, indicating that HERs increased awareness of programs and rebates. However, this was not the case for LIHEAP (no significant difference in awareness between groups), which the HERs explicitly promoted to increase participation.
- The HERs provided an aggregate uplift in participation in (6%) and savings from (2%) other PPL energy efficiency programs. There was very little difference in the average number of other programs that PPL customers participated in between the treatment and control groups.
- The HERs did not appear to influence customers to make any of seven energy savings improvements or any of seven energy saving behaviors (no significant difference between treatment and control groups), except that more treatment-group than control-group respondents reported turning down their heating thermostat when leaving the house or sleeping.
- The HERs did not appear to improve customers' attitudes toward energy efficiency, reduce customer barriers to saving energy, or influence customers to visit PPL's website to look for ways to save energy (no significant difference between treatment and control groups).
- Over three-fourths of surveyed customers reported being very or somewhat satisfied with the HERs, which is higher than the survey results found for the Residential Program in PY6. In addition, respondents who received the free LED bulb reported significantly lower satisfaction than customers who did not receive the free LED.
- Surveyed treatment-group customers gave a significantly higher satisfaction rating for PPL compared with control-group customers in regard to both overall satisfaction and satisfaction with

PPL helping to lower monthly energy usage. Customers in the low-income program reported a higher satisfaction rating than customers in the residential, non-low-income program.

B.7.2.2.3 Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan. The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. For the data-collection tasks requiring sampling, Cadmus achieved sample sizes that provided 90/10 confidence/precision for each survey; for interviews that did not require sampling, Cadmus met the targeted number of completes. Adding the mode used for surveys (web, phone, mail) in Table 10-13 would complete the table and inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with actionable recommendations following conclusions and ample evidence supporting the conclusions. One conclusion, however, did not have, but likely could have had, an accompanying recommendation, and the third conclusion contained a repeating sentence, one of which should be removed. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

Cadmus included some findings from the PY6 Residential Energy-Efficiency Behavior & Education Program in this chapter, such as readership of the HERs, but did not report these findings in the Residential Energy-Efficiency Behavior & Education Program chapter because the results were reported in the PY6 process evaluation. Cadmus referenced the PY6 Residential results in the PY7 report as a comparison to the Low-Income program's survey results. Cadmus could improve the report by noting in the Methods section that they are comparing PY6 Residential results to PY7 Low-Income results. Multiple comparisons are made in the chapter, and noting them in the Methods section would clear any confusion a reader might experience. In addition, four of the conclusions did not include accompanying recommendations.

B.7.2.3 Low-Income Winter Relief Assistance Program (WRAP) and De Facto Heating Pilot

B.7.2.3.1 Brief Overview of the Program and Its Success

The Act 129 WRAP, the focus of this evaluation, operates in tandem with PPL's Universal Services WRAP. The former targets customers at or below 150% of the FPL while the latter targets customers at or below 200% of the FPL. Both are available to customers in existing single-family and multifamily housing (three or more dwelling units) where 50% or more of the tenants are income-qualified and are intended to operate seamlessly so that customers are not aware of which program they are receiving services from.

PPL works with community-based organizations to implement the program. WRAP provides eligible customers with a free energy audit and a list of pre-approved equipment upgrades and other needed energy-related services. WRAP contractors install the recommended upgrades, perform other energy-related services, and provide energy education to the customer at no cost to the customer.

The types of upgrades and services that customers can receive are divided into three types: baseload (targeting those without electric heat and without electric water heater), low-cost (targeting customers without electric heat but with electric water heater), and full-cost (targeting customers with electric

heat and electric water heater). Baseload products include installation of efficient lighting, refrigerator replacement, air conditioner replacement, dehumidifier replacement, changing or cleaning of heating and cooling filters, dryer venting (electric dryer), and power strips and smart plugs. Low-cost products include all baseload products as well as water-heating products, such as water heater replacement, water heater pipe wrap, faucet aerators, and efficient showerheads. Full-cost products and services include all baseload and low-cost products as well as shell products, such as insulation (e.g., attic, floor, wall), infiltration (e.g., caulking, weather stripping, blower door testing), HVAC repair and replacement, duct insulation and repair, and window repair and replacement.

In PY7, the program introduced the Low-Income Energy Assistance Program (LEAP) tracking system and a new component, the De Facto Heating Pilot. The pilot targets WRAP-eligible customers who have inoperable oil heat and use inefficient or unsafe electric heat sources, such as portable electric heaters or electric stoves, and installs high-efficiency heat pump systems (as well as the other eligible WRAP measures) at no cost to the customer.

WRAP met or exceeded all its planned PY7 and Phase II energy savings and participation except for its planned participation in PY7. WRAP achieved 124% of its planned MWh/yr energy savings and 99% of its planned participation in PY7. In all of Phase II, WRAP achieved 113% of its planned energy savings and 100% of its planned participation. The De Facto Heating Pilot, however, fell short of achieving its planned energy savings and participation. The pilot achieved 30% of its planned MWh/yr energy savings and 55% of its planned participation.

B.7.2.3.2 Summary of the Process Evaluation Findings

For the PY7 WRAP process evaluation, Cadmus conducted an interview with program staff and the implementer (n=1), participant phone surveys (n=141), and a database and QA/QC review (n=203). The following findings emerged from the process evaluation:

- WRAP met or exceeded all its planned PY7 and Phase II energy savings and participation except for its planned participation goal in PY7.
- Program staff reported being very satisfied with the LEAP tracking system and reported that the program ran smoothly in PY7.
- The program manager reported that CAP enrollment increased 25% in PY7 and that referrals through CAP were a strong contributor to PY7 WRAP participation.
- Most surveyed participants (71%) reported being very satisfied with the program; satisfaction was higher for full-cost and low-cost participants compared with baseload participants. Less satisfied participants recommended improving the contractor experience.
- Most survey participants (80%) reported high satisfaction with PPL. Low-cost participants reported higher satisfaction than full-cost and baseload participants. About half of surveyed participants (53%) reported that their opinion of PPL had improved since participating in WRAP.
- The program used mail-in postcards as its targeted marketing strategy and had less success with the cards in PY7 than in PY6, but the online application and toll-free number launched during PY6 helped increase participation in PY7.
- Most surveyed participants (81%) reported being knowledgeable about ways to save energy in their home prior to participating in WRAP. Surveyed participants indicated that the most important product features that affected their decision to purchase a product were the amount of energy it used (96%) and the purchase price (93%).
- Over half of surveyed participants (56%) agreed that their HVAC systems work fine and don't need replacing; 46% agreed that making an investment in energy efficiency is risky; 34% agreed that

information about energy efficiency is confusing or overwhelming; and 25% agreed that they are not sure what they can do to save energy at home.
- Most surveyed participants (83%) could recall examples of energy savings ideas provided during the in-home energy audit, and nearly all (94%) reported taking at least one of the steps to save energy.

For the De Facto Heating Pilot process evaluation, Cadmus reviewed the pilot database and conducted phone interviews with the program manager, one installation contractor, and three participants. Cadmus attempted a census of the 11 participants who installed heat pumps through the program. Cadmus also tracked four key program performance indicators: project costs, continued use of space heaters and room air conditioners following participation, customer satisfaction, and participant awareness of other PPL programs.

The following findings emerged from the process evaluation:

- The pilot did not meet its planned energy savings, participation, or cost-effectiveness for PY7. This was partly due to a short pilot time line, projects being larger and more expensive than anticipated, overestimation of ex ante savings, and only one contractor working with the program, instead of three.
- The pilot will not continue in Phase III.
- The program installed 10 DHPs, one ASHP, two HPWHs, and 11 WRAP full-cost jobs.
- Selecting qualified participants and homes from the 2,000 income-eligible customers and getting them to participate was very difficult, primarily due to the amount and rigidity of the screening criteria required to identify eligible homes, particularly the number of heating zones in homes.
- The pilot manager reported challenges communicating with the installation contractor because the contractor did not have a standard cost-quotation process that included enough detail to assess eligibility.
- Average project costs per home were higher than anticipated, limiting the number of participants to 11 instead of up to 20 under a fixed program budget.
- Two of the three surveyed participants reported high satisfaction with the contractor, the money they saved with the heat pump, and the money they saved with the WRAP measures; all three were satisfied with their home's comfort and overall were satisfied with the program.
- Two of the three surveyed participants reported high satisfaction and one reported moderate satisfaction with PPL. One participant's opinion of PPL improved significantly after participation.
- None of the three survey participants reported using portable space heaters or planned to use room air conditioners after participating in the pilot.
- One of the three survey participants reported awareness of other PPL programs.

B.7.2.3.3 Summary of the Process Evaluation Audit

The evaluations were consistent with the evaluation plan except that Cadmus increased the number of completed WRAP participant surveys, to include more low-cost and full-cost job participants. The methodology sections adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, would be very informative. For the data-collection tasks requiring sampling, Cadmus achieved sample sizes that provided 90/10 confidence/precision per survey sample. For interviews that did not require sampling, Cadmus met the targeted number of completes except for De Facto Pilot participants (n=3/11). Adding the mode used for surveys (web, phone, mail) in Table 9-31 would help complete the table and inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with actionable recommendations following conclusions and ample evidence supporting the conclusions. One WRAP conclusion (second) and two pilot conclusions (second and third), however, did not have, but likely could have had, accompanying recommendations. The report also included tables of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.3 Non-Residential Programs

Cadmus reported on process evaluations for four non-residential programs: The Continuous Energy Improvement Program, Custom Incentive Program, Prescriptive Equipment Program, and Master Metered Low-Income Multifamily Housing Program. In accordance with the evaluation plan, Cadmus did not perform an evaluation of the School Benchmarking Program since a full process evaluation was conducted in PY6; the program was working as planned, and it does not generate energy savings.
For the process evaluations of the above programs, Cadmus reviewed program documents and data, interviewed utility and implementation staff and contractors, and surveyed program participants. The document and program data review informed identification of program goals, activities, and updates, and in some instances, development of program theory and logic models. The research issues addressed by the primary data-collection activities (in-depth interviews and surveys) varied among programs but generally included the effectiveness of program administration, implementation, and delivery, and customer and market actor program satisfaction, participation, challenges, and recommendations.

Cadmus followed the evaluation plan for each program's process evaluation with four exceptions, which Cadmus explained in the PY7 Annual Report:

1) Cadmus and PPL moved the planned contractor and designer interviews, and additional benchmarking research, to PY8 in Phase III for the Custom Incentive Program (see Section 4.4.2 in annual report).
2) Cadmus conducted a web-plus-phone survey instead of a web survey of Prescriptive Rebate Program participants, to achieve the targeted number of completes (see Section 2.3.2 in the annual report).
3) Cadmus and PPL decided not to conduct interviews with agricultural trade allies in the Prescriptive Rebate Program, due to several complications (see Section 2.4.2 in the annual report).
4) Cadmus did not complete the targeted number of completed interviews with energy champions in the Continuous Energy Improvement Program (see Section 13.4.3.2 in the annual report).

The findings were presented in a clear manner with one exception: results in Sections 4.4.9, 4.4.10, and 4.4.11 would be easier to process if provided in a table instead of bullets or short paragraphs. The conclusions overall were well supported by the findings, and were mostly concise and informative. The recommendations followed from the conclusions, and most of the recommendations were clear and actionable. The SWE Team did note two Custom Incentive Program recommendations that included multiple recommendations that could be separated.

For each program, a brief program description, summary of the process evaluation findings, and review (audit) of the annual report follow below. The SWE Team notes two general comments about the methods discussions for the process evaluations of all programs.

First, the sample and disposition tables for the surveys conducted as part of the process evaluation are missing the survey mode (web, phone, mail) used; however, this was provided in the text. The addition

of the survey mode would complete the tables and make it so the reader does not have to refer to the text to find which mode was used. The SWE Team notes that it did not include survey mode in this table's template provided to the EDCs, but that the mode would be a good addition. Second, including more information about the methods used to conduct analyses, such as the type of analysis (e.g., means, medians, frequencies, percentages, qualitative coding) and the types (e.g., Chi-square, t-test) and values of any statistical tests conducted, would be very informative.

B.7.3.1 Continuous Energy Improvement Program

B.7.3.1.1 Brief Overview of the Program and Its Success

The Continuous Energy Improvement Program provides technical support for schools to develop and implement a Strategic Energy Management Plan (SEMP). The implementer, Strategic Energy Group, assists all schools within each of the 8 participating districts with development of a SEMP to implement.

Each district identifies an energy manager to develop an energy reduction goal, a methodology for measuring energy savings, and a plan to continually improve its energy performance. Best practices are shared during monthly meetings, workshops, and conference calls led by the implementer. Forty-four schools continued participation through PY7.

The program met or exceeded its PY7 and Phase II planned MWh/yr energy savings and participation. In PY7, the program achieved 183% of its planned energy savings and 100% of its planned participation. For all of Phase II, the program achieved 149% of its planned energy savings and 100% of its planned participation.

B.7.3.1.2 Summary of the Process Evaluation Findings

In PY7, Cadmus conducted two interviews with program staff and the implementer, 23 participant surveys with school district energy managers and school energy champions, and a database review and QA/QC review of records. Cadmus also measured a key performance indicator for the program, customer satisfaction.

Findings from the process evaluation included the following:

- The program met or exceeded its PY7 and Phase II planned energy savings, and participation. This was due in part to school districts having higher consumption than initially assumed during program design, resulting in many more opportunities to save energy, and some schools had non-incented capital improvement projects ongoing during the baseline and performance periods.
- Interviewed staff reported that the program is working well, with schools taking ownership of the program and doing SEMP plans on their own.
- The implementer mentioned two challenges: expanding the pilot to the rest of the schools in the districts was more time consuming due to insufficient communication between the schools and the program, and schools did not regularly or consistently report their energy usage in the EPA Portfolio Manager software used for tracking energy usage.
- Cadmus created a participant profile of the schools and districts.
- Customer satisfaction exceeded the planned target of 80% reported satisfaction; 87% of surveyed participants reported being very satisfied, and 13% reported being somewhat satisfied with the program. Participants were especially satisfied with the monthly monitoring, targeting and reporting (MT&R) meetings and receiving information about their energy use.

- Surveyed school district energy managers and school champions reported that the greatest challenges involved organizing and gaining commitment from others involved in the schools and not having enough time to dedicate to the program. Some school energy champions also reported not having enough information to make plans and take action, and having difficulty maintaining momentum with the program.
- Most surveyed participants indicated that their district or school would not have enrolled in the program without the incentive.
- All surveyed participants reported high overall satisfaction with PPL. Over half of participants said their opinion of PPL improved after participating in the program.
- Overall, SEMP adoption was high across all program participants, with all of the school districts having some or full adoption of practices involving customer commitment, planning and implementation, and measuring and reporting energy performance. However, the number of schools with full adoption declined from PY6, due to infrequent updates of program planning materials.
- Most survey participants reported that the program was extremely or somewhat influential in their decision to implement energy efficiency projects.

Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan. The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, would be very informative. None of the interviews required sampling, and Cadmus achieved the targeted number of completed interviews with all groups except energy champions (n=15/18). While the survey mode is discussed in the text, adding the mode used for surveys (web, phone, mail) in Table 13-12 would complete the table and inform the reader without having to refer to the text.

Program findings were clearly summarized, with actionable recommendations following from conclusions supported by ample evidence. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.3.2 Custom Incentive Program

B.7.3.2.1 Brief Overview of the Program and Its Success

The C/I Custom Incentive Program offers financial incentives to customers for installing extensive energy efficiency projects, retro-commissioning existing equipment, making repairs, optimizing equipment, making operational and process improvements that result in cost-effective energy savings, and installing equipment measures or systems that are not covered by the Prescriptive Equipment Program or the Pennsylvania TRM. The program offers performance-based incentives for the avoided or reduced energy consumption resulting from the project, and there is an annual cap for the incentive amount for each project and customer. Proposed upgrades must be pass the program's cost-effectiveness criteria, and projects must be approved by the implementer, DNV GL Energy Services USA, before equipment can be installed. Eligible customers are reimbursed up to 50% of a project's costs (not including labor) upon completion of a successful, cost-effective project. The program ended in PY7.

The program exceeded it planned PY7 goals but did not meet its planned goals for all of Phase II. In PY7, the program achieved 125% of its planned MWh/yr energy savings but the program did not have

planned participation for PY7. For all of Phase II, the program achieved 91% of its planned MWh/yr energy savings goal and 89% of its planned participation.

B.7.3.2.2 Summary of the Process Evaluation Findings

In PY7, Cadmus conducted two interviews with program and implementer staff and 24 phone and web participant surveys representing 26 properties. Cadmus also measured a key performance indicator for the program, customer satisfaction.

The following findings emerged from the process evaluation:

- The program exceeded its PY7 planned energy savings but did not meet its planned Phase II energy savings, or participation.
- Cadmus created participant profiles of participating customers.
- Customer satisfaction exceeded the planned target of 80% reported satisfaction; 87% of surveyed participants reported high satisfaction. Most participants were also very or somewhat satisfied with the application process, the program's terms and conditions, eligibility requirements, availability of qualified equipment, performance of installed equipment, time to complete paperwork, convenience of inspections, and simplicity of the overall process. For the majority of these program elements, customer satisfaction increased from PY6.
- Most surveyed customers reported high satisfaction with PPL, and satisfaction increased from PY6. About one-third of surveyed customers (7 out of 24) reported that their opinion improved after participating, but a majority (58%) reported that their opinion did not change.
- Surveyed participants commented that program staff was very helpful and that projects moved fairly quickly and seamlessly once they got started.
- Surveyed customers suggested improvements to the program, including providing better communication about timing, completing the review of materials and application steps more quickly, providing more options for rebated equipment, and improving the wait list.
- Surveyed customers chose to upgrade equipment to replace old or broken equipment, save money/energy, or make improvements to existing systems.
- Most respondents began thinking about their projects because of staff recommendations, internal observations, or recommendations from a contractor or auditor.
- Most respondents reported that their contractor, vendor, or distributor provided the most assistance in designing their project.
- The most important reported criteria for determining whether to go forward with a project were the return on investment, energy and operating costs, and initial costs.

B.7.3.2.3 Summary of the Process Evaluation Audit

The research activities were consistent with the PY7 evaluation plan. Plans from the last annual report to interview contractors and other project designers, and to conduct additional benchmarking research to investigate eligibility requirements of other custom programs, will be conducted in Phase III. An explanation for why this change was made was not provided.

The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, and the types of the statistical tests conducted, would be very informative. For the participant surveys, Cadmus achieved sample sizes that provided 85/15 confidence/precision; Cadmus also achieved the targeted number of completed interviews that did not require sampling.

Program findings were clearly summarized, with actionable recommendations following from conclusions supported by ample evidence. Results in Sections 4.4.9, 4.4.10, and 4.4.11 would be easier to process if provided in a table instead of bullets or short paragraphs. The two recommendations consisted of multiple recommendations that could be separated. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.3.3 Prescriptive Equipment Program

B.7.3.3.1 Brief Overview of the Program and Its Success

The C/I Prescriptive Equipment Program offers incentives to offset the costs of energy efficient lighting, non-lighting, and agriculture equipment. Incentives are provided through two channels by PPL. The standard channel requires the customer to obtain pre-approval before ordering or purchasing the equipment. For the direct discount delivery channel, a contractor evaluates possible upgrades and makes recommendations, the customer chooses which upgrades to purchase, and the contractor obtains pre-approval, installs the upgrades, and submits the paperwork. The program targets small C/I customers, large C/I customers, the GNI sector, institutional and educational customers, and agricultural customers.

In PY7, the program canceled the direct discount channel due to a shortage of funding and a growing wait list. The program also offered a limited time (three months) offer for increased incentive amounts for HVAC and HPWHs.

The program exceeded its planned PY7 and Phase II MWh/yr energy savings but did not meet its planned Phase II participation. In PY7, the program achieved 158% of its planned energy savings; there was not planned participation for PY7. For all of Phase II, the program achieved 120% of its planned energy savings and 42% of its planned participation.

B.7.3.3.2 Summary of the Process Evaluation Findings

In PY7, Cadmus conducted two interviews with program staff and the implementer, 80 web and phone lighting and equipment participant surveys, and a database review and QA/QC review of records. Cadmus also measured two key performance indicators: customer satisfaction and incentive processing time.

The evaluation found the following:

- The program exceeded it planned PY7 and Phase II MWh/yr energy savings but did not meet its planned Phase II participation.
- The program did not meet its goal for 80% customer satisfaction; 77% of surveyed participants reported high satisfaction. The program goal for processing all rebates within six weeks was not applicable during PY7 because the program implemented a wait list.
- The program has been operating for seven years and has built a robust network of contractors to support it and drive participation.
- With improved tracking in PY7, the program managed participation rates and avoided program oversubscription.
- The limited-time higher incentives for HVAC equipment and HPWHs had a minimal effect on participation.

- The pre-approval process added in PY6 resulted in more effort needed to review and approve applications than anticipated.
- There is very limited uptake in rebates for agriculture equipment, but the program received applications for six different agricultural measures in PY7 for the first time.
- Cadmus created a profile of participants who used the prescriptive equipment and prescriptive equipment lighting rebates.
- Most surveyed participants were satisfied with their contractor, eligibility requirements, the program's terms and conditions, availability of qualifying equipment, time to complete paperwork, convenience of inspections, and simplicity of the overall process. However, satisfaction with the time it took to receive the rebate has been on the decline since PY5, likely due to the pre-approval process in PY6 and wait list in PY7.
- Surveyed participants suggested improvements to the application communications, wait list, and application and rebate processing times so they can better manage their projects.
- Most of the program participants (80%) learned about the program through their contractor.
- About half of lighting participants (55%) and 41% of equipment participants reported that their opinion of PPL has improved since participating in the program.
- The evaluation survey occurred up to two years after some participants completed projects, and survey results could be affected by recall bias.

B.7.3.3.3 Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan, with two exceptions. First, Cadmus conducted a phone survey of participants to increase the number of completes after achieving a lower than expected response rate for the web survey. Second, Cadmus and PPL decided not to conduct interviews with agricultural trade allies because participation was low, projects occurred late in the evaluation period, and it is uncertain if agricultural equipment will remain in the program in Phase III.

The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, would be very informative. For the data-collection tasks requiring sampling, Cadmus attempted a census; Cadmus also achieved the targeted number of completed interviews that did not require sampling. Adding the mode used for surveys (web, phone, mail) in Tables 2-23 and 2-25 would complete the tables and inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with actionable recommendations following conclusions and ample evidence supporting the conclusions. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

B.7.3.4 Master Metered Low-Income Multifamily Housing Program

B.7.3.4.1 Brief Overview of the Program and Its Success

The Master Metered Low-Income Multifamily Housing Program targets owners or managers of master metered multifamily low-income housing buildings (at or below 150% of the FPL) with five or more units in PPL's service territory. The program provides a free walk-through audit of the building followed with analysis and a report that shows the potential energy savings for installing recommended energy efficient measures. These may include direct installation and prescriptive efficiency measures. Eligible customers may also receive rebates through other PPL programs to offset the incremental costs of

upgrades. The implementer is SmartWatt Energy, and it offers interest-free financing to participating buildings, if the participant is interested.

For PY7, the program added nursing homes as an eligible building type, which resulted in several large projects. The program exceeded its planned MWh/yr energy savings for PY7 but did not meet the planned savings for all of Phase II. In PY7, the program achieved 119% of its planned MWh/yr savings and in Phase II, the program achieved 94% of its planned MWh/yr savings.

B.7.3.4.2 Summary of the Process Evaluation Findings

For the PY7 process evaluation, Cadmus conducted phone interviews with program staff and the implementer (n=2), analyzed results from 44 leave-behind tenant postcard surveys, analyzed the results of 156 implementer-administered tenant education workshop satisfaction surveys at 10 buildings, and reviewed building characteristics data for 50 Phase II participating buildings. Building characteristics included year built, area, number of stories and occupants, vacancy rate, and primary HVAC system, water heating system, and fuel source for units and common areas. Cadmus also measured three key performance indicators: customer complaints, safety violations, and tenant energy education workshop satisfaction.

The following findings emerged from the process evaluation:

- The program exceeded its planned MWh/yr energy savings for PY7 but did not for all of Phase II, primarily due to limited multifamily opportunities remaining at the end of PY6 (which led to the program eligibility expansion to nursing homes), a ramp-down of program activities, and a focus on lighting upgrades instead of other qualified upgrades.
- Program staff reported that up-front costs, tight operating budgets, and a reluctance to take on additional debt were the most important reasons that some building owners or operators did not participate after receiving an audit or did not do comprehensive upgrades. Only one participating building took advantage of the interest-free financing offered by the implementer.
- The program will not be offered in Phase III, but eligible participants can participate in WRAP and the Prescriptive Equipment Program in Phase III.
- Interviewed staff reported that they were pleased with the addition of nursing home buildings to the program in PY7, as it helped them meet program goals without increasing marketing and outreach.
- Cadmus did not find any customer complaints or safety violations for PY7.
- Cadmus created participating building profiles based on building characteristics. The participating buildings were primarily midsized (less than 100,000 sq. ft.); built in the 1970s, 1980s, or 1990s; and had 50 or fewer tenant units.
- Most surveyed tenants (78%) reported high satisfaction with the installation contractors, but this was significantly lower than in PY6 (95%).
- Nearly all respondents (94%) who completed the tenant postcard survey reported high satisfaction with the tenant education workshops; 71% of those who responded to the energy education workshop survey reported the workshop was very beneficial; 82% reported the professionals conducting the workshops were excellent; and 84% rated the auditors as excellent.
- LEDs constituted 94% of products installed in tenant units, and 77% of respondents to the tenant postcard survey reported high satisfaction with the LEDs. Other potential upgrades—faucet aerators, showerheads, and thermostatic shower restriction valves—each constituted 1% of installed products. Respondents were least satisfied with the showerhead.

- The most common energy saving actions reported by surveyed tenants were turning off appliances when not in use (63%), unplugging appliances when not in use (41%), decreasing the thermostat in winter (39%), using fans more than air-conditioning (33%), and installing LEDs (33%).

B.7.3.4.3 Summary of the Process Evaluation Audit

The evaluation was consistent with the evaluation plan. The methodology section adequately explained the evaluation activities and analyses, and included the required sampling and disposition information and tables. Including more information about the methods used to conduct analyses, such as the type of analysis used, and the types and values of the statistical tests conducted, would be very informative. None of the interviews required sampling, and Cadmus achieved the targeted number of completes. Adding the mode used for surveys (web, phone, mail) in Table 11-12 would complete the table and inform the reader without having to refer to the text where the survey mode is reported.

Program findings were clearly summarized, with recommendations following conclusions and ample evidence supporting the conclusions. One conclusion (third), however, did not have, but likely could have had, an accompanying recommendation (e.g., the last sentence of the conclusion). The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

APPENDIX C | EDC EE&C PROGRAM PLAN REVISIONS DURING PHASE II

This appendix provides detail on any revisions made by the EDCs to their original EE&C program plans for Phase II. These updates may have occurred prior to or during the course of Phase II, but were identified in officially revised EE&C plans by each EDC and approved by the PUC. Below is a description of the changes for each EDC's Phase II plan.

C.1 DUQUESNE LIGHT

No changes were made to the original Duquesne Phase II EE&C plan filed on November 15, 2012 and approved on March 14, 2013.

C.2 FIRSTENERGY – METROPOLITAN EDISON, PENNSYLVANIA ELECTRIC COMPANY, PENNSYLVANIA POWER COMPANY, WEST PENN POWER

No changes were made to the original FirstEnergy Utilities Phase II EE&C plans filed on November 13, 2012 and approved on March 14, 2013.

C.3 PECO ENERGY

PECO changed several items in its Phase II EE&C plan after publication of the original plan dated November 1, 2012 and approved on February 28, 2013. It was subsequently revised on March 13, 2013 and February 28, 2014 to incorporate program changes as detailed below. PECO noted several regulatory and operational developments that led to Phase II program changes. Specifically, the following issues guided PECO Phase II planning:

- TRM adjustments from the Commission's with revised measure level savings and incremental costs, as well as updated NTG estimates for a variety of measures
- New projections for mix of measures from CSPs and a decrease in total CSPs resulting from a lower contract cost
- Phase I EE&C plan performance that was significantly higher than original targets;
- Successful deployment of the Smart AC Saver programs in PY 2013, with a TRC ratio of 3.2
- Adjustments to the Smart Home Rebates Program for the anticipated portion of CFL measures purchased and installed in small commercial buildings
- Adjustments to the Smart Usage Profile Program to reflect savings accruing only in PY 2015 due to savings decay of a one-year measure life.

As a result of these developments, PECO made the following program changes for Phase II:

- Changes to the Low-Income Energy Efficiency Program to increase customer participation in both refrigerator recycling and replacement programs and increase CFL use through additional community events
- Changes to Smart Equipment and Smart Construction Incentives programs for GNI and C/I customers due to increased participation associated with more aggressive outreach and marketing plans
- Expansion of the Smart Energy Saver Program due to an increased interest in participation from schools
- Allocation of an additional $20.3 million in the Smart AC Saver programs so that this program may continue through the entire Phase II plan period (PY6 and PY7)
- Consolidation of similar type measures (e.g., multiple wattages of CFLs consolidated into "CFL screw-in bulbs") for more flexibility in light of changing markets and available products.

C.4 PPL

PPL made minor changes to their Phase II EE&C plan originally filed on November 15, 2012 and approved on March 14, 2013. The final and current revised version of the EE&C plan was approved on June 5, 2015. The maximum allowable funding specified in the Implementation Order for PPL Electric was $184.5 million. The final revised Plan totals $184.5 million.

APPENDIX D | ACEEE SCORECARD FORMAT

The data provided in the following tables is required for completion of the 2015 ACEEE Scorecard. Included are the Pennsylvania statewide EE budgets and expenditures, verified gross annual and lifetime savings, and verified net annual and lifetime savings.

Table D- 1: Pennsylvania Statewide EE Budget and Expenditures

EDC	Actual PY7 EE Expenditures ($)	Approved Budget for PY7 ($)
Duquesne	$16,033,000	$19,497,797
FE: Met-Ed	$18,906,855	$25,519,550
FE: Penelec	$16,422,862	$24,096,572
FE: Penn Power	$3,901,655	$6,821,749
FE: West Penn	$17,054,581	$24,207,741
PECO	$91,147,823	$91,081,490
PPL	$64,716,000	$75,824,000
Total	**$228,182,776**	**$267,048,899**

Table D- 2: Pennsylvania Statewide Gross Verified Annual and Gross Verified Lifetime MWh Savings

EDC	Gross Verified Annual Savings (MWh)	Gross Verified Lifetime Savings (MWh)
Duquesne	142,187	1,562,136
FE: Met-Ed	171,420	1,412,232
FE: Penelec	164,398	1,449,520
FE: Penn Power	27,280	239,330
FE: West Penn	158,760	1,360,706
PECO	528,301	6,025,303
PPL	313,976	3,406,665
Total	**1,509,707**	**15,455,892**

Table D- 3: Pennsylvania Statewide Net Verified Annual and Net Verified Lifetime MWh Savings

EDC	Net Verified Annual Savings (MWh)	Net Verified Lifetime Savings (MWh)
Duquesne	104,999	1,404,839
FE: Met-Ed	124,981	1,412,232
FE: Penelec	126,682	1,449,520
FE: Penn Power	19,187	239,330
FE: West Penn	120,335	1,360,706
PECO	324,572	3,531,577
PPL	238,012	2,591,240
Total	**1,058,768**	**11,989,444**

APPENDIX E | COMPENDIUM OF SWE PHASE II REPORTS AND MEMOS

E.1 EVALUATION FRAMEWORK

E.1.1 Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs, June 2013

As required in Act 129 and the EE&C Implementation Order, the Evaluation Framework outlines the procedures of the SWE Team and the expectations of the EDCs in order to comply with the audit of the information submitted in the program. The document further explains the process for updating the TRM, guidelines for tracking and reporting data for the EDC, the M&V expectations of the program, and applicable deadlines. This audit plan and Evaluation Framework was originally released in December 2009 as a Phase I audit plan and was updated in November of 2011. For Phase II, the Evaluation Framework was approved as a separate document in June 2013 and subsequently updated in June 2014 and July 2015.[77]

E.2 BASELINE STUDIES

E.2.1 Pennsylvania Statewide Residential Baseline Study, April 2014[78]

The residential baseline study evaluated the characteristics of the energy-using equipment, the efficient electric equipment stock, and building characteristics present in the residential sector of Pennsylvania for the seven EDC service territories. The study identified the critical data-collection needs from the on-site surveys that will be integral to future resource planning and energy efficiency activities in Pennsylvania. A total of 490 site surveys stratified by EDC, housing segment, and annual kWh consumption were conducted. The desired level of precision for EDC-specific results, ±10% precision with 90% confidence, necessitated a total of 70 on-site visits per EDC. The data for all EDCs were then aggregated to the statewide level, and these estimates carry precision of ±5% precision with 95% confidence.

E.2.2 Pennsylvania Non-Residential End Use and Saturation Study, April 2014[79]

The C/I baseline study evaluates the characteristics of the energy-using equipment and building stock present in Pennsylvania for the seven EDC service territories. Nexant used its experience working with the Pennsylvania EDCs as a part of the SWE Team evaluating their current energy efficiency programs and performing previous energy efficiency potential studies to identify output parameters that will be integral to future resource planning and energy efficiency activities in Pennsylvania. The study began by analyzing the EDC customer billing data to provide a framework in which to gather additional primary and secondary data. This study evaluated the characteristics of Pennsylvania's building stock by performing 491 C/I on-site customer surveys in seven EDC territories. These surveys were designed to inventory the current energy-using equipment with regards to type, fuel, efficiency, saturations, and operating conditions, as well as document the characteristics of the buildings themselves.

[77] PA PUC website, www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/act_129_statewide_evaluator_swe_.aspx.
[78] PA PUC website, www.puc.pa.gov/Electric/pdf/Act129/SWE-2014_PA_Statewide_Act129_Residential_Baseline_Study.pdf.
[79] PA PUC website, www.puc.pa.gov/Electric/pdf/Act129/SWE-2014_PA_Statewide_Act129_Non-Residential_EndUse_Saturation_Study.pdf

E.3 METERING STUDIES

E.3.1 Statewide Commercial and Residential Light Metering Study, January 2014[80]

The SWE was contracted by the PUC to perform a light metering study for the State of Pennsylvania and its seven largest EDCs. The purpose of this study was to provide updated lighting load profile information to the PUC to assist in the calculations of electric peak demand and energy savings for lighting energy efficiency programs in Pennsylvania. Specifically, this report presents lighting load shapes, CFs, HOU, and HVAC interactive factors.

E.4 MARKET POTENTIAL STUDIES

E.4.1 Residential Energy Efficiency Potential Study for Pennsylvania, February 2015[81]

The Energy Efficiency Potential Study examines the potential to reduce electric consumption and peak demand through the implementation of energy efficiency technologies and practices in residential, commercial, and industrial facilities, as well as associated activities in Pennsylvania. This study assesses electric energy efficiency potential throughout the seven Pennsylvania investor-owned EDC service areas over 10 years, from June 1, 2016 through May 31, 2025.

E.4.2 Demand Response Potential for Pennsylvania, February 2015[82]

In its February 2014 Demand Response Implementation Order, the Commission directed the SWE to conduct a demand response potential study during Phase II of Act 129 to examine the costs and benefits of pursuing statewide policies that may encourage the development and deployment of demand response resources during Phase III of Act 129, or June 1, 2016, through May 31, 2021. The SWE Team communicated its approach for this study to the PUC, TUS staff, and the Act 129 Stakeholders and has sought continuous feedback and comment from those groups. As a result of this collaboration, the SWE Team prepared a thorough analysis to estimate the demand response potential and presented the results by EDC.

E.4.3 Distributed Generation Potential Study for Pennsylvania, March 2015[83]

The Distributed Generation Potential Study examines the distributed generation (DG) market potential analysis performed by the SWE for the State of Pennsylvania through a 10-year period of June 1, 2016 through May 31, 2025. The State of Pennsylvania commissioned the study as a companion report to the Energy Efficiency Potential Study described above. The SWE conducted this study noting that EE&C measures that count toward a possible Phase III energy reduction target can include commission-approved DG technologies such as solar photovoltaic and CHP.

E.5 PROGRAM STUDIES

E.5.1 Residential Behavioral Program Persistence Study, December 2015[84]

The SWE was contracted by the PUC in the 2016 TRM Update Final Order to conduct an analysis of the HER persistence of savings in advance of Phase III of Act 129. This report presents the analysis

[80] PA PUC website, www.puc.pa.gov/pcdocs/1340978.pdf.
[81] PA PUC website, www.puc.pa.gov/pcdocs/1345079.pdf.
[82] PA PUC website, www.puc.pa.gov/pcdocs/1345077.docx.
[83] PA PUC website, www.puc.pa.gov/pcdocs/1355000.pdf.
[84] PA PUC website, www.puc.pa.gov/Electric/pdf/Act129/SWE_Res_Behavioral_Program-Persistence_Study.pdf.

completed by the SWE in response to the order to evaluate the persistence in energy savings achieved by the OPower HER programs run by PPL and Duquesne.

E.6 GUIDANCE MEMOS

E.6.1 GM-022: Peak Demand Reduction Definition for Program Year 5

This guidance memo addresses the misalignment between the 2013 TRM and the Phase II Evaluation Framework and provides the EDCs and their evaluation contractors with guidance for calculating peak demand savings from their EE&C plans in PY5.

E.6.2 GM-023: CFL Bulbs with Lumen Range Outside of EISA

This memo clarifies an issue that was identified in the 2013 TRM Residential Lighting section. Some implementers are offering standard (i.e., general service lamp) CFLs with lumen ranges outside of EISA requirements (e.g., >2600 lumens) and are unsure how to determine the appropriate baseline for these bulbs. Guidance is provided to address this issue.

E.6.3 GM-024: Consistent Net-to-Gross Method for EDCs

This memo provides an approach for EDCs to calculate NTG.

E.6.4 GM-025: Consistent Spillover Method for EDCs

This memo provides an approach for EDCs to calculate spillover.

E.6.5 GM-026: Appliance Retirement Programs (ARP) NTG Method

This memo provides an approach for EDCs to calculate NTG for appliance recycling programs.

E.6.6 GM-027: Data Source Consistency in Non-Residential Lighting Savings Calculations

This memo provides guidance on how to calculate site-specific CFs based on HOU and in the instance where that information is not available, provides guidance on using the TRM.

E.6.7 GM-028: ARP TRM 2015 Clarification

This memo provides clarity on an issue that was identified in the 2015 TRM Residential Refrigerator/Freezer Recycling with and without Replacement section (2.4.3 of the 2015 TRM). Because the program theory and logic for appliance retirement differs significantly from standard “downstream” incentive programs (which typically offer rebates for the purchase of efficient products), the approach to estimating gross and net impacts (including free-ridership and induced replacement) is also significantly different. The 2015 Pennsylvania TRM provides both gross and net (free-ridership and secondary market impacts) savings for these measures. These sections closely follow the recommended methodology from U.S. DOE UMP Protocol for Refrigerator Retirement.

E.6.8 GM-029: TRM Guideline for De Facto Heating Measure – NTG Guidance

During the process of creating the Draft 2016 TRM, PPL submitted an IMP modifying two existing residential TRM measures: Electric HVAC (2.2.1) and Ductless Mini-split Heat Pumps (2.2.3). The modifications introduced a new baseline to both measures where a customer without natural gas service has a broken-beyond-repair oil heating system and is heating their home with portable electric space heaters (referred to as de facto heating). Such a situation provides opportunity for substantial

electricity savings by replacing the broken-beyond-repair oil heating system and portable electric space heaters with either a DHP or central ASHP. However, there may be cases where a customer does not currently have air conditioning and the installation of an ASHP or a DHP introduces an additional summer cooling load that was not present before. In these cases, the additional cooling load and peak demand have been induced by the energy efficiency program and, therefore, the net savings from the implementation of this measure needs to reflect this. As the Pennsylvania TRM only presents gross savings calculations and values, the purpose of this memo is to supplement the two affected measures in the TRM and provide guidance on calculating net savings when de facto heating is the baseline.

E.7 TECHNICAL REFERENCE MANUALS

The TRMs are the basis of energy savings measure details and guidelines required for the SWE, EDCs, TUS, and other involved parties in order to successfully administer Act 129. Included below are the relevant TRMs for Phase II:

E.7.1 2014 Technical Reference Manual[85]

E.7.2 2015 Technical Reference Manual[86]

E.7.3 2016 Technical Reference Manual[87]

E.8 SWE ANNUAL REPORTS

The SWE annual reports are the summation of the SWE Team's findings for the given program year, with a focus on the cost-effectiveness and viability of the current program standards. The reports address the TRM standards and implementation success, as well as feedback from the seven EDCs involved in the program year. The SWE annual reports applicable to Phase II are listed here:

E.8.1 SWE Annual Report for Program Year 5: June 1, 2013 – May 31, 2014[88]

E.8.2 SWE Annual Report for Program Year 6: June 1, 2014 – May 31, 2015[89]

E.8.3 SWE Annual Report for Program Year 7: June 1, 2015 – May 31, 2016

E.9 MONTHLY PROGRESS REPORTS

The monthly progress reports are developed by the SWE Team and submitted to the PA PUC following the month to which they are applicable. Items typically covered in these reports are major protocol discussions with regard to the TRM, important audit activity for the program year, and communication of the schedule for reporting as required. Monthly progress reports are grouped by program years:

E.9.1 SWE Monthly Progress Reports, Program Year 5: June 1, 2013 – May 31, 2014

E.9.2 SWE Monthly Progress Reports, Program Year 6: June 1, 2014 – May 31, 2015

E.9.3 SWE Monthly Progress Reports, Program Year 7: June 1, 2015 – May 31, 2016

[85] PA PUC website, www.puc.pa.gov/pcdocs/1265230.docx.
[86] PA PUC website, www.puc.pa.gov/pcdocs/1333318.docx.
[87] PA PUC website, www.puc.pa.gov/pcdocs/1370278.docx.
[88] PA PUC website, www.puc.pa.gov/Electric/pdf/Act129/SWE_PY5-Final_Annual_Report.pdf.
[89] PA PUC website, www.puc.pa.gov/Electric/pdf/Act129/SWE_PY6-Final_Annual_Report.pdf.

APPENDIX F | GLOSSARY OF TERMS

-A-

Accuracy: An indication of how close a value is to the true value of the quantity in question. The term can also be used in reference to a model or a set of measured data, or to describe a measuring instrument's capability.

Achievable Potential: The amount of energy use that efficiency can realistically be expected to displace, assuming the most aggressive program scenario possible (e.g., providing end users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.

Adjustments: For M&V analyses, factors that modify baseline energy or demand values to account for independent variable values (conditions) in the reporting period.

Administrator: A person, company, partnership, corporation, association, or other entity selected by the EDC, and any subcontractor who is retained by an aforesaid entity to contract for and administer energy efficiency programs under Act 129.

-B-

Baseline Data: The measurements and facts describing facility operations and design during the baseline period. This includes energy use or demand and parameters of facility operation that govern energy use or demand.

Baseline Forecast: A prediction of future energy needs that does not take into account the likely effects of new efficiency programs that have not yet been started.

Baseline Model: The set of arithmetic factors, equations, or data used to describe the relationship between energy use or demand and other baseline data. A baseline model may also be a simulation process involving a specified simulation engine and set of input data.

Baseline Period: The period of time selected as representative of facility operations before retrofit.

Bias: The extent to which a measurement or a sampling or analytic method systematically underestimates or overestimates a value.

Billing Data: Has multiple meanings. Metered data obtained from the electric or gas meter used to bill the customer for energy used in a particular billing period. Meters used for this purpose typically conform to regulatory standards established for each customer class. Also used to describe the data representing the bills customers receive from the energy provider and the customer billing and payment streams associated with customer accounts. This term is used to describe both consumption and demand, and account billing and payment information.

Billing Demand: The demand used to calculate the demand charge cost. This is often the monthly peak demand of the customer, but it may have a floor of some percentage of the highest monthly peak of the previous several months (a demand "ratchet"). May have other meanings associated with customer account billing practices.

Building Energy Simulation Models: Computer models based on physical engineering principles or standards used to estimate energy usage or savings. These models do use billing or metered data, but usually incorporate site-specific data on customers and physical systems. The models usually require such site-specific data as square footage, weather, surface orientations, elevations, space volumes, construction materials, equipment use, lighting, and building occupancy. These models can usually account for interactive effects between end uses (e.g., lighting and HVAC), part-load efficiencies, and changes in external and internal heat gains or losses. Examples of building energy simulation models include ADM2, BLAST, and DOE-2.

-C-

Capacity: The amount of electric power for which a generating unit, generating station, or other electrical apparatus is rated by the user or manufacturer. The term is also used for the total volume of natural gas that can flow through a pipeline over a given amount of time, considering factors such as compression and pipeline size.

Coefficient of Variation: The sample standard deviation divided by the sample mean (Cv = sd/y).

Coincident Demand: The metered demand of a device, circuit, or building that occurs at the same time as the peak demand of the building or facility or at the same time as some other peak of interest, such as a utility's highest load during peak load hours. This should properly be expressed to indicate the peak of interest, e.g., "demand coincident with the building peak."

Confidence: An indication of how close a value is to the true value of the quantity in question. Confidence is the likelihood that the evaluation has captured the true impacts of a program within a certain range of values (i.e., precision).

Conservation: Steps taken to cause less energy to be used than would otherwise be the case. Examples include improved efficiency, avoidance of waste, and reduced consumption. Related activities include installing equipment (e.g., a computer to ensure efficient energy use), modifying equipment (e.g., making a boiler more efficient), adding insulation, and changing behavior patterns.

Cost-Effectiveness: An indicator of the relative performance or economic attractiveness of any energy efficiency EE investment or practice when compared with the costs of energy produced and delivered in the absence of such an investment. In the energy efficiency EE field, the term refers to the present value of the estimated benefits produced by an energy efficiency EE program as compared with the estimated total program costs, from the perspective of either society as a whole or of individual customers, to determine if the proposed investment or measure is desirable from a variety of perspectives, e.g., whether the estimated benefits exceed the estimated costs. See also TOTAL RESOURCE COST (TRC) TEST. The 2008 Act 129 enacted by the Pennsylvania Legislature mandates use of the TRC Test for determining cost-effectiveness.

Cross-Sector Sales: These are sales of energy -efficiency measures as part of sector-specific programs which that are installed across multiple sectors. This occurs most notably when energy -efficient lighting measures are purchased from a retailer through a residential upstream lighting program but are installed in commercial facilities.

Customer: Any person or entity responsible for payment of an electric or gas bill and with an active meter serviced by a utility company.

Customer Information: Non-public information and data specific to a utility customer that the utility acquired or developed in the course of providing utility services.

Cv: See COEFFICIENT OF VARIATION.

-D-

Deemed Savings: An estimate of the reported energy savings or energy demand savings outcome for a single unit of an installed energy efficiency measure that (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose, and (b) is applicable to the situation being evaluated.

Demand: The time rate of energy flow. Demand usually refers to electric power and is measured in kilowatts (kW; equals kWh/hr) but can also refer to natural gas, usually as Btus/hr, kBtus/hr, therms/day, or ccf/day. Example: Ten 100-watt lamps consume electricity at the rate of 1,000 watts, or 1 kilowatt (kW).

Demand (Utility): The rate or level at which electricity or natural gas is delivered to users at a given point in time. Electric demand is expressed in kilowatts (kW). Demand should not be confused with load, which is the amount of power delivered or required at any specified point(s) on a system.

Demand Charge: The sum to be paid by a large electricity consumer for its peak usage level.

Demand Responsiveness: Activities or equipment that induce consumers to use energy at different (lower-cost) times of day or to interrupt energy use for certain equipment temporarily, usually in direct response to a price signal. Examples include interruptible rates, doing laundry after 7:00 p.m., and air conditioner recycling programs.

Demand Savings or Demand Reduction: The reduction in the demand from the pre-retrofit baseline to the post-retrofit demand, once independent variables (e.g., weather, occupancy) have been adjusted for. This term is usually applied to billing demand (to calculate cost savings) or to peak demand (for equipment sizing purposes).

Demand Side Management (DSM): The methods used to manage energy demand, including energy efficiency, load management, fuel substitution, and load building. Also see LOAD MANAGEMENT.

Direct Energy Savings (Direct Program Energy Savings): The savings from programs responsible for achieving specific energy efficiency EE goals. Typically, these are resource acquisition

programs or programs that install or expedite the installation of energy -efficient equipment and that directly cause or help cause energy efficiency EE to be achieved. Rebate, incentive, and direct-install programs provide direct energy savings.

Direct-Install or Direct-Installation Programs: Programs that provide free energy efficiency EE measures and their installation for qualified customers. Typical measures distributed by these programs include low-flow showerheads and compact fluorescent bulbs CFLs.

Distributed Generation: Involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation-level) peak loads or displacing the need to build additional (or upgrade) local distribution lines.

-E-

EDC Proposed Savings: Energy savings and demand reductions proposed by EDCs and developed using alternative values or savings protocols to those in the TRM. EDC proposed savings can include savings based on research conducted by EDCs or their evaluation contractors or from other data sources.

Efficiency: The ratio of the useful energy delivered by a dynamic system (e.g., a machine, engine, or motor) to the energy supplied to it over the same period or cycle of operation. The ratio is usually determined under specific test conditions.

Electric Distribution Company: A publically owned electric service provider.

End Use (Measures or Groups): Refers to a broad or sometimes narrow category on which a program is concentrating efforts. Examples include refrigeration, food service, HVAC, appliances, building envelope, and lighting.

Energy Consumption: The amount of energy consumed in the form in which it is acquired by the user. The term excludes electrical generation and distribution losses.

Energy Cost: The total cost for energy, including such charges as base charges, demand charges, customer charges, power factor charges, and miscellaneous charges.

Energy Efficiency: The use of less energy to perform the same function. Describes programs designed to use energy more efficiently—doing the same with less. For the purposes of this report, energy efficiency programs are distinguished from DSM programs, which are utility-sponsored and -financed, whereas the term "energy efficiency" is not limited to a particular sponsor or funding source. The term "energy conservation" has also been used, but it has the connotation of doing without in order to save energy rather than using less energy to perform the same function, and so is not used as much today. Many people use the two terms interchangeably.

Energy Efficiency Improvement: Reduced energy use for a comparable level of service, resulting from installation of an energy efficiency measure or adoption of an energy efficiency practice. Level of service may be expressed as the volume of a refrigerator, temperature levels, production output of a manufacturing facility, or lighting level per square foot.

Energy Efficiency Measure: Equipment, subsystems, or systems, or modification of equipment, subsystems, systems, or operations, on the customer side of the meter, for the purpose of reducing energy or demand (and hence energy or demand costs) at a comparable level of service.

Energy Efficiency of Equipment: The percentage of gross energy input that is realized as useful energy output of a piece of equipment.

Energy Efficiency of a Measure: A measure of the energy used to provide a specific service or to accomplish a specific amount of work (e.g., kWh/cubic foot of a refrigerator, therms/gallon of hot water).

Energy Efficiency Practice: The use of high-efficiency products, services, and practices, or an energy-using appliance or piece of equipment, to reduce energy use while maintaining a comparable level of service when installed or applied on the customer side of the meter. Energy efficiency activities typically require permanent replacement of energy-using equipment with more efficient models. Examples include refrigerator replacement, light fixture replacement, and cooling equipment upgrades.

Energy Efficiency Ratio (EER): The ratio of output cooling in BTUs per hour to input electrical power in watts at a given operating point. EER is generally calculated using a 95°F outside temperature and an inside temperature of 80°F at 50% relative humidity. The higher a unit's EER rating, the more energy efficient it is.

Energy Management System: A control system (often computerized) designed to regulate the energy consumption of a building by controlling the operation of energy-consuming systems (e.g., HVAC, lighting, and water-heating systems).

Energy Savings or Energy Reduction: The reduction in energy use from the pre-retrofit baseline to the post-retrofit energy use, once independent variables (e.g., weather, occupancy) have been adjusted for.

Engineering Models: Engineering equations used to calculate energy usage and savings. These models are usually based on a quantitative description of physical processes that transform delivered energy into useful work such as heat, lighting, or motor drive. In practice, these models may be reduced to simple equations in spreadsheets that calculate energy usage or savings as a function of measurable attributes of customers, facilities, or equipment (e.g., lighting use = watts × hours of use).

Evaluation: The performance of studies and activities aimed at determining the effects of a program; any of a wide range of assessment activities associated with understanding or documenting program performance or potential performance, or with assessing program or program-related markets and market operations; any of a wide range of evaluative efforts, including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

Evaluation, Measurement, and Verification (EM&V): Evaluation involves retrospectively assessing the performance and implementation of an energy efficiency or demand response program.

M&V refers to data collection, monitoring, and analysis used to calculate gross energy and demand savings from *individual sites or projects*. M&V can be a subset of program impact evaluation. Generally speaking, the differentiation between evaluation and project M&V is that evaluation is associated with programs and M&V with projects.

Ex Ante Savings Estimate: Also known as reported savings. Savings estimated by the program implementer (EDC or CSP). (From the Latin for "beforehand.")

Ex Post Evaluation Estimated Savings: Also known as verified savings. Savings estimates reported by an independent evaluator after the energy impact evaluation and the associated M&V efforts have been completed. If only the term "ex post savings" is used, it is assumed that it refers to the ex post evaluation estimate, the most common usage. (From the Latin for "from something done afterward.")

Ex Post (Program) Administrator-Estimated Savings: Savings estimates reported by the administrator after program implementation has begun (administrator-reported ex post). (From the Latin for "from something done afterward.")

Ex-Post (Program) Administrator-Forecasted Savings: Savings estimates forecasted by the administrator during the program and portfolio planning process. (From the Latin for "from something done afterward.")

Expected Useful Life: The assumed life expectancy, in years, of an energy efficiency measure.

-F-

Free-Driver: A nonparticipant who adopts a particular efficiency measure or practice as a result of a utility program. See SPILLOVER for aggregate impacts.

Free-Rider: A program participant who would have implemented a program measure or practice in the absence of the program within the same time frame.

-G, H-

Gross Reduction or Gross Savings: The change in energy consumption or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated. Unless otherwise stated in this report, "gross reduction" and "gross savings" are used interchangeably.

Heating Seasonal Performance Factor: Used to describe the heating efficiency of heat pumps. It is a measure of the estimated seasonal heating output in BTUs divided by the amount of energy consumed in watt-hours.

-I, J, K-

Impact Evaluation: An approach used to measure program-specific induced changes in energy usage or demand (e.g., kWh, kW, or therms) or behavior attributed to energy efficiency and demand

response programs.

Impact Year: Depending on the context, either (a) the 12 months subsequent to program participation used to represent program costs or load impacts occurring in that year, or (b) any calendar year after the program year in which impacts may occur.

Incentives: Financial support (e.g., rebates, low-interest loans) to install energy efficiency measures. The incentives are solicited by the customer and based on the customer's billing history or customer-specific information.

Independent Variables: Factors that affect energy use and demand in a building but that cannot be controlled (e.g., weather, occupancy).

Indirect Energy Savings (Indirect Program Energy Savings): Typically result from information, education, marketing, or outreach programs that are expected to result in energy savings achieved through the actions of the customers exposed to the program's efforts, without direct enrollment in a program that has energy savings goals.

IPMVP Option A – Partially Measured Retrofit Isolation: Savings are determined by partial field measurement of the energy use of the system to which the measure was applied; separate from the energy use of the rest of the facility. Measures are likely to be partially deemed, meaning that some, but not all, parameter(s) are stipulated in the TRM.

IPMVP Option B – Retrofit Isolation: Savings are determined by field measurement of the energy use of the system to which the measure was applied; separate from the energy use of the rest of the facility. All key parameters are measured and not deemed.

IPMVP Option C – Whole Building: Savings are determined by measuring energy use at the facility level. Values obtained either with short-term or continuous on-site measurement can be used in conjunction with billing analysis regression models to calibrate the savings estimated from program participation.

IPMVP Option D – Calibrated Simulation: Savings are determined through simulation of energy use of components or a whole facility. Simulation routines must be demonstrated to adequately model actual energy performance of the facility through calibration with utility billing data or end-use metering.

-L-

Line Loss Factor: Energy loss due to heating of conductors caused by electrical resistance along the transmission and distribution lines of the electric grid.

Load Management: Utility demand management practices directed at reducing the maximum kilowatt demand on an electric system and/or modifying the coincident peak demand of one or more classes of service to better meet the utility system's capability for a given hour, day, week, season, or year.

Load Shapes: Representations such as graphs, tables, and databases that describe energy consumption rates as a function of another variable, such as time or outdoor air temperature.

Load Shifting: Moving electric load from one time period in a day to another time period. An example would be moving electric water heating load from peak hours to off-peak hours.

-M-

Market Effects Evaluation: The evaluation of the change in the structure or functioning of a market or the behavior of participants in a market that results from one or more program efforts. Typically, the resultant market or behavior change leads to increased adoption of energy efficient products, services, or practices.

Market Transformation: A reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced, or changed.

Measurement: A procedure for assigning a number to an observed object or event.

Measurement and Verification (M&V): Data collection, monitoring, and analysis associated with the calculation of gross energy and demand savings from individual sites or projects. M&V can be a subset of program impact evaluation.

Metering: The collection of energy consumption data, over time, through the use of meters. These meters may collect information with respect to an end use, a circuit, a piece of equipment, or a whole building (or facility). Short-term metering generally refers to data collection for no more than a few weeks. End-use metering refers to separate data collection for one or more end uses in a facility, such as lighting, air conditioning, or refrigeration. Spot metering is an instantaneous measurement (rather than over time) to determine an energy consumption rate.

Monitoring: Gathering of relevant measurement data, including but not limited to, energy consumption data, over time to evaluate equipment or system performance. Examples include chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

-N-

Net Savings: The total change in load that is attributable to an energy efficiency program. Net savings may include, implicitly or explicitly, the effects of free-drivers, free-riders, energy efficiency standards, changes in the level of energy service, participant and nonparticipant spillover, and other causes of changes in energy consumption or demand.

Net-to-Gross Ratio (NTGR): A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.

Nonparticipant: Any consumer who was eligible for but did not participate in the subject efficiency program in a given program year. Each evaluation plan should provide a definition of a nonparticipant as it applies to a specific evaluation.

Non-Response Bias: The effect of a set of respondents refusing or choosing not to participate in research; typically, larger for self-administered or mail-out surveys.

-P-

Partial Free-Rider: A program participant who would have implemented, to some degree, a program measure or practice in the absence of the program. Examples include participants who bought an ENERGY STAR appliance in the absence of the program, but due to the program, purchased a more efficient appliance or bought the appliance sooner than planned.

Participant: A consumer who received a service offered through an efficiency program in a given program year. In this definition, "service" can refer to a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information, and other services, items, or conditions. Each evaluation plan should define "participant" as it applies to the specific evaluation.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Persistence Study: A study to assess changes in program impacts over time (including retention and degradation).

Portfolio: Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).

Precision: The indication of the closeness of agreement among repeated measurements of the same physical quantity.

Process Evaluation: A systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination, and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

Program: A group of projects, with similar characteristics and installed in similar applications. Examples include a utility program to install energy efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, and a state residential energy efficiency code program.

Program Year: The 12-month period starting on June 1 and ending on May 31 of the next year.

Program Year 3 (PY3): The period between June 1, 2011 and May 31, 2012.

Program Year 4 (PY4): The period between June 1, 2012 and May 31, 2013.

Program Year 5 (PY5): The period between June 1, 2013 and May 31, 2014.

Program Year 6 (PY6): The period between June 1, 2014 and May 31, 2015.

Program Year 7 (PY7): The period between June 1, 2015 and May 31, 2016.

Program Year to Date: The period starting on June 1 of a program year and extending through the end of the current quarterly reporting period in the program year.

Project: An activity or course of action involving one or more energy efficiency measures at a single facility or site.

-R-

Realization Rate: A factor representing ex post savings estimates divided by ex ante savings estimates that is applied to gross savings to determine verified savings estimates.

Regression Analysis: Analysis of the relationship between a dependent variable (response variable) and specified independent variables (explanatory variables). The mathematical model of their relationship is known as regression equation.

Reliability: Refers to the likelihood that observations can be replicated.

Reporting Period: The time following implementation of an energy efficiency activity during which savings are to be determined.

Retrofit Isolation: The savings measurement approach defined in IPMVP Options A and B, and ASHRAE Guideline 14, that determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration. ASHRAE Guideline 14 provides guidelines for reliably measuring energy and demand savings of commercial equipment.

Rigor: The higher the level of rigor, the greater the confidence in the accuracy and precision of the results.

-S-

Seasonal Energy Efficiency Ratio (SEER): The rating of a unit representing the cooling output in Btus during a typical cooling season divided by the total electric energy input in watt-hours during the same period. The higher a unit's SEER, the more energy efficient it is.

Spillover: Reductions in energy consumption or demand resulting from an energy efficiency program, beyond the program-related gross savings of the participants. There can be participant and

nonparticipant spillover.

Stakeholder: An organization with interest in or concern with Act 129 activities.

Statistically Adjusted Engineering (SAE) Models: Statistical analysis models that incorporate the engineering estimate of savings as a dependent variable.

Stipulated Values: See DEEMED SAVINGS.

-T, U, V-

Technical Reference Manual (TRM): Standards for measuring and verifying applicable demand-side management or energy efficiency measures used by EDCs to meet the Act 129 consumption and peak demand reduction targets.

Total Resource Cost (TRC) Test: Analyzes the costs and benefits of energy efficiency and conservation plans.

TRM Verified Savings: Savings estimated based on the Commission-approved TRM.

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall within some degree of confidence.

Unit Energy Consumption: Average annual unit energy consumption of equipment.

Value of Information: A balance between the level of detail (rigor) and the level of effort required (cost) in an impact evaluation.

Variable Frequency Drive (VFD): A system for controlling the rotational speed of an alternating current electric motor by controlling the frequency of the electrical power supplied to the motor.

Verified Reduction or Verified Savings: A change in energy consumption or demand that has undergone rigorous evaluation, measurement, and verification to ensure its accuracy within a prescribed level of confidence and precision.

APPENDIX G | PROCESS AND IMPACT EVALUATION RECOMMENDATIONS AND ACTIONS – UPDATES FROM EDCS

This appendix provides updates on the actions taken by the EDCs to respond to evaluation consultants' recommendations that EDCs were still considering as of the time of the Phase II SWE Annual Report. The recommendation statuses are provided by EDC and program type.

G.1 DUQUESNE

Sections G.1.1 through G.1.8 provide the process and impact evaluation recommendations for Duquesne programs which were still being considered by Duquesne at the time the Phase II SWE Annual Report was finalized. The updated status of Duquesne's responses are provided in each table.

G.1.1 Residential Energy Efficiency Program

Recommendations	**EDC Status of Recommendation** (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 Monitor ENERGY STAR® for criteria changes and estimates on market penetration rates. For Phase III, additional rebate criteria or tiered incentives could help promote increased savings and reduce free ridership. For example, the Consortium for Energy Efficiency (CEE)[1] publishes criteria for efficiency tiers beyond ENERGY STAR® for several residential appliances and equipment. Also, one CEE initiative defines two efficiency tiers above ENERGY STAR® for residential clothes washers.[2] However, this was not part of the utility's Phase III and would likely require a refiling to implement. It also may or may not be worthwhile offering tiered incentives, given the low penetration of electric water heating in the utility's territory.	Under consideration
Recommendation 2 Consider leveraging the REEP, LIEEP, and SEP kits to introduce LEDs to participants in Phase III. LEDs could be provided in addition to one or more CFLs and may result in lower free ridership. However, the cost effectiveness of such an addition should be reviewed first.	Under consideration
Recommendation 3 Duquesne Light should consider updating Wattley or changing this well-known Watt Choices image, if Phase III activities shift away from primary promotion of CFLs to primary promotion of LEDs. Without such a shift, at some point in Phase III the utility may be heavily promoting LEDs while its primary marketing icon visually promotes alternatives to LEDs (i.e., CFLs). This is a timing issue and it is also a delicate market one. Wattley is widely known in the territory and is as very positive program image. Changing or removing such an image should only be done after considerable thought and possibly testing regarding the consequences.	Under consideration

[1] Consortium for Energy Efficiency. CEE. http://www.cee1.org/
[2] CEE Super Efficient Home Appliances Initiative. High efficiency specifications for Residential Clothes Washers. Effective March 7, 2015. http://library.cee1.org/sites/default/files/library/12282/CEE_ResidentialClothesWasherSpec_07Mar2015.pdf

G.1.2 Residential Appliance Recycling Program

Recommendations	**EDC Status of Recommendation** (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider boosting survey sample sizes in PY8 for this program, to determine whether free ridership and net-to-gross factors are indeed increasing. Modify the survey questionnaire to try to probe more deeply the reasons for any free ridership identified, and consider conducting focus groups if needed (i.e., if the reasons are not clear from the surveys).	Under consideration

G.1.3 School Energy Pledge Program

Recommendations	**EDC Status of Recommendation** (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 Duquesne Light plans for a different program to replace SEP during Phase III. Therefore, no recommendations are offered at this time.	N/A

G.1.4 Whole House Energy Audit Program (WHEAP)

Recommendations	**EDC Status of Recommendation** (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 As the utility initiates its Phase III WHEAP, it should carefully monitor costs relative to savings and ensure that all savings opportunities are being taken advantage of once a utility representative is in the customer home. Visit costs are incurred once the program auditor is on site; any incremental savings that can be obtained as a result of the visit are likely to only improve cost effectiveness.	Under consideration
Recommendation 2 Track the implementation rate for REEP Rebates that are recommended through the new and differently implemented WHEAP in PY8, to determine whether specific actions are needed to ensure that the link between the two programs is being made effectively to participants. Track the awareness of REEP rebates through participant surveys in PY8 for the same reason.	Under consideration
Recommendation 3 Consider sending follow-up email notices to participants after they have participated in the program (e.g., at least one quarter or more later), reminding them of recommendations made and rebate opportunities available through REEP if they have not participated as recommended. Also, consider conducting regular reviews of program tracking data to understand REEP Rebate adoption rates among WHEAP participants after they have participated in WHEAP.	Under consideration

G.1.5 Home Energy Reports (HER)

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 No recommendations for the HER program are offered at this time.	N/A

G.1.6 Low-Income Energy Efficiency Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 For fulfillments through WHEAP, Duquesne Light was able to maintain refrigerator replacement lead times, but Navigant notes that the program activities were limited, thereby reducing the potential for backlog issues. During Phase III, Duquesne Light should monitor replacement lead times, particularly as activities ramp up. If issues are detected, then the program manager work to address the situation, making sure to communicate with participants, so that any negative impacts on satisfaction from the delays are minimized. Navigant found in PY6 that these backlogs and lack of communication were a significant source of dissatisfaction.	Under consideration

G.1.7 Commercial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 Monitor participant satisfaction with the time frame required for them to receive their rebate checks, and determine whether participants have unrealistic expectations regarding the probable timing of receiving these payments. If a substantial number of participants identify this as an issue in PY8 and cause for dissatisfaction, consider conducting more extensive analysis of time frames for receiving rebate checks, as well as the feasibility of instituting a procedure whereby program management is automatically notified when a participant has waited longer than a pre-specified period before they receive their rebate check, so that management can then contact the customer to provide an update as to when the check will be issued. It may also be important to more effectively communicate the likely time frame for receiving rebate checks to the customers.	Under consideration
Recommendation 2 Monitor closely program participation as identified in PMRS, the Act 129 program tracking system, to ensure that the issue of program participants being discovered after evaluation research has already been conducted does not recur in PY8 or later years.	Under consideration

G.1.8 Industrial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1 Monitor participant satisfaction with the time frame required for them to receive their rebate checks, and determine whether participants have unrealistic expectations regarding the probable timing of receiving these payments. If a substantial number of participants identify this as an issue in PY8 and cause for dissatisfaction, consider conducting more extensive analysis of time frames for receiving rebate checks, as well as the feasibility of instituting a procedure whereby program management is automatically notified when a participant has waited longer than a pre-specified period before they receive their rebate check, so that management can then contact the customer to provide an update as to when the check will be issued. It may also be important to more effectively communicate the likely time frame for receiving rebate checks to the customers.	Under consideration
Recommendation 2 Monitor closely program participation as identified in PMRS, the Act 129 program tracking system, to ensure that the issue of program participants being discovered after evaluation research has already been conducted does not recur in PY8 or later years.	Under consideration

G.2 FIRSTENERGY EDCS (MET-ED, PENELEC, PENN POWER, WEST PENN)

G.2.1 Residential Appliance Turn-In

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Reduce reported savings for RACs to 150 kWh per unit.	Implemented
Consider using bill inserts to address recycling concerns outside of the program.	Rejected – goes beyond scope of program
Consider adding a message to the rebate check that provides information about other FirstEnergy programs.	Accepted
Monitor free-ridership closely in PY8, with frequent surveys and additional questions to add details surrounding reported appliance discard and appliance transfer scenarios.	Accepted

G.2.2 Energy Efficient Products

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and/or customers more quickly if project documentation is incomplete.	Implemented for Phase III

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Increase one-on-one communication and improve response time between participating program contractors and their ICSP representative.	Implemented for Phase III
Use one-on-one communication to increase contractor awareness of program communication tools – such as the newsletter and/or portal – that already exist.	Implemented for Phase III
Consider annual or bi-annual calls or meetings with participating contractors – in lieu of or in addition to webinars – to provide specific information on program offerings and/or changes that are relevant to them, and provide the opportunity for contractor feedback.	Implemented for Phase III
Continue to use individual Appliance and HVAC subprogram NTG ratios during planning, rather than the overall program NTG ratio.	Implemented
For upstream lighting, report lamp source type, lamp type, wattage, lumens in the T&R system.	Implemented for Phase III
Remove the EDC name from equipment descriptions	Implemented for Phase III
Continue to engage participating retailers in program design, implementation, and marketing efforts.	Implemented
Continue direct marketing and outreach efforts to customers, as well as cross-marketing such as retailer displays and signage, to further increase awareness of FE programs	Implemented
Consider additional outreach efforts to inform customers of the energy and non-energy related benefits of program-qualifying LED bulbs.	Implemented for Phase III
Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and/or customers more quickly if project documentation is incomplete.	Implemented for Phase III
Increase one-on-one communication and improve response time between participating program contractors and their ICSP representative.	Implemented for Phase III

G.2.3 Residential Home Performance

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
For the New Homes component, flag homes with greater than 20,000 kWh for a REM/Rate baseline	Implemented for Phase III
For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any	Implemented for Phase III
Collect customer e-mail addresses during customer contact opportunities such as program feedback, rebate forms, and calls to the Customer Contact Center (CCC), etc., to use in future marketing campaigns. Be sure the language included permits future solicitation. Provide a "subscribe	Being Considered for Phase III based on capabilities of ICSP
Consider revising the rebate structure for the audit-recommended improvements to adjust the focus of the program more towards encouraging implementation of	Implemented for Phase III
Consider other energy savings modeling tools that may have advantages over Surveyor. Holding an informational seminar on how the savings values are determined may also	Implemented for Phase III

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue to market the program through bill inserts and steer customers to the program via the Behavior subprogram Home Energy Reports. Communicating how the program can solve energy-related problems for the	Implemented for Phase III
Discount OPower reported impacts by approximately 10% to account for dual- participation adjustments that occur	Being Considered / Partially Implemented
The default interior lighting energy usage in REM/Rate appears to be systematically higher than verified through on-site inspections. Consider asking REM/Rate to reduce lighting power density by 20% or to increase baseline CFL	Being Considered. The implementer, PSD, updates REM/Rate specifications annually. The next opportunity is for PY9.
Review and ensure the New Homes rebate submission & payment process is as streamlined as	Implemented
Deliver New Homes program value beyond incentives via Webinar, effective program tools, etc. Two of six builders specifically indicated they would attend future webinars	Implemented
Market New Homes program specifically to builders that began with the program, but dropped out along the way – especially as the program becomes more streamlined or	Implemented
For the New Homes program, consider requiring HERS ratings and associated REM/Rate models on a sampled basis rather than for the census of homes, from high-volume builders.	The Company prefers to represent the actual savings above code for each rebated new home, rather than to rely on sampling. Sampling would not be beneficial for most builders and raters.

G.2.4 Residential Low-Income

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.	Implemented
For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any other lamps included in the kits.	Implemented for Phase III

G.2.5 Commercial and Industrial Energy Efficient Equipment Program - Small

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Ensure continued engagement with past participants as they are likely to participate in the future.	Implemented
If participation is lacking in the future, consider a referral/recruitment award program from past participants.	Being Considered as appropriate
Lower ex ante energy savings Threshold to 750 MWh from 800 to trigger up-front evaluation of lighting projects to better align with 2016 TRM. At the same time, increase threshold from 400 MWh to 500 MWh for non-lighting projects to maintain expected 50/50 balance in reported MWh between sampled and "certainty" projects.	Implemented

G.2.6 Commercial and Industrial Energy Efficient Buildings – Small Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
In Phase III, consider subsuming this program into the C/I Energy Efficient Equipment Program - Small to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Implemented
Review and improve contractor tracking procedures.	Implemented for Phase III
Review the application process for possible efficiencies.	Implemented for Phase III
Continue support to contractors, including consistent ICSP contact and marketing materials.	Implemented for Phase III
Continue to market to past participants as well as nonparticipants if additional participation is needed.	Implemented for Phase III

G.2.7 Commercial and Industrial Energy Efficiency Equipment– Large Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue conducting outreach with trade allies and contractors to promote the program when working with commercial customers, and continue incorporating case studies and testimonials into marketing materials provided to customers and trade allies.	Implemented
Seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the program to management staff.	Being Considered for Phase III with ICSP
Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented
Lower ex ante energy savings Threshold to 750 MWh from 800 to trigger up-front evaluation of lighting projects to better align with 2016 TRM. At the same time, increase threshold from 400 MWh to 500 MWh for non-lighting projects to maintain expected 50/50 balance in reported MWh between sampled and "certainty" projects.	Implemented

G.2.8 Commercial and Industrial Energy Efficient Buildings – Large Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
In Phase III, consider subsuming this program into the C/I Energy Efficient Equipment Program - Large to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Implemented
Review and improve contractor tracking procedures.	Implemented for Phase III
Review the application process for possible efficiencies.	Implemented for Phase III
Continue support to contractors, including consistent ICSP contact and marketing materials.	Implemented for Phase III

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue to market to past participants as well as nonparticipants if additional participation is needed.	Implemented for Phase III
Consider engaging new contractors.	Implemented for Phase III

G.2.9 Government and Institutional Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue conducting outreach with trade allies and contractors to promote the program when working with commercial customers, and continue incorporating case studies and testimonials into marketing materials provided to customers and trade allies.	Implemented
Seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the program to management staff.	Being Considered
Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented
Consider stipulating an annual indoor lighting hours of use of 1,000 hours for all program participants	Implemented in latter part of PY7. ADM has also provided a memo with this recommendation to the new ICSP in PY8.

G.3 PECO

G.3.1 Smart Home Rebates

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO program managers and the CSP should continue to monitor the SHR lighting data and conduct regular QC checks to minimize errors.	**Being Considered:** PECO is working with implementation CSP and tracking system CSP to ensure errors are caught before placed into the tracking system.
Recommendation 2: PECO and the CSP must capture all unit-specific data relating to energy savings estimates in the tracking data for all projects.	**Implemented:** In Phase III, we have done a complete review of data inputs and will ensure that all relevant data points are captured in the tracking system.
Recommendation 3: If additional low-income savings are needed by PECO, provide low-income customers with mail-in rebate incentives on LEDs. Mail-in rebates in the form of coupons can educate and motivate participation.	**Being Considered:** PECO is already offering a targeted retail lighting program that is bringing LED bulbs in retail stores that may be non-traditional lighting in heavy low-income areas. These LEDs have greater discounts applied.
Recommendation 4: a. Use focused marketing efforts to improve the perceptions of LEDs and overcome confusion hindering LED adoption. Focused marketing can highlight the benefits of efficient lighting, educate customers on LED capabilities, and help customers understand how to navigate the range of options. Marketing outside of the store (web-based, emails, etc.) may help overcome confusion. b. Continue to engage customers at store locations. Use direct, in-person interactions to educate and	**Being Considered/Implemented:** a. Will work with ICF to develop more education and focused marketing around LED benefits and technologies. b. We continue to have our retail field team for outreach and customer engagement. We are looking to supplement the staffing with additional resources. c. By the end of 2016, we will phase CFLs out of this program and are carefully monitoring the acquisition cost of the LEDs.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
motivate customer adoption of energy efficient products. This can also help overcome confusion that may arise from the wide variety of products in the market. c. Monitor LED acquisition costs on a quarterly basis to identify when to fully transition incentive dollars from CFLs to LEDs to make them competitive with halogen and other non-energy efficient bulbs.	
Recommendation 5: Leverage strong working relationships with HVAC contractors and installers to increase participation in the non-lighting aspect of SHR.	**Implemented:** We are working with distributors and manufacturers to help communicate program offers and education to contractors in addition to continuing the relationships with contractors.
Recommendation 6: Focus education and marketing efforts on HVAC installers for the non-lighting aspect of SHR in Phase III as the program ramps back up and invites new installation companies to the program.	**Implemented:** We are working closer with contractors to help them increase efficient products in the market place. We expect challenges due to the lower rebate levels in Phase III, however are leveraging our relationships to promote non-lighting products.

G.3.2 Smart House Call

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Continue to maintain the high rates of customer satisfaction and rapport that energy advisors have built with customers, through the following: a. Maintaining the personalized feel of the program b. Providing a learning experience to customers with varying degrees of knowledge about energy efficiency	a. **Implemented** b. **Implemented**
Recommendation 2: a. Maintain relationships with customers and keep them open by marketing PECO and other program opportunities. b. Develop and implement an energy advisor checklist that includes each of the actions an energy advisor must take to complete a successful site visit; items that may be included: • Provide thorough home visits with insightful information offered to participants • Install measures that are compatible with customers' homes; test installations • Send audit report to all audit participants • Follow up with customers to check on installed measures and encourage additional action	a. **Implemented** b. **Implemented**
Recommendation 3: Do not let goals for improving TRC compromise positive customer experience and satisfaction. a. Discontinue CFL installations and install 100% LEDs b. Continue to market the program using past strategies that have proven effective and test new targeted marketing tactics	a. **Being Considered:** Working with CSP to find alternative solutions in the lighting market to provide LED solutions that fall within the designed budget for Phase III. b. **Implemented**
Recommendation 4: a. Build on PY7's successful marketing tactics to maintain impacts among core demographics. • Smaller, more frequent direct mail events yielded a steady flow of participants • Word of mouth is strong and growing • Implement targeted marketing to engage new demographic groups at higher rates.	a. **Being Considered:** We are working with the EEMF to try additional marketing tactics that yield same results at a lower cost. However, the core marketing tactics deemed valuable are still part of the overall marketing plan. b. **Implemented**

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 5: Shape the SHC program as a gateway to the Smart Ideas portfolio of programs. Engage more effectively in cross-program promotion by improving the ability of energy advisors to educate customers.	**Implemented**

G.3.3 Smart Appliance Recycling

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: a. PECO should monitor the financial health of their CSP to avoid program interruptions in Phase III. b. PECO should develop response plans for programs relying on a single CSP. These plans should define the protocol for data transfers between a departing CSP and PECO.	a. **Implemented:** PECO is monitoring the financial health of the CSP to avoid program interruptions in Phase III. b. **Being Considered**
Recommendation 2: PECO's response to JACO's closure can inform the response plans of other programs reliant on a turnkey CSP.	**Being Considered**
Recommendation 3: PECO should engage in statewide discussions to develop a more robust method for estimating net savings.	**Being Considered**

G.3.4 Smart Usage Profile

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Monitor the month-by-month progression of percentage savings from waves to optimize savings projections and program size in Phase III.	**Implemented:** In Phase III, PECO plans to incorporate data analytics into program monitoring to help identify areas of opportunity and develop target channeling.
Recommendation 2: Acquire and apply more data on household characteristics, lifestyles, and propensities to increase engagement and program channeling.	**Implemented:** In Phase III, PECO plans to incorporate data analytics into program monitoring to help identify areas of opportunity in the area of customer personalization.
Recommendation 3: a. Utilize other PECO customer points of contact to gather participant email addresses for the purposes of electronic report delivery. b. PECO should document clear intentions and metrics for the email and web portal components of the program, especially for Phase III, and set and track goals accordingly.	**Being Considered:** PECO is working on developing a business intelligence and customer data analytics component of the program to advance its channeling and outreach pathways.

G.3.5 Smart Energy Saver

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should consider whether or not offering nightlights as an energy-saving device for non-DI programs is appropriate for the portfolio.	**Being Considered:** PECO is considering if offering nightlights in non-DI programs/solutions makes sense in the next Phase.
Recommendation 2: If program implementation deviates from program design, PECO should review the design assumptions to ensure that the program plan and corresponding program expectations are achievable. PECO may decide to update either the design assumptions or program implementation to meet expectations or align the program with the original design intent.	**Not Applicable:** This program was morphed into another solution for the low-income and multifamily customer segments, and will be tracked according to the design assumptions to meet desired outcome.

G.3.6 Smart Energy Saver

Recommendations	EDC Status of Recommendations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should consider whether or not offering nightlights as an energy-saving device for non-DI programs is appropriate for the portfolio.	**Being Considered:** PECO is considering if offering nightlights in non-DI programs/solutions makes sense in the next Phase.
Recommendation 2: If program implementation deviates from program design, PECO should review the design assumptions to ensure that the program plan and corresponding program expectations are achievable. PECO may decide to update either the design assumptions or program implementation to meet expectations or align the program with the original design intent.	**Not Applicable:** This program was morphed into another solution for the low-income and multifamily customer segments, and will be tracked according to the design assumptions to meet desired outcome.

G.3.7 Smart Builder Rebates - FIX

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Monitor rebate processing time on a monthly basis to ensure the CSP is meeting the incentive payment timing goals in Phase III.	**Implemented:** PECO is now monitoring rebate-processing time on a monthly basis to ensure the CSP is meeting the incentive payment timing goals.
Recommendation 2: Conduct broader outreach among nonparticipating builders in Phase III using the Code-Plus participation option to recruit code-level builders.	**Implemented:** PECO is conducting a broader outreach among nonparticipating builders.
Recommendation 3: Provide builders support with recruiting and educating contractors in Phase III through program-sponsored training and outreach.	**Being Considered:** Working with outside resources to develop and implement a plan to educate raters and builders alike to the benefits of building to energy-efficient standards, but also on how to effectively communicate it with customers/consumers.

G.3.8 Low-Income Energy Efficiency

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
Recommendation 1: Collect existing refrigerator data from participants and use the PY8 IMP to estimate ex ante refrigerator savings.	**Implemented:** PECO's CSP is collecting existing refrigerator data and using the PY8 IMP to estimate ex ante refrigerator savings.
Recommendation 2: Ensure schedule expectations are clear and applied consistently across customers; consider follow-up with customers to encourage further action.	**Implemented:** PECO is working with the CSP to ensure schedule expectations are clear and encouraging further actions by following up with customers.
Recommendation 3: Shift to LEDs only; target distribution of free bulbs to households with incandescent bulbs.	**Being Considered**
Recommendation 4: Develop targeted program materials that prioritize next steps and guide customers to the most appropriate program component.	**Implemented:** PECO is working with a Marketing firm to enhance current program materials, which would include next steps and guide customers to other programs.
Recommendation 5: Increase number of customers benefiting from comprehensive program measures.	**Being Considered**
Recommendation 6: Acquire and apply data on low-income household characteristics; tailor future program implementation strategies to meet the needs of eligible customers.	**Being Considered**

G.3.9 Smart A/C Saver - Residential

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
Recommendation 1: a. PECO should ensure the program database contains necessary data to allow Navigant to calculate verified savings via comparison group analysis in Phase III. b. PECO should be prepared to quickly and securely transfer program database information to Navigant for verified savings analysis in Phase III.	a. **Implemented:** Interval data will be available; will have to collaborate with Navigant to define the format. b. **Being Considered:** PECO will work with Navigant to extract AMI data as soon as it is available, which is at the earliest around 4 weeks after the event takes place.
Recommendation 2: Prepare for a possible drop in satisfaction.	**Implemented**
Recommendation 3: Consider notifying customers after events.	**Being Considered**
Recommendation 4: Consider running a pilot to test satisfaction impacts of notifying customers after conservation events.	**Rejected:** PECO will find a way to work around maintaining customer satisfaction.
Recommendation 5: Evaluate energy efficiency program participation rates within AC Saver as compared to general population.	**Being Considered:** PECO needs to assess how the AC program can leverage its participant interest to extend beyond DR.

G.3.10 Smart A/C Saver – Commercial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
Recommendation 1: c. PECO should ensure the program database contains necessary data to allow Navigant to calculate verified savings via comparison group analysis in Phase III. d. PECO should be prepared to quickly and securely transfer program database information to Navigant	a. **Implemented:** Interval data will be available; will have to collaborate with Navigant to define the format. b. **Being Considered:** PECO will work with Navigant to extract AMI data as soon as it is available, which is at the earliest around 4 weeks after the

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
for verified savings analysis in Phase III.	event takes place.
Recommendation 2: PECO should prepare for a possible drop in program satisfaction.	**Implemented**
Recommendation 3: Consider running a pilot to test satisfaction impacts of notifying customers after conservation events.	**Rejected:** PECO will find way to work around maintaining customer satisfaction.
Recommendation 4: If PECO is concerned that program participation is too high, consider paying low-performing customers to not participate in the program.	**Being Considered:** PECO needs to assess how the AC program can leverage its participant interest to extend beyond DR.

G.3.11 Smart Equipment Incentives – Commercial & Industrial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected, AND Explanation of Action Taken by EDC)
Recommendation 1: Segment population further to explore the value of the SEI program and identify marketing or outreach approaches to reach the harder to reach segments. Develop marketing approaches for specific business types to cater to the needs of that segment.	**Implemented:** PECO has been working on a robust marketing plan with EEMF to target the industrial and commercial sector areas that are hard to reach. This will be done through direct marketing with trade allies, as well as enlisting the help of LCS.
Recommendation 2: a. Change the trade ally incentives program to incent targeted project types or customer segments. b. Outreach to engage new trade allies in the program (especially local contractors, who are less likely to pursue projects in other states where incentives are richer).	a. **Implemented:** In Phase III, PECO revised the program design to incent the trade ally's on a project or customer basis, to offer a comprehensive solution as oppose to measure based approach and alter the trade ally incentives program to incent targeted project types or customer segments. b. **Implemented:** Currently hosting many webinars inviting existing and new potential trade allies.
Recommendation 3: Increase assistance with completing required documentation and TRM worksheets for custom projects.	**Implemented:** PECO is offering "hand-held" assistance with translating the TRM specifications for custom projects.
Recommendation 4: Use the "limited time offer" as a lever in future years if participation is low.	**Implemented:** PECO is working with EEMF to establish a lever to have better controls around program participation.
Recommendation 5a: PECO should require the implementer to build in a "flag" in their project database that identifies if a site is threshold metering. The implementer should then make sure to send over the project files to evaluator as soon as they are entered into the system.	**Implemented:** PECO and Navigant made formal recommendation to ICF to continuously monitor for threshold metering projects. Once a project has been flagged, ICF will contact Navigant as per PECO's instructions.
Recommendation 5b: Streamline database by limiting number of dates and removing unnecessary fields. Assess data requirements of all relevant parties (PECO, SWE, and Navigant) and only include required fields.	**Being Considered**

G.3.12 Smart Equipment Incentives– Government and Institutional

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Segment population further to explore the value of the SEI program and identify marketing or outreach approaches to reach the harder to reach segments. Develop marketing approaches for specific business types to cater to the needs of that segment.	**Implemented:** PECO has been working on a robust marketing plan to target the industrial and commercial sector areas that are hard to reach.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: a. Change the trade ally incentives program to incent targeted project types or customer segments. b. Outreach to engage new trade allies in the program (especially local contractors, who are less likely to pursue projects in other states where incentives are richer).	**Implemented:** In Phase III, PECO revised the program design to incent the trade ally's on a project or customer basis, to offer a comprehensive solution as oppose to measure based approach.
Recommendation 3: Increase assistance with completing required documentation and TRM worksheets for custom projects.	**Implemented:** PECO is offering "hand-held" assistance with translating the TRM specifications for custom projects.
Recommendation 4: Use the "limited time offer" as a lever in future years if participation is low.	**Implemented:** PECO is working with EEMF to establish a lever to have better controls around program participation.
Recommendation 5: a. PECO should require the implementer to build in a "flag" in its project database that identifies if a site is threshold metering. The implementer should then make sure to send over the project files to evaluator as soon as they are entered into the system. b. Streamline database by limiting number of dates and removing unnecessary fields. Assess data requirements of all relevant parties (PECO, SWE, and Navigant) and only include required fields.	**Being Considered:** Working with tracking system vendor to capture these features in the next Phase.

G.3.13 Smart Construction Incentives

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Ensure that all projects are complete before the close of the incentive process: • Set clear occupancy expectations when qualifying projects • Re-emphasize TRM rules to the entire team • Strengthen post-install inspection protocol • Strengthen post-install documentation review	**Being Considered:** PECO will ensure that these point are refined and implemented going into Phase III. CSP and program managers will be held accountable to institute protocols.
Recommendation 2: Leverage strong relationships with committed trade allies to achieve greater program participation. Continue trade ally training and recruitment as a tool to sustain current program performance.	**Implemented:** Strengthening the trade ally training and recruitment to maintain existing and form new relationships.
Recommendation 3: Provide early and continuous outreach efforts, especially for new construction projects. Avoid using new construction as a lever for portfolio-level savings.	**Implemented:** This recommendation was implemented in late stages of the Phase II plan. However, the wait list in Phase II pushed the program behind schedule and it became difficult to capture early stage projects.
Recommendation 4: Strive for greater measure end-use diversification in Phase III (with special emphasis away from lighting projects).	**Implemented:** The whole building model approach was designed to create projects that are more comprehensive.

G.3.14 Smart Multi-Family Solutions Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Monitor expansion of DI offerings in Phase III, focusing on LED penetration in each project to reduce free ridership.	**Implemented:** Going into Phase III, coordinated with CSP to track LED measures in the PECO database.
Recommendation 2: Advertise the long-term energy cost savings associated with the new Phase III prescriptive offerings.	**Implemented:** Phase III prescriptive offerings will include marketing efforts which will focus on enhancing the trade ally network and promotion materials.
Recommendation 3: Develop and implement a program representative checklist to encourage prescriptive and cross-program participation.	**Implemented/ Being Considered:** For Phase II, we had a quick reference guide for all of the prescriptive offerings for Multifamily Solutions. This quick reference guide is currently being updated for Phase III. A brochure is currently being developed to cross promote residential Smart Ideas programs.

G.3.15 Smart On-Site

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: a. PECO should leverage completed SOS projects to promote the technology. CHP system owners expressed pride for their projects and may welcome the opportunity to publicize their success. If PECO wishes to foster the market for CHP in its service territory, it could invite CHP owners to speak about their experiences with the technology and PECO's program at relevant industry events. Some CHP owners might be willing to host such events at their facility and provide tours of the system. b. Provide design support to customers.	a. **Being Considered:** PECO is using marketing awareness campaigns as well as direct marketing outreach segmentation tactics to drive participation in this program. b. **Implemented:** PECO did incorporate the design support incentive as part of the Phase III program offering.
Recommendation 2: Set final Phase III project enrollment deadlines of January 1, 2019 for projects over 1 MW and January 1, 2020 for projects less than 1 MW to mitigate completion risks that lead to portfolio-level uncertainty.	**Being Considered:** PECO is actively reshaping the enrollment strategies for Phase III by placing specific eligibility criteria and guidelines for project participation and enrollment to mitigate compliance risk. Project eligibility information will be communicated upfront as part of the application process.
Recommendation 3: PECO should host an open house for participants and developers to meet PECO and CSP staff to discuss any substantive changes to the program in Phase III.	**Being Considered**
Recommendation 4: Create a liaison with the DEP.	**Rejected**
Recommendation 5: Develop a program manual for developers and participants. The program manual should provide a standardized feasibility template, a process chart describing key milestones, and more details regarding enrollment, interconnection, and incentive payout.	**Implemented**

G.3.16 Smart Business Solutions

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: The CSP sales auditor should further refine the process for gathering and documenting accurate lighting schedules for use in the savings estimates presented to customers and in the calculation of ex ante savings. The CSP should also review the TRM HOU values for new measures—such as night covers—and other measures added to the program in Phase III.	**Being Considered:** A separate tab will be added to the Schedule C for the sales auditor to document discrepancies between the posted HOU and the true HOU.
Recommendation 2: Going forward into Phase III, PECO should use the program—renamed Whole-Building—as a lever for fine-tuning portfolio-level goals and targets, depending on budget.	**Implemented:** In the new plan for Phase III, the program is renamed to reflect the treatments and offerings it presents.
Recommendation 3: PECO should have the CSP more proactively propose the installation of TLED lamps and fixtures as the primary replacement for T12s.	**Implemented:** T12s have been proactively replaced with other more efficient measures.
Recommendation 4: PECO should take full advantage of the face time with customers during a Whole-Building audit in Phase III by connecting them with other aspects of the small C&I program such as behavioral and equipment systems solutions. The CSP should collect primary data while onsite to provide accurate energy savings estimates for these other prescriptive technologies and begin the rebate paperwork for the customer.	**Implemented**: Currently in process.

G.4 PPL

G.4.1 Prescriptive Equipment Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider providing more support in filling out the applications with examples of completed applications on the website and a point of contact available to answer questions about the application forms	Implemented.
Consider incorporating a way for applicants to track the status of their application online.	Implemented.
Consider reaching out to trade allies who are active in the program and explain at the beginning of the year that a wait list could occur in the future.	Implemented.
Consider posting an update on the website explaining why a wait list was implemented and when the wait list is expected to be removed.	Will be implemented if there is a waitlist in Phase III.
Consider requiring the ICSP to add a QA/QC protocol for lighting projects to ensure Appendix C inputs and results match EEMIS.	Implemented.
Consider enhancing QC processes to identify record duplicates, out-of-range values, and flag entries when data fields are populated that are not applicable to the rebated equipment (e.g., heating capacities for air conditioners).	Implemented. Additional QA/QC was implemented for Phase III and will be continually improved.

G.4.2 Residential Retail Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Equipment--Consider implementing an online model-number lookup mechanism for customers, including incentive levels, to minimize confusion when tiered rebates are offered for the same type of appliance.	Being considered.
Equipment--Consider replacing refrigerators with another common household appliance that will have a larger impact in terms of both savings and customer satisfaction with the program and with PPL Electric Utilities.	Rejected but may be reconsidered over time. During the Phase III EE&C Plan, PPL rejected replacing refrigerators with another household appliance. No other appliances (washing machines, dishwashers, etc.) have materially higher savings or a lower program acquisition cost. Also, the purchase of a new refrigerator often leads to the recycling of an old one.
Upstream Lighting--Work with retailers to use product placement as a lower-cost mechanism for generating sales lift rather than more aggressive incentives throughout the year. Additionally, PPL Electric Utilities could consider working with the ICSP to track product placement across all retailers, to the greatest degree practical, so that the program is credited for all activities that increase sales.	Implemented where possible. Some retailers will not allow PPL much control over merchandising or provide PPL with product placement information/documentation. Through in-store inspections, the ICSP will try to influence and document product placement.
Upstream Lighting--Consider ways to organize the program to decrease freeridership by focusing on the products or retailers with less competition from non-program-eligible LEDs and products where demand is more elastic in response to price changes.	Will be considered if the NTGR is too low. Based on the PY7 evaluation, the NTGR is currently acceptable but PPL will continually look to improve the NTGR where possible within program budget constraints (i.e. ensure PPL hits its savings targets within the program's cost budget).
Upstream Lighting--Work with the ICSP to identify opportunities to increase variation in program activity specifically within hard-to-reach retailers, by introducing new products with lower price points, special promotions, or pricing experiments, if possible.	Implemented.
Upstream Lighting--Watch market trends and purchasing patterns during Phase III. This includes monitoring the pricing of program and non-program bulbs, as well as consumer attitudes about quality versus price, to maintain the impact of program incentives.	Implemented. Market effects and saturation studies are in progress as of October 2016.
Upstream Lighting--Consider bundling advertising of CFL recycling bin locations with other promotional materials as a cost-effective method to increase awareness.	Being considered.

G.4.3 Custom Incentive Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider providing customers with a tool to track the real time progress of their application through each application milestone	Implemented.
Consider providing additional detail regarding the waitlist and what customers should expect during this period	Being considered – Currently no waitlist for Phase III, but will consider this if a waitlist is implemented.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider allowing the evaluator to review standard calculators to determine if correct baseline is being used	Implemented.
Continue to request evaluator support to determine if certain projects that fall below the 500,000 kWh/hr threshold should be elevated to the large stratum when there is high uncertainty in the measure, baseline, or calculation approach for new or overly complicated measures.	Implemented.
Consider allowing for the ICSP and evaluator to review data collection protocols collaboratively	Implemented.

G.4.4 Residential Energy-Efficiency Behavior & Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Residential Energy-Efficiency Behavior & Education Program	
Closely monitor the monthly savings and customer support calls and e-mails of the new behavior program in Phase III by setting up some key performance indicators derived from observations of Phase II.	Implemented.
Compare the energy-savings performance between Phase II and Phase III to note program design impacts and any transition challenges, especially through comparisons of PY7 and PY8.	Will be implemented (Phase III savings will be determined late in Phase III). Will also be evaluated by Cadmus in PY8.

G.4.5 Residential Home Comfort Program

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Require the AHRI certificate and the two heating capacity values of the existing equipment and the new equipment for fuel-switching rebate forms.	Being considered and will likely be implemented.
Strengthen cross-program awareness initiatives in Phase III, such as adding banners to rebate forms, clear infographics to program materials, and PPL Electric Utilities' contact information to program materials.	Implemented.
Add instructions and helpful information on rebate forms to assist participants in filling them out.	Implemented and will be continually improved further.
Explore opportunities to involve manufactured homes dealers in the program, such as offering incentives for each qualifying manufactured home sold.	Being considered.
Consider further study of other manufactured homes programs to determine if other program delivery and incentive structures are successful in realizing participation.	Being considered.
Consider further study to assess the potential market for electrically heated manufactured homes.	Being considered.

G.4.6 Student and Parent Energy Efficiency Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Monitor LED bulb installation rates in PY8 and consider reducing the number of LEDs included in the kits in PY9 if ISRs continue to decrease.	Being considered. PPL will certainly monitor the PY8 LED bulb installation rate and determine if program changes are required (reduce the number of bulbs or improve messaging to encourage a higher installation rate.)
Review student guides and education and installation materials to assess opportunities to further highlight LED benefits (compared to both incandescent and CFLs) and encourage installation.	Being considered. PPL will certainly monitor the PY8 LED bulb installation rate and determine if program changes are required (reduce the number of bulbs or improve messaging to encourage a higher installation rate.)
Consider increasing the grade-appropriate classroom instructions and discussion about the furnace whistle, showerhead, and faucet aerator items to encourage installation. Consider other ideas to increase installation rates, other than, or in addition to, changing the products in the kit.	Will be implemented. Since the program is well underway for PY8, any changes will likely be for PY9.
Consider a streamlined HEW data collection process where all student cohorts can input the data online instead of filling out a Scantron form.	Being considered. Since the program is well underway for PY8, any changes will likely be for PY9.

G.4.7 Low-Income WRAP Status Report Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider emphasizing to contractors the importance of clearly explaining to customers which products and services will be installed or conducted after the audit takes place and when installations will occur	Implemented.
Consider emphasizing the energy education portion of the audit, and take time to explain ways to save energy	Implemented.

G.4.8 De Facto Heating Pilot Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider conducting an assessment of the market and technology in future pilot programs and adjust the evaluation plan accordingly.	Will be implemented for future pilots.
Consider establishing the contractor scheduling process earlier to reduce (or eliminate) effects of non-performing contractors.	Implemented. The scheduling process for Phase 3 WRAP work was significantly improved.
Encourage future implementers provide leave-behind materials describing the programs and how to contact the utility.	Being considered for future pilots.

G.4.9 Low-Income Energy-Efficiency Behavior & Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider sending additional paper home energy reports and/or developing print versions of some of the digital content to send to low-income customers.	Implemented as part of the Phase III marketing strategy. Information targeted for low-income customers is rarely limited to a digital channel.
Consider using other channels (e-mail, billing statements, and programs) to encourage all treatment customers (low-income and non-low-income) to visit the new Phase III program's web portal.	Will be implemented shortly when PPL markets the portal/hub ("soft launch" was October 2016).
Investigate whether the home energy reports convinces treatment customers (low-income and non-low-income) to visit the Phase III Customer Engagement Hub and the program's web portal and to complete the online home energy assessment.	Will be implemented.

G.4.10 Master Metered Low-Income Multifamily Housing Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
In Phase III, consider recruiting low-income nursing home buildings to reach the low-income WRAP planned savings for master metered multifamily buildings. Likewise, consider recruiting nursing homes that are not income-eligible into the Phase III Prescriptive Equipment program.	Implemented. Low-income nursing homes are eligible for WRAP (there is not a separate MF program in Phase III).
In Phase III, explore options to increase incentives for HVAC equipment and comprehensive building retrofits in the master metered multifamily market segment, to reduce the gap between the incentives and the actual cost of these retrofits to program participants.	Rejected. As part of the Phase III EE&C Plan, PPL determined that it could not offer higher incentives for HVAC in master metered multifamily buildings. PPL will continually monitor Phase 3 savings and budgets and adjust incentives or programs if necessary.
In Phase III, continue to offer tenant education under the low-income WRAP to recommend energy-efficiency actions tenants and householders can take to improve the energy performance of their buildings.	Implemented.

G.4.11 E-Power Wise Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider removing the furnace whistle from the energy-savings kit and explore offering a rebate for furnace filters instead	Being considered and will likely be implemented.
Monitor progress and identify any early issues with the two-kit delivery system; Add questions to the agency interviews as a part of the PY8 evaluation to gather feedback from agencies.	Implemented.
Ensure that the program provides sufficient training and materials geared toward one-on-one interactions between clients and agencies.	Being considered and will likely be implemented.

G.4.12 Wise Home Pilot Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Include additional low-cost screening step, such as a phone call, to verify self-reported customer information, e.g., heating and cooling equipment and fuel type.	Being considered and will likely be implemented.
Include information about low-income programs in customers' monthly energy bills.	Will be implemented as part of the Phase III marketing strategy.
Provide more clear information regarding the conditional nature of program and pilot offerings.	Will be implemented.
Train technicians about other program offerings to inform participants.	Will be implemented.

G.4.13 Continuous Energy Improvement Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Consider maintaining the same baseline period for all schools.	Being considered.
Consider using at least 12 months for school baselines.	Being considered.
Ensure baseline periods for schools do not overlap with implementation periods for other schools within the same district.	Being considered.
Encourage CEI participants to enroll in other PPL Electric programs.	Will be implemented when program is launched.
Provide schools with a timeline of CEI activities, and communicate how incentive money is being distributed throughout the district	Being considered.
Ask that participants conduct at least yearly updates to all program documents	Being considered.

PENNSYLVANIA PUBLIC UTILITY COMMISSION

Act 129 Statewide Evaluator
Phase II Final Report

Prepared by
Statewide Evaluation Team

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